

## **828 Digital Control**

**9907-247, 9907-248; Hardware Only**  
**CSA Certified 2244634; CE Compliant**

**Hardware 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 **26455**, *Customer Publication Cross Reference and Revision Status & Distribution Restrictions*, 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 **26455**, *Customer Publication Cross Reference and Revision Status & Distribution Restrictions*, 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 Out-of-date translations are marked with .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.

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LINKnet  
OpTrend  
Woodward

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LON and LonTalk (Echelon Corporation)  
Modbus (Schneider Automation Inc.)

# Warnings and Notices

## 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 Mark

**EMC Directive** Declared to 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.

This controlling device, manufactured by the Woodward Governor Company, is applied solely as a component to be incorporated into a larger, prime mover, system. Woodward Governor declares that this controlling device complies with the EMC Directive requirements when put into service per the installation and operating instructions outlined the product manual. All wiring must also follow the wiring and shielding requirements given in the specific, separate, software manual.

### **IMPORTANT**

This controlling device is intended to be put into service only upon incorporation into a prime mover system that itself has met the requirements of the above Directive and bears the CE mark.

**Low Voltage Directive** Declared to 2006/95/EC COUNCIL DIRECTIVE of 12 December 2006 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits.

## North American Compliance

**CSA** CSA Certified for Class I, Division 2, Groups A, B, C, and D, T4A at 70 °C ambient for use in the United States and Canada: CSA Certificate 2244634. These listings are limited to those units bearing the CSA agency identification.

### **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 or Zone 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, Division 2 ou Zone 2.

### **IMPORTANT**

Installation wiring must be in accordance with Class I, Division 2 wiring methods in Article 501–4(b) of the NEC, and in accordance with the authority having jurisdiction.

### **IMPORTANT**

All peripheral equipment must be suitable for the location in which used.

## Safety Related Installation Limitations

- Wiring must be in accordance with North American Class I, Division 2 wiring methods as applicable, and in accordance with the authority having jurisdiction.
- Field wiring must be suitable for at least 75 °C for operating ambient temperatures expected to exceed 50 °C.
- A fixed wiring installation is required.
- Do not connect more than one main power supply to any one fuse or circuit breaker.
- Connect ground screw to earth ground (see Figures 1-1a, 1-1b).

## Marine Type Approval Compliance

|  |  |
|--|--|
| <b>American Bureau of Shipping (ABS)</b> | 2007 Steel Vessel Rules 1-1-4/7.7, 4-2-1/7.3, 4-2-1/7.5.1, 4-9-3/17, 4-9-7/13, 4-9-2/11.7 & 4-9-4/23 (Low Voltage Models only)   |
| <b>Bureau Veritas (BV)</b>               | Certified for Environmental Category EC Code: 33<br>Certified for use on AUT-UMS, AUT-CSS, AUT-PORT and AUT-IMS Classed Vessels  |
| <b>Det Norske Veritas (DNV)</b>          | Certified for Marine Applications, Temperature Class B, Humidity Class A, Vibration Class B, EMC Class A, and Enclosure Class B per DNV Rules for Ships Pt. 4, Ch. 9 Control and Monitoring Systems and Pt. 4, Ch.'s 2 & 3, Rotating Machinery |
| <b>Germanischer Lloyd (GL)</b>           | Environmental Category C; EMC2 per Type Tests Part 2, Edition 2003: Regulations for the Use of Computer and Computer on Board  |
| <b>Lloyd's Register (LR)</b>             | LR Type Approval Test Specification No. 1:1996 for Environmental Categories ENV1, ENV2, and ENV3   |
| <b>Nippon Kaiji Kyokai (NKK)</b>         | Rules Ch. 1, Part 7, of Guidance for the approval and Type approval of materials and equipment for marine use and relevant Society's Rules (Low Voltage Models only)   |
| <b>Registro Italiano Navale (RINA)</b>   | RINA Rules for the Classification of Ships – Part C Machinery, Systems and Fire Protection – Ch. 3, Sect. 6, Tab. 1.   |

# Chapter 1.

## General Information

### Introduction

This manual describes the Woodward 828 Digital Control hardware, 9907-247 (low voltage) and 9907-248 (high voltage).

### Application

The 828 Digital Control can be programmed to suit applications requiring two magnetic pickups (MPUs) or proximity switches (e.g. for torsional filtering) as the hardware includes two speed inputs. It also includes four analog inputs, three analog outputs, eight discrete inputs and three discrete outputs, all of which can be programmed to satisfy the application. The control can be used in load sharing systems as it contains circuitry and connections to support this.

The two LON channels can be used to support Woodward LonTalk or LINKnet input/output nodes control functions.

The 828 control (Figure 1-1) consists of a single printed circuit board in a sheet-metal chassis. Connections are via three terminal strips and three 9-pin subminiature D connectors.

### Control Options

The 828 control requires the following power supply input voltages, with 40 W as the nominal power consumption at rated voltage:

- 18–40 Vdc (24 or 32 Vdc nominal)
- 90–150 Vdc (125 Vdc nominal)

Discrete input voltages provide on/off command signals to the electronic control. Each discrete input requires 10 mA at its 24 Vdc nominal voltage rating (for 24 volt switching logic).

Other control options are:

- proximity switch input for speed signal frequencies below 100 Hz (see NOTE)
- tandem actuator outputs
- dual actuator outputs (0–200 mA)

The control may be used with either proximity switches (see NOTE) or magnetic pickups. The minimum frequency for steady state speed control is 7.5 Hz. For more information see Control Specifications (inside back cover).

**IMPORTANT**

**EU Directive compliant applications are not currently able to use proximity switches due to the sensitivity of the switches.**

## 828 Digital Speed Control Accessories

- Hand Held Programmer (Figure 1-2), part number 9907-205, can be used for adjusting the 828 control. It plugs into serial port J1 of the control. This part is EU Directive compliant.
- SPM-A Synchronizer, for synchronizing the generator phase to that of the power bus. The synchronizer generates a close generator breaker signal to parallel the generator with the power bus.
- Power Output Sensor, for load sharing or droop operation in mechanical load applications.
- Real Power Sensor, for load sharing or droop-parallel generator applications.
- Digital Synchronizer and Load Control (DSLCC) for generator load management.
- LINKnet nodes for additional input/output control functions.

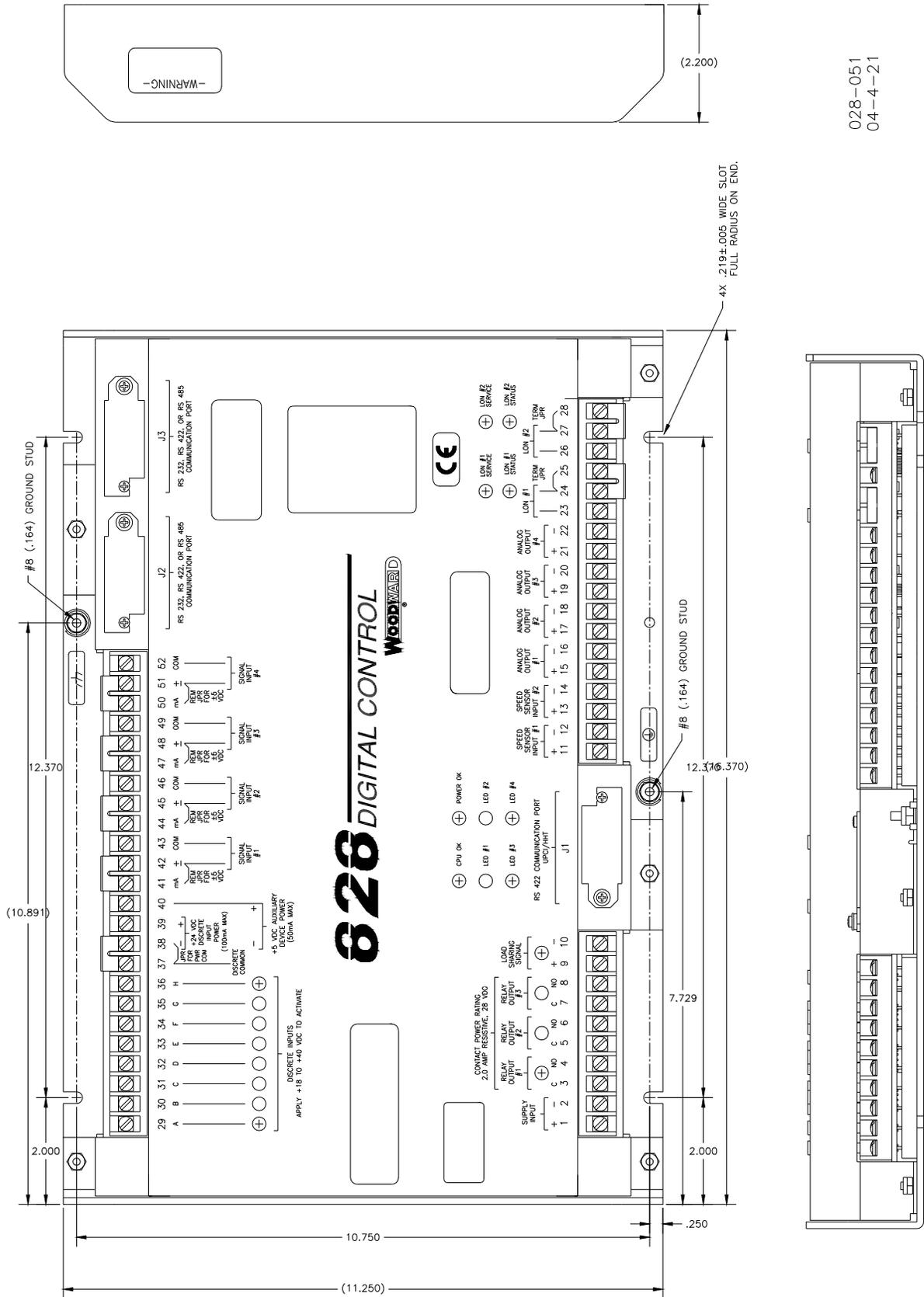


Figure 1-1. 828 Controller Outline Drawing

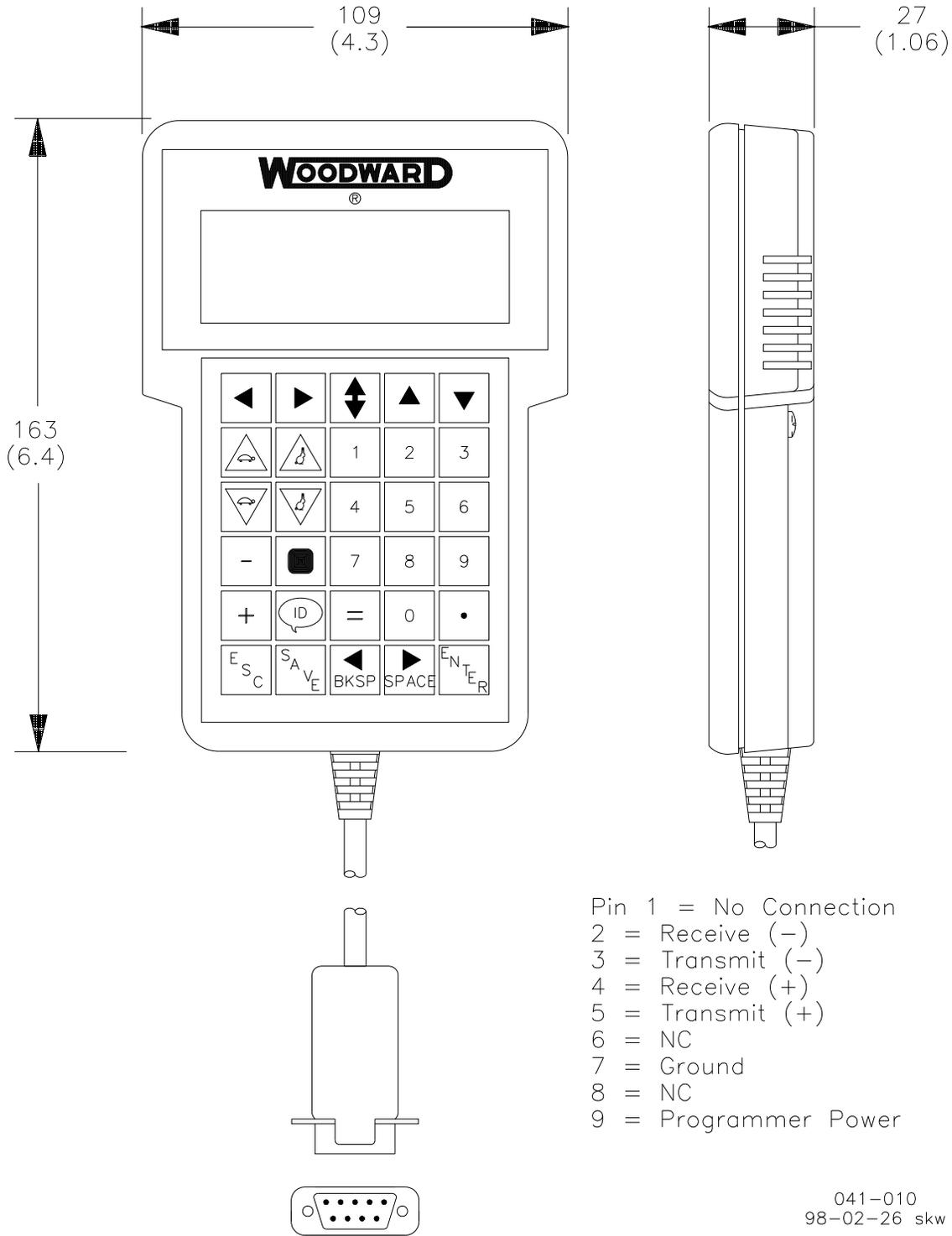


Figure 1-2. Handheld Programmer Outline Drawing

041-010  
98-02-26 skw

## Chapter 2. Installation

### Introduction

This chapter contains general installation instructions for the 828 control. Power requirements, environmental precautions, and location considerations are included to help you determine the best location for the control. Additional information includes unpacking instructions, electrical connections, and installation checkout procedures.

### Unpacking

Before handling the control, read Electrostatic Discharge Awareness (page v). Be careful when unpacking the electronic control. Check the control for signs of damage such as bent panels, scratches, and loose or broken parts. If any damage is found, immediately notify the shipper.

### Power Requirements

The high-voltage versions of the 828 Digital Speed Control require a voltage source of 90 to 150 Vdc. The low-voltage versions require a voltage source of 18 to 40 Vdc.

#### **NOTICE**

To prevent damage to the control, do not exceed the input voltage range.

#### **IMPORTANT**

If a battery is used for operating power, an alternator or other battery-charging device is necessary to maintain a stable supply voltage.

#### **NOTICE**

To prevent damage to the control, make sure that the alternator or other battery-charging device is turned off or disconnected before disconnecting the battery from the control.

### Location Considerations

Consider these requirements when selecting the mounting location:

- adequate ventilation for cooling
- space for servicing and repair
- protection from direct exposure to water or to a condensation-prone environment
- protection from high-voltage or high-current devices, or devices which produce electromagnetic interference in excess of levels defined in EN50082-2
- avoidance of vibration
- selection of a location that will provide an operating temperature range of –40 to +70 °C (–40 to +158 °F)

The control must NOT be mounted on the prime mover.

## Specific Marine Installation Requirements

Marine Type approval requirements change over time. In recent years, there has been at least the addition of a stricter emission limit. A 156–165 MHz band notch has been added and referred to here as the “Marine Notch”. To address the Marine Notch, additional installation limitations are required for new installations under the updated Marine Type approvals.

All wiring, except for the last 12 inches (305 mm) adjacent to the control connection terminals must be inside a metal conduit, metal cable armoring, enclosed metal cable way, or similar metal acting as a secondary shield. The metal acting as the secondary shield must be grounded to the same reference ground as the control chassis. In some cases, the chassis reference ground is also referred to as Protective Earth (PE). All wiring must also follow the wiring and shielding requirements given in the specific, separate software manual.

The control must be mounted on a metal mounting plate that is grounded to the same reference ground potential as the control’s chassis.

Alternatively, if the installation is limited to areas of the ship where at least 6 dB attenuation of the RF signals from the control can be guaranteed, no additional special measures are needed. The signals in the 156–165 MHz range must be attenuated by 6 dB before they reach the receiver antenna or receiver (interference point), and the control must be >3 m away from the antenna or receiver. This is a specific installation dependency, and some examples may include:

- A grounded, metal, IP rated cabinet with all cabling staying inside it for more than 2 m length, with any shield terminations at the cabinet exit/entry point and all unshielded cable routed directly against the metal cabinet.
- A below-deck metal engine room where none of the cabling, including power, leaves the engine room.

If using a specific installation location or method as a means to meet the Marine Notch requirements, instead of a secondary metal shield for cabling, consult the ship builder. Acceptability of the installation for obtaining 6 dB of RF attenuation in the 156–165 MHz range must be provided by the ship builder. Woodward will not know the ship installation application or requirements to provide guidance.

## Internal Jumpers

The 828 control has ten, two-position internal jumpers (JPR1 through JPR20) located on the top of the printed circuit board. If it is necessary to change any jumper to match your control requirements, and this suits the nature of the software, be sure to read Electrostatic Discharge Awareness (page v).

Remove power and all inputs. Wait 45 seconds, then remove cover. With your fingers or a small pair of tweezers, carefully remove the appropriate jumper and replace it securely over the proper two connectors (see Figure 2-1).

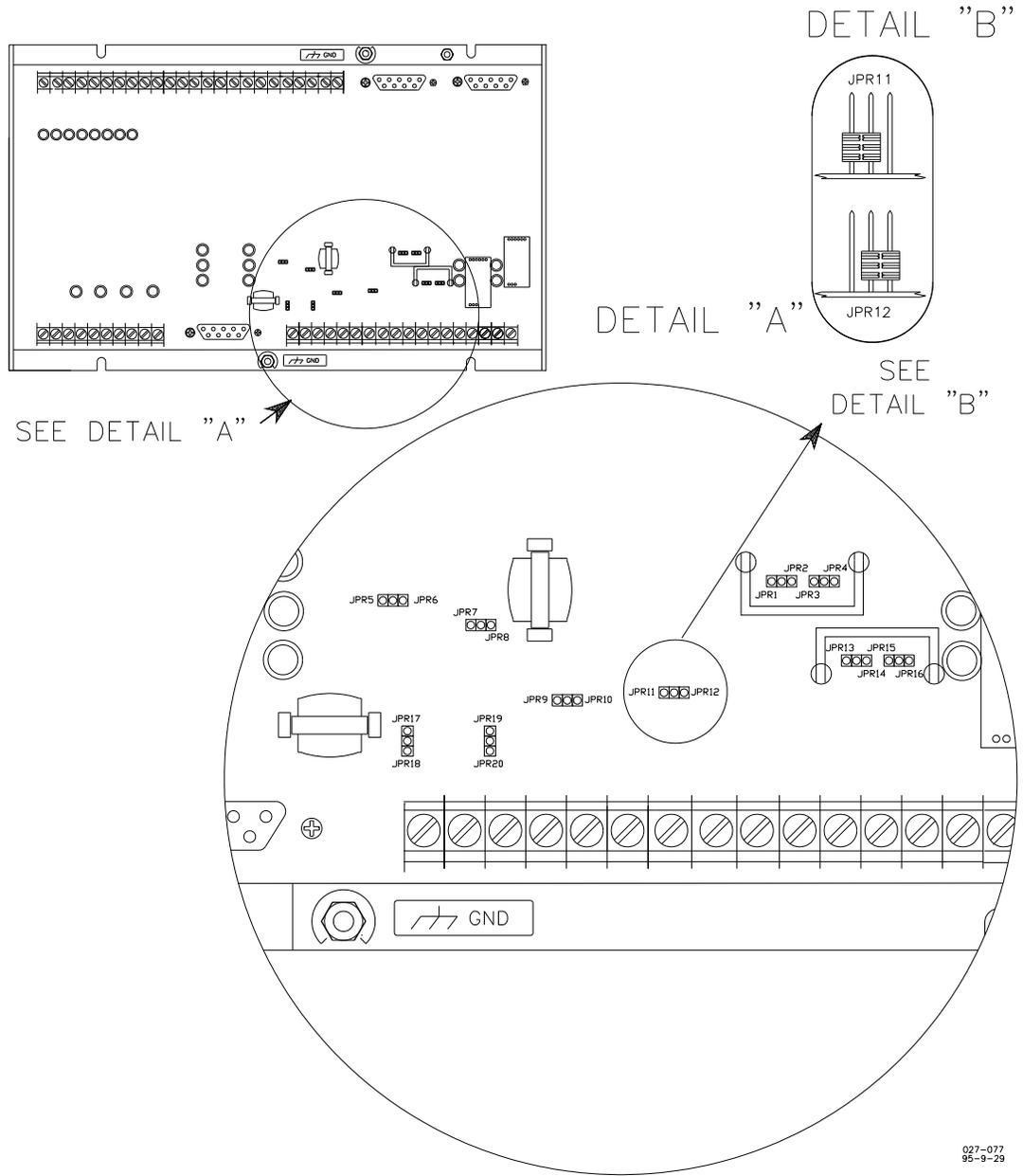


Figure 2-1. 828 Control Internal Jumpers

027-077  
85-9-29

The jumper connections are listed:

|   |              |                    |  |
|---|--------------|--------------------|--|
|   | JPR10        | analog output #1   | 0–1 mA                                   |
| * | JPR9         | analog output #1   | 0–20 mA                                  |
|   | JPR12        | analog output #2   | 0–1 mA                                   |
| * | JPR11        | analog output #2   | 0–20 mA                                  |
| * | JPR13 & JPR2 | actuator output #1 | 0–200 mA, single                         |
|   | JPR13 & JPR1 | actuator output #1 | 0–20 mA, single                          |
|   | JPR14 & JPR2 | actuator output #1 | 0–160 mA, tandem                         |
|   | JPR15 & JPR3 | actuator output #2 | 0–200 mA, single                         |
| * | JPR15 & JPR4 | actuator output #2 | 0–20 mA, single                          |
|   | JPR16 & JPR3 | actuator output #2 | 0–160 mA, tandem                         |
|   | JPR5 & JPR17 | speed sensor #1    | proximity switch<br>(see NOTE on page 2) |
| * | JPR6 & JPR18 | speed sensor #1    | magnetic pickup                          |
|   | JPR7 & JPR20 | speed sensor #2    | proximity switch<br>(see NOTE on page 2) |
| * | JPR8 & JPR19 | speed sensor #2    | magnetic pickup                          |

\*—default jumper settings

## Electrical Connections

External wiring connections and shielding requirements for each installation are shown in Chapter 5 of the software manual appropriate to the application.

### Shielded Wiring

All shielded cable must be twisted conductor pairs. Do not attempt to tin the braided shield. All signal lines should be shielded to prevent picking up stray signals from adjacent equipment. Connect the shields to the nearest chassis ground. Wire exposed beyond the shield should be as short as possible, not exceeding 50 mm (2 inches). The other end of the shields must be left open and insulated from any other conductor. DO NOT run shielded signal wires along with other wires carrying large currents. See Woodward application note 50532, Interference Control in Electronic Governing Systems for more information.

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.
2. Using a sharp, pointed tool, carefully spread the strands of the shield.
3. Pull inner conductor(s) out of the shield. If the shield is the braided type, twist it to prevent fraying.
4. Remove 6 mm (1/4 inch) of insulation from the inner conductors.

Installations with severe electromagnetic interference (EMI) may require additional shielding precautions. Contact Woodward Governor Company for more information.

## Power Supply (Terminals 1/2)

Power supply output must be low impedance (for example, directly from batteries). DO NOT power the control from high-voltage sources with resistors and zener diodes in series with the control power input. The 828 control contains a switching power supply which requires a current surge to start properly.

### NOTICE

To prevent damage to the control, do not power a low-voltage control from high-voltage sources, and do not power any control from high-voltage sources with resistors and zener diodes in series with the power input.

Run the power leads directly from the power source to the control. DO NOT POWER OTHER DEVICES WITH LEADS COMMON TO THE CONTROL. Avoid long wire lengths. Connect the positive (line) to terminal 1 and negative (common) to terminal 2. If the power source is a battery, be sure the system includes an alternator or other battery-charging device.

If possible, do NOT turn off control power as part of a normal shutdown procedure. Leave the control powered except for service of the system and extended periods of disuse.

### NOTICE

Do NOT apply power to the control at this time. Applying power may damage the control.

To prevent damage to the engine, apply power to the 828 control at least 60 seconds prior to starting the engine. The control must have time to do its power up diagnostics and become operational. Do not start the engine unless the green POWER AND CPU OK indicator on the 828 control cover comes on, because test failure turns off the output of the control.

## Analog Outputs (#1 & #2) (Terminals 15/16 & 17/18)

Use shielded twisted-pair wires to connect to terminals 15(+) & 16(-) and 17(+) & 18(-). For an electrically isolated input device such as a 4 to 20 mA input analog meter, the shield should be grounded at the control end of the cable. For input to other devices, use the recommendation of the device manufacturer.

### NOTICE

To prevent possible damage to the control or poor control performance resulting from ground loop problems, we recommend using current-loop isolators if the 828 control's analog inputs and outputs must both be used with non-isolated devices. A number of manufacturers offer 20 mA loop isolators. Consult Woodward Governor Company for further information.

## Actuator Outputs (#1 & #2) (Terminals 19/20 & 21/22)

The actuator wires connect to terminals 19(+) & 20(-) and 21(+) & 22(-). Use shielded wires with the shield connected to chassis at the control.

## Speed Signal Inputs (Terminals 11/12 & 13/14)

Connect a magnetic pick-up (MPU) or proximity switch (see NOTE on page 2) to terminals 11 and 12. You may need to connect a second MPU/proximity switch to terminals 13 and 14 (see relevant application manual). Use shielded wire for all speed sensor connections. Connect the shield to the chassis. Make sure the shield has continuity the entire distance to the speed sensor, and make sure the shield is insulated from all other conducting surfaces.

### **WARNING**

The number of gear teeth is used by the control to convert pulses from the speed sensing device to engine rpm. To prevent possible serious injury from an overspeeding engine, make sure the control is properly programmed to convert the gear-tooth count into engine rpm. Improper conversion could cause engine overspeed.

## Load Sharing Lines Input (Terminals 9/10)

Connect the output of a Woodward Load Sensor, or another 828 control's load sharing lines, to terminals 9(+) and 10(-). Use a shielded twisted-pair cable. Wire the remainder of the load sensor in accordance with the wiring diagram for the sensor used.

## Discrete Inputs (Terminals 29–36)

For Lloyd's Register of Shipping applications, use only isolated contacts (dry or signal rated) for the discrete inputs. Power these contacts from the control-supplied Aux Voltage.

Discrete inputs are the switch input commands to the 828 control. In low voltage systems, or other systems where nominal 24 Vdc is available, the discrete inputs should be powered by this external voltage.

If you are using the control-supplied aux voltage, jumper terminal 37 to terminal 38. This connects the control's common to the discrete input common. Terminal 39 then supplies power (approximately +24 Vdc) to the discrete inputs. Since the aux voltage is not isolated from other control circuits, use only isolated contacts (dry or signal voltage rated) for the discrete circuits. **DO NOT POWER ANY OTHER DEVICES WITH THE AUX VOLTAGE SOURCE.**

If you are supplying the discrete input voltage (24 Vdc), connect the voltage source negative (-) to terminal 37 (**DO NOT INSTALL THE JUMPER FROM TERMINAL 37 TO 38**). Then run the voltage source positive (+) to the appropriate switch or relay contact and then to the corresponding discrete input.

## Analog Inputs (#1, #2, #3, & #4) (Terminals 42/43, 45/46, 48/49, & 51/ 52)

Use shielded twisted-pair cable to connect to terminals 42(+) & 43(-), 45(+) & 46(-), 48(+) & 49(-), and 51(+) & 52(-). Ensure that a jumper is installed between relevant terminals (41 & 42-#1, 44 & 45-#2, 47 & 48-#3, 49 & 50-#4) for the mA input. These inputs are not isolated from the other control inputs and outputs (except the power supply input and the discrete inputs). If any other analog input or output is used in a common ground system, an isolator must be installed. A number of manufacturers offer 20 mA loop isolators. Consult Woodward Governor Company for further information.

### Installation Checkout Procedure

With the installation complete, do the following checkout procedure before beginning set point entry or initial start-up adjustments.

1. Visual inspection
  - A. Check the linkage between the actuator and fuel metering device for looseness or binding. Refer to the appropriate actuator manual, and Manual 25070, Electric Governor Installation Guide for additional information on linkage.



**WARNING** To prevent possible serious injury from an overspeeding engine, the actuator lever or stroke should be near but not at the minimum position when the fuel valve or fuel rack is at the minimum fuel delivery position.

- B. Check for correct wiring in accordance with the plant wiring diagram, (see relevant Application Manual).
  - C. Check for broken terminals and loose terminal screws.
  - D. Check the speed sensor(s) for visible damage. If the sensor is a magnetic pickup, check the clearance between the gear and the sensor, and adjust if necessary. Clearance should be between 0.25 and 1.25 mm (0.010 and 0.050 inch) at the closest point. Make sure the gear runout does not exceed the pickup gap.
2. Check for grounds

Check for grounds by measuring the resistance from all control terminals to chassis. All terminals except terminals 2 and 24 should measure infinite resistance (the resistance of terminals 2 and 24 depends on whether a floating or grounded power source is used). If a resistance less than infinite is obtained, remove the connections from each terminal one at a time until the resistance is infinite. Check the line that was removed last to locate the fault.

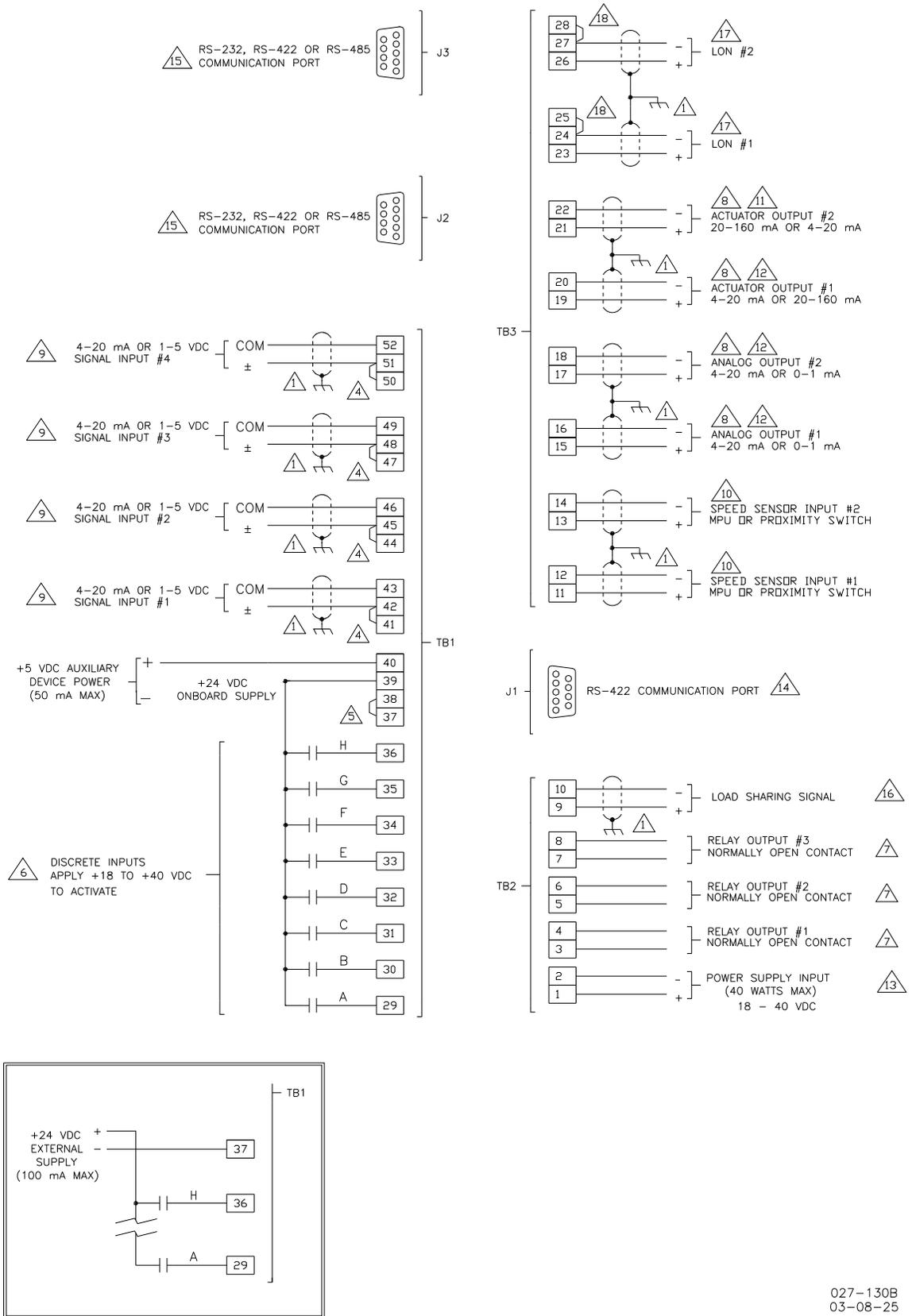
### Serial Port Communications

The 828 has two serial ports for communications. They may be software configured as RS-232, RS-422, or RS-485. These ports may be software configured to function as Modbus communications ports at the time the application software is written. If the J2 and J3 port are configured as a Modbus port, they will support either Modbus ASCII or Modbus RTU protocols.

**Notes for Figure 2-2:**

1. Shielded wires are twisted pairs, with shield grounded at one end only. When mounting control to bulkhead, use the grounding stud and hardware supplied with the chassis to ensure proper grounding.
2. Shields must not be grounded at any external point unless otherwise noted.
3. All shields must be carried continuously through all terminal blocks and must not be tied to other shields except at the common ground point. Tie all shields together at the ground stud located near connector J1.
4. Remove jumper for voltage input.
5. Remove jumper if using external discrete input power.
6. Discrete inputs are isolated from other circuits and intended to be powered by TB1-39 (+24 Vdc) leaving the jumper in place. Input current is nominally 10 mA per input into 2210  $\Omega$ .
7. Unless otherwise specified:
  - A. Relays shown de-energized
  - B. Relays energize for function
  - C. Relay contact ratings for minimum 100 000 operations:

|            |                               |
|------------|-------------------------------|
| Resistive— | 20 A at 28 Vdc                |
|            | 0.1 A at 115 Vac 50 to 400 Hz |
| Inductive— | 0.75 A at 28 Vdc 0.2 henry    |
|            | 0.1 A at 28 Vdc lamp          |
8. Analog output signals to other systems must be isolated from ground either by design or employment of isolation amplifiers.
9. Analog input signals from other systems must be isolated from ground either by design or employment of isolation amplifiers.
10. Factory set for MPU input.
11. Factory sep for 20–160 mA output.
12. Factory set for 4–20 mA output.
13. Internal power supply provides dc isolation between the power source and all other inputs and outputs.
14. Communication port J1 can only be used with the Woodward ST2000 handheld programmer.
15. Communication port J2 or J3 can be configured as an RS-232, RS-422, or RS-485 serial interface.  
Port configuration can be done in the application software only.  
For the pin assignment of J2 and J3, see hardware manual 02758.
16. This analog output may connect to a metering/controlling device. The shield should be continuous between all connected devices with a single shield termination point to ground.
17. Use twisted pair shielded wires only.



027-130B  
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Figure 2-2. 828 I/O

## Termination

For RS-422, termination should be located at the receiver when one or more transmitters are connected to a single receiver. When a single transmitter is connected to one or more receivers, termination should be at the receiver farthest from the transmitter. Figure 2-3 is an example.

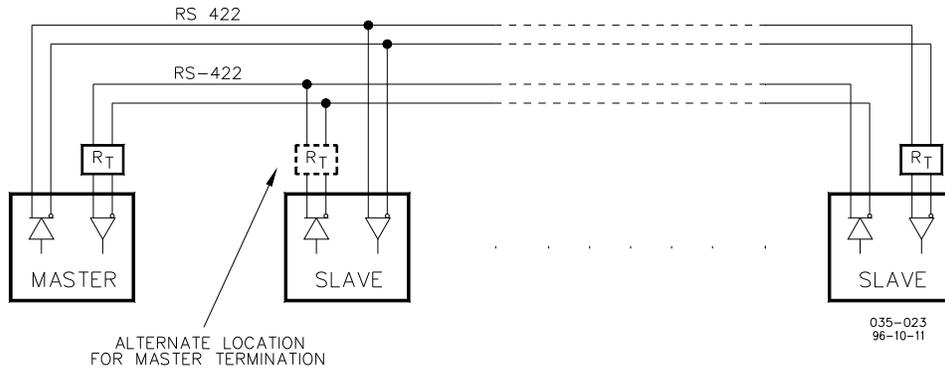


Figure 2-3. RS-422 Terminator Locations

Communicating with the OpTrend operator interface is a special case of Figure 2-3. Because the OpTrend master cannot put its transmitter into a high-impedance state, and our bit rate is less than 90K bits/sec, termination is not needed at the slave. Termination is needed at the OpTrend receiver, but because there is no way to locate it there, it has to be put at the alternate location.

For RS-485, termination should be at each end of the cable. If termination can't be located at the end of a cable, put it as close as possible to the ends. Figure 2-4 is an example.

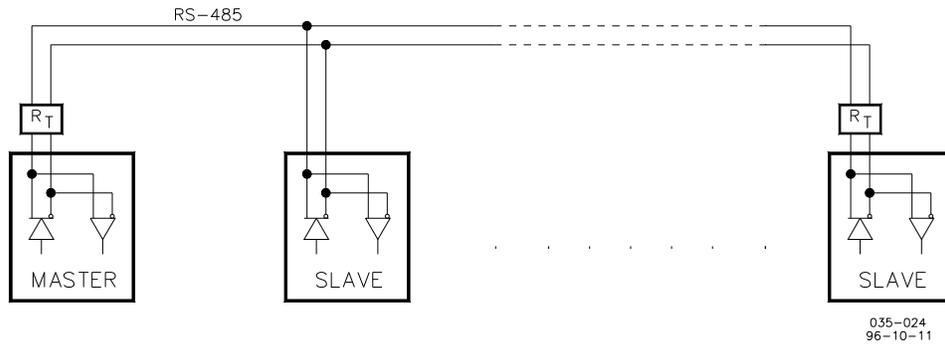


Figure 2-4. RS-485 Terminator Locations

If you do not know if a master can put its transmitter into a high-impedance state, terminate the line as shown in Figure 2-3. It does not hurt to terminate the line even when it is not needed as in the case of the OpTrend operator interface.

Termination is accomplished using a three-resistor voltage divider between a positive voltage and ground. The impedance of the resistor network should be equal to the characteristic impedance of the cable. This is usually about 100 to 120 ohms. The purpose is to maintain a voltage level between the two differential lines so that the receiver will be in a stable condition. The differential voltage can range between 0.2 and 6 volts; but the maximum voltage between either receiver input and circuit ground must be less than 10 volts. There is one termination resistor network for each port located on the 828 board. Connection to this resistor network is made through the 9-pin connectors on pins 6 and 9. See Figures 2-5 through 2-8 for termination and cable connection examples.

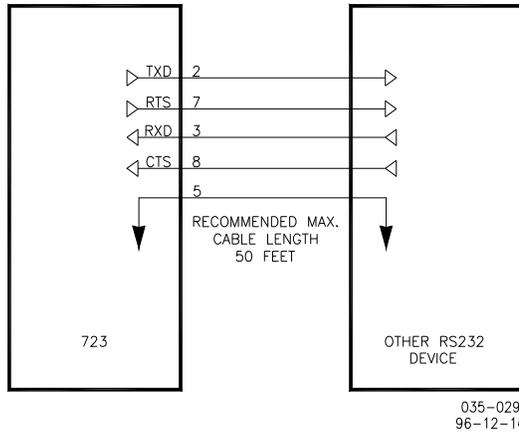


Figure 2-5. 828 RS-232 Connections

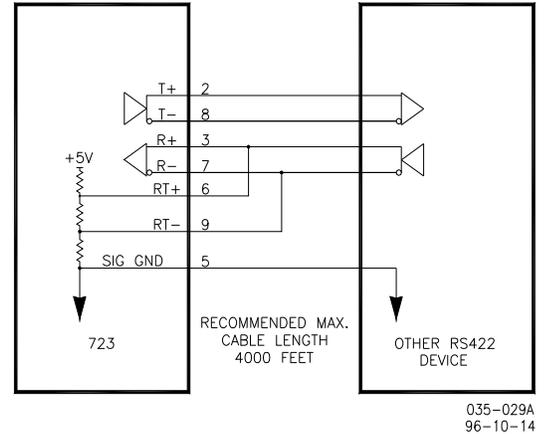


Figure 2-6. 828 RS-422 Connections w/Optional Termination at Receiver

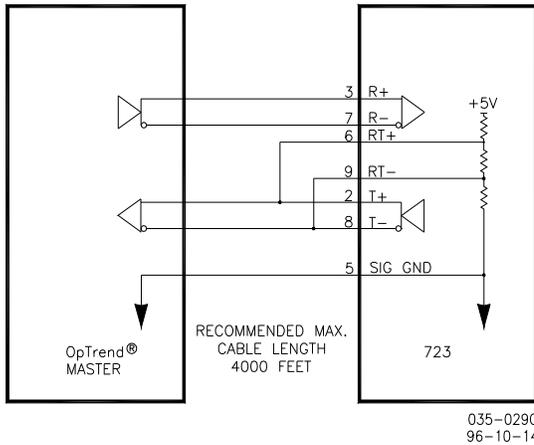


Figure 2-7. 828 RS-422 Connections w/Optional Termination at Transmitter

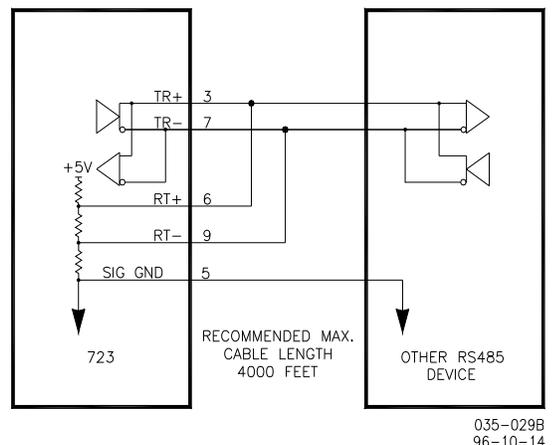


Figure 2-8. 828 RS-422 Connections w/Optional Termination at Transmitter

## Grounding and Shielding

The RS-422 and RS-485 specifications state that a ground wire is needed if there is no other ground path between units. The preferred method to do this is to include a separate wire in the cable that connects the circuit grounds together. Connect the shield to earth ground at one point only. The alternate way is to connect all circuit grounds to the shield, and then connect the shield to earth ground at one point only. If the latter method is used, and there are non-isolated nodes on the party line, connect the shield to ground at a non-isolated node, not at an isolated node. Figures 2-9 and 2-10 illustrate these cabling approaches.

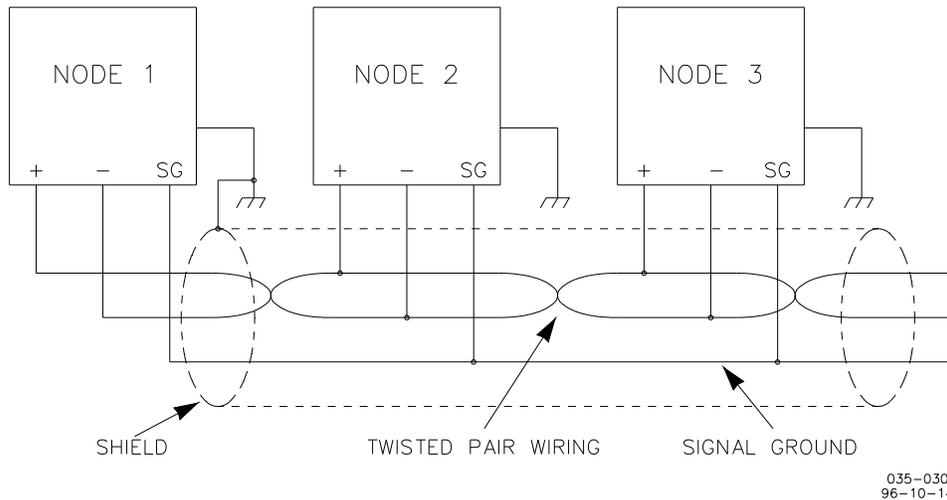


Figure 2-9. Preferred Multipoint Wiring Using Shielded Twisted-pair Cable with a Separate Signal Ground Wire

**IMPORTANT** The SG (signal ground) connection is not required if signal ground is unavailable.

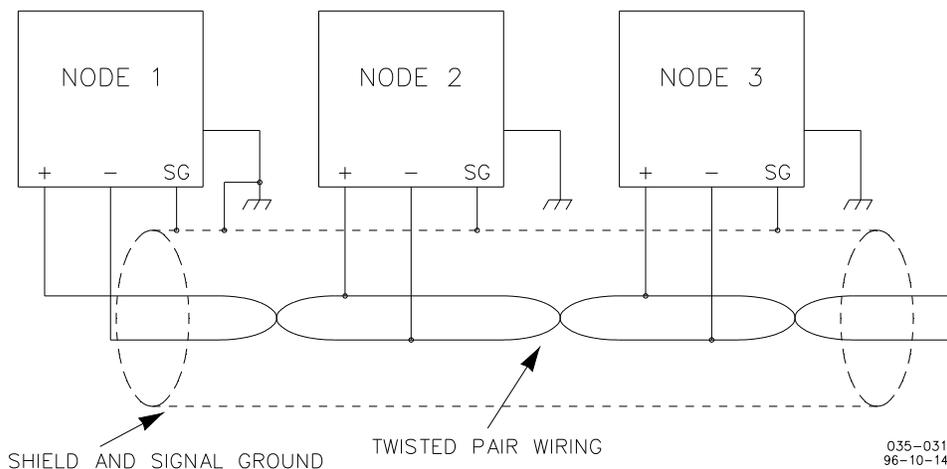


Figure 2-10. Alternate Multipoint Wiring Using Shielded Twisted-pair Cable without a Separate Signal Ground Wire

## Special Setup Procedures

### Node Addresses

The LINKnet modules each have rotary switches that set the module address. Before installing or replacing the modules, insure that the addresses are set to the value listed on the hardware description for that module.

**IMPORTANT**

Non-isolated nodes may not have a signal ground available. If signal ground is not available, use the alternate wiring scheme in Figure 2-10 with the signal ground connection removed on those nodes only.

## Chapter 3.

# Entering Control Set Points

### Introduction

Due to the variety of installations, plus system and component tolerances, the 828 control must be tuned to each system for optimum performance.

This chapter contains information on how to enter control set points through the control's menu system using the Hand Held Programmer. If you have access to the Watch Window software tool and Servlink software, you can set up and tune the 828 control from a PC (personal computer) using the instructions in Chapter 4 of this manual.



**An improperly calibrated control could cause an engine overspeed or other damage to the engine. To prevent possible serious injury from an overspeeding engine, read this entire procedure before starting the engine.**

### Hand Held Programmer and Menus

The Hand Held Programmer is a hand-held computer terminal that gets its power from the 828 control. The terminal connects to the RS-422 communication serial port on the control (terminal J1). To connect the terminal, slightly loosen the right-hand screw in the cover over J1 and rotate the cover clockwise to expose the 9-pin connector. Then firmly seat the connector on the terminal into J1.

The programmer does a power-up self-test whenever it is plugged into the control. When the self-test is complete, the screen will display two lines of information. This is information relating to the application. Pressing the ID key will change the display to show the part number of the software and version letter.

The programmer screen is a four-line, backlit LCD display. The display permits you to look at two separate functions or menu items at the same time. Use the UP/DOWN ARROW key to toggle between the two displayed items. The BKSP and SPACE keys will scroll through the display to show the remainder of a prompt if it is longer than the display screen's 18 characters.

The 828 has two sets of menus—the Service menus and the Configure menus. The Service menus allow easy access and tuning while the engine is running. The Configure menus may be entered only if the I/O is shutdown (hence the engine stopped).

## Configure Menus

To access the Configure menus, the engine must be shut down. Press the • key. The display will show, “To select configure, press enter”. Press the ENTER key and the display will show, “To shutdown I/O, press enter”. Press the ENTER key and this will allow you into the Configure menus.

### **IMPORTANT**

**If the engine is running during this process, it will be shut down due to shutting down the I/O of the control.**

To move between the menus use the LEFT ARROW and RIGHT ARROW keys. To move through the set points within a menu, use the UP ARROW and DOWN ARROW keys. Once within a menu, to return to the menu header, press the ESC key.

To leave the Configure menus press the ESC key. The set points will be automatically saved when leaving Configure.

## Service Menus

To access the Service menus press the DOWN ARROW key. To move between menus, and to move through set points within menus follow the instructions as for the Configure menus. Also to return to the menu header, or to leave Service, follow the Configure instructions.

## Adjusting Set Points

To adjust a set point, use the TURTLE UP or the RABBIT UP keys to increase the value, and the TURTLE or RABBIT DOWN keys to decrease the value. The RABBIT UP and RABBIT DOWN keys will make the rate of change faster than the TURTLE UP and TURTLE DOWN keys. This is useful during initial setup where a value may need to be changed significantly. Where necessary, to select TRUE, use either the TURTLE UP or the RABBIT UP keys, and to select FALSE, use the TURTLE DOWN or RABBIT DOWN keys.

Use the + or – keys to change integer values in the application software.

To obtain an exact value, press the = key. Key in the required figure and press ENTER.

### **IMPORTANT**

**This may be done only if the figure is within 10% of the existing value.**

To save set points at any time, use the SAVE key. This will transfer all new set point values into the EEPROM memory. The EEPROM retains all set points when power is removed from the control.

### **IMPORTANT**

**To prevent possible damage to the engine resulting from improper control settings, make sure you save the set points before removing power from the control. Failure to save the set points before removing power from the control causes them to revert to the previously saved settings.**

## Hand Held Programmer Keys

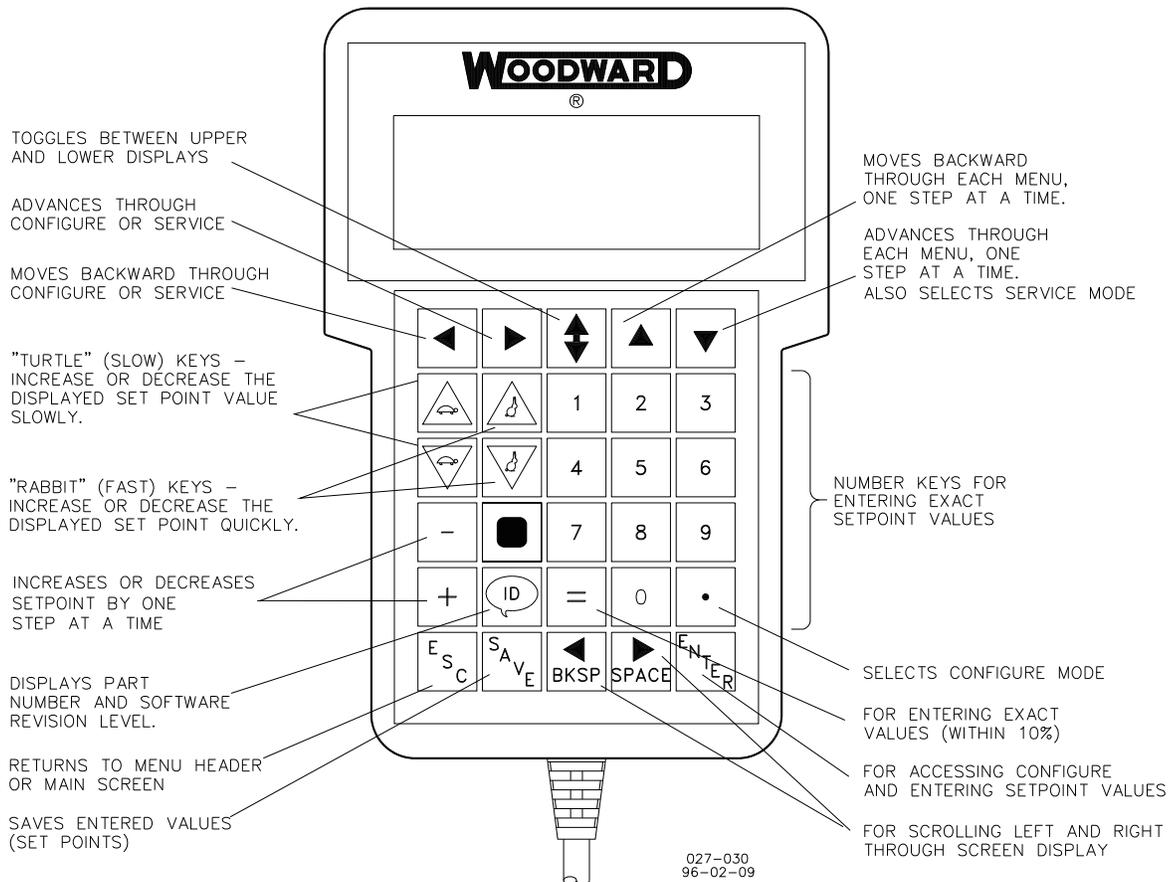


Figure 3-1. Hand Held Programmer Functions

The programmer keys do the following functions (see Figure 3-1):

|                 |   |
|-----------------|---|
| (left arrow)    | Moves backward through Configure or Service, one menu at a time.                              |
| (right arrow)   | Advances through Configure or Service, one menu at a time.                                    |
| (up/down arrow) | Toggles between the two displayed items.  |
| (up arrow)      | Moves backward through each menu, one step at a time.   |
| (down arrow)    | Advances through each menu, one step at a time. Selects Service from Main Screen.             |
| (turtle up)     | Increases the displayed set point value slowly.   |
| (turtle down)   | Decreases the displayed set point value slowly.   |
| (rabbit up)     | Increases the displayed set point value quickly (about 10 times faster than the turtle keys). |
| (rabbit down)   | Decreases the displayed set point value quickly (about 10 times faster than the turtle keys). |
| - (minus)       | Increases set point values by one step at a time.   |
| + (plus)        | Decreases set point values by one step at a time.   |
| (solid square)  | Not used.   |
| ID              | Displays the 828 control part number and software revision level.                             |
| ESC             | To return to menu header or to main screen.   |
| SAVE            | Saves entered values (set points).  |
| BKSP            | Scrolls left through line of display.   |
| SPACE           | Scrolls right through line of display.  |
| ENTER           | Used when entering exact values and accessing Configure.                                      |
| = (equals)      | For entering exact values (within 10%).   |
| • (decimal)     | To select Configure.  |

# Chapter 4.

## Using Servlink with Watch Window

### Using Watch Window

Here are brief instructions for using the Watch Window in conjunction with Servlink to view the variables for your 828 control on a PC (personal computer). These instructions are meant to be introductory only. Full on-line help is available in each application. It is assumed that you already have Servlink and Watch Window installed. The default installation location can be found by clicking the START icon (Microsoft Windows 95 or later) on the main menu bar and then clicking the PROGRAMS menu item. Look for an icon called WOODWARD WATCH WINDOW.

1. Make sure that all other programs that may access your computer communications port are shut down.
2. Get the right cable to talk from your PC to the control (5416-614 will work for J2 and J3, 5416-870 for J1).
3. Start the Servlink server and open a new file. Select the proper COM port for your PC, verify that POINT TO POINT communications mode is selected, and verify that the baud rate matches the baud rate of the 828 . The default baud rate is 19 200. See the on-line help file if you have been changing the port settings of your control.
4. Select OK. If everything is working right, you should see an animated picture of a string of "1"s and "0"s flying from the control to the PC on your screen. You now have a network definition file whose default name is NET1. You should save this file as "your filename.NET" (use FILE/SAVE AS). Link this name to your control part number, as it will work only with that application. For instance, if the upper level control number is 9907-031, you could save the file as 9907031.NET. Do not disconnect the server.
5. In the Servlink window you will now have another dialog window titled "your filename.net". In this window you will see a ballhead icon and a control identifier name. Unless you have given the control a serial number (or name) with the SLSN.EXE program, this name will display as "<unidentified>".
6. Start the Watch Window application. When Watch executes, you will have a screen displaying three windows entitled Watch Window, Explorer, and Inspector.
7. The Explorer window will have two groups displayed, SERVICE and CONFIGURE. Double clicking on either of these will expand them to show groups of values. Explorer is used only to locate a tunable or monitor value. In order to change a value or monitor a value, you must drag and drop a value from the Explorer window into the Inspector window.

8. Once a value is displayed in the Inspector, you can see several blocks of information. The most important blocks for a tunable value are the FIELD and VALUE blocks. The FIELD block is used to identify a particular value, and the VALUE block displays the current value of a variable. There are two types of values available in Watch. One is a monitor value, which is marked in the INSPECTOR window with a pair of glasses. This means it may only be looked at. The other value is a read/write value, which is marked with a pencil. The read/write type may be modified using the up and down arrows in the value block.

## Downloading to the 828

### **IMPORTANT**

**This is the only way to download to an 828, and it will not work on a regular 723.**

1. Make sure that all other programs that may access your computer's communication port are shut down.
2. Get the right cable to talk from your PC to the control J1 port (5416-870 ).
3. Start the Servlink server and open a new file. From the dialog window, select the proper COM port for your PC, select POINT TO POINT communications mode, and set the baud rate to 19200.
4. Select OK. If everything is working right, you should see an animated picture of a string of "1"s and "0"s flying from the control to the PC on your screen. You now have a network definition file whose default name is NET1. You should save this file. Link this name to your control part number as it will only work with that application. For instance if the upper level control number is 9907-031, you could save the file as 9907031.NET. Do not disconnect the server.
5. In the Servlink window you will now have another dialog window titled "your filename.net". In this window you will see a ballhead icon and a control identifier name. Unless you have given the control a serial number (or name) with the SLSN.EXE program, this name will display as "<unidentified>". Note this name.

Start the Watch Window program. Under the title bar in the Explorer window you will find a tab with your network file and the control ID displayed. Right click this tab to display the pop-up menu, and select LOAD APPLICATION. This will close the Inspector window and open a new window where you will enter the name of the file you want to download. Once the filename is correct, click on the OPEN button. A Warning screen will ask you to make sure the engine is shut down before downloading. Downloading will proceed automatically once you accept the message to shut down the engine.

### **WARNING**

**Be sure the engine is shut down before downloading. An engine overspeed is possible if the engine is running during the download process.**

## Transferring Tunable Values Between 828 Controls

**IMPORTANT**

Note that this will not work with regular 723 controls.

1. Make sure that all other programs that may access your computer's communication port are shut down.
2. Get the right cable to talk from your PC to the control (5416-870 for J1 , 5415-614 for J2 or J3).
3. Start the Servlink server and open a new file. From the dialog window, select the proper COM port for your PC, select POINT TO POINT communications mode, and set the baud rate to 19200.
4. Select OK. If everything is working right, you should see an animated picture of a string of "1"s and "0"s flying from the control to the PC on your screen. You now have a network definition file whose default name is NET1. You should save this file. Link this name to your control part number as it will only work with that application. For instance if the upper level control number is 9907-031, you could save the file as 9907031.NET. Do not disconnect the server.
5. In the Servlink window you will now have another dialog window titled "your filename.net". In this window you will see a ballhead icon and a control identifier name. Unless you have given the control a serial number (or name) with the SLSN.EXE program, this name will display as "<unidentified>". Note this name.
6. Start the Watch Window program. Under the title bar in the Explorer window you will find a tab with your network file and the control id displayed. Right click this tab to display the pop-up menu, and select CONFIGURATION. If you want to take the configuration from a control, select SAVE TO FILE. If you want to download a new configuration to a control with an existing application, then select LOAD FROM FILE.
7. If you select SAVE TO FILE, you will have to provide the name of a file that you want to save the configuration to. If your control has a part number of 9907-031 then you might want to call this file 9907031.cfg. Make the name meaningful so you can find it easily the next time you need it.
8. If you select LOAD FROM FILE you will get a confirmation warning telling you that the unit will be shut down. If you answer yes then you will be asked for the name of the configuration file that you want to download.

# Chapter 5.

## Product Support and Service Options

### Product Support Options

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

1. Consult the troubleshooting guide in the manual.
2. Contact the **OE Manufacturer or Packager** of your system.
3. Contact the **Woodward Business Partner** serving your area.
4. Contact Woodward technical assistance via email ([EngineHelpDesk@Woodward.com](mailto:EngineHelpDesk@Woodward.com)) with detailed information on the product, application, and symptoms. Your email will be forwarded to an appropriate expert on the product and application to respond by telephone or return email.
5. If the issue cannot be resolved, you can select a further course of action to pursue based on the available services listed in this chapter.

**OEM or 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 current list of Woodward Business Partners is available at [www.woodward.com/directory](http://www.woodward.com/directory).

### Product Service Options

Depending on the type of product, the following options for servicing Woodward products may be available through your local Full-Service Distributor or the OEM or Packager of the equipment system.

- 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 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.

**Flat Rate Repair:** Flat Rate Repair is available for many of the standard mechanical products and some of the electronic 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.

**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. 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 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's Full-Service Distributors offer various Engineering Services for our products. For these services, you can contact the Distributor by telephone or by email.

- 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.

**Product Training** is available as standard classes at many Distributor locations. Customized classes are also available, which can be tailored to your needs and held at one of our Distributor 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 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 one of the Full-Service Distributors listed at [www.woodward.com/directory](http://www.woodward.com/directory).

## Contacting Woodward's Support Organization

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory at [www.woodward.com/directory](http://www.woodward.com/directory), which also contains the most current product support and contact information.

You can also contact the Woodward Customer Service Department at one of the following Woodward facilities to obtain the address and phone number of the nearest facility at which you can obtain information and service.

| <b>Products Used in<br/>Electrical Power Systems</b> |                     | <b>Products Used in<br/>Engine Systems</b> |                     | <b>Products Used in Industrial<br/>Turbomachinery Systems</b> |                     |
|--|---------------------|--|---------------------|---|---------------------|
| <b>Facility</b>                                      | <b>Phone Number</b> | <b>Facility</b>                            | <b>Phone Number</b> | <b>Facility</b>   | <b>Phone Number</b> |
| Brazil   | +55 (19) 3708 4800  | Brazil                                     | +55 (19) 3708 4800  | Brazil  | +55 (19) 3708 4800  |
| China  | +86 (512) 6762 6727 | China                                      | +86 (512) 6762 6727 | China   | +86 (512) 6762 6727 |
| Germany:   |                     | Germany                                    | +49 (711) 78954-510 | India   | +91 (129) 4097100   |
| Kempen   | +49 (0) 21 52 14 51 | India                                      | +91 (129) 4097100   | Japan   | +81 (43) 213-2191   |
| Stuttgart  | +49 (711) 78954-510 | Japan                                      | +81 (43) 213-2191   | Korea   | +82 (51) 636-7080   |
| India  | +91 (129) 4097100   | Korea                                      | +82 (51) 636-7080   | The Netherlands   | +31 (23) 5661111    |
| Japan  | +81 (43) 213-2191   | The Netherlands                            | +31 (23) 5661111    | Poland  | +48 12 295 13 00    |
| Korea  | +82 (51) 636-7080   | United States                              | +1 (970) 482-5811   | United States   | +1 (970) 482-5811   |
| Poland   | +48 12 295 13 00    |  |                     |   |                     |
| United States  | +1 (970) 482-5811   |  |                     |   |                     |

## Technical Assistance

If you need to contact technical assistance, you will need to provide the following information. Please write it down here before contacting the Engine OEM, the Packager, a Woodward Business Partner, or the Woodward factory:

### General

Your Name \_\_\_\_\_

Site Location \_\_\_\_\_

Phone Number \_\_\_\_\_

Fax Number \_\_\_\_\_

---

### Prime Mover Information

Manufacturer \_\_\_\_\_

Engine Model Number \_\_\_\_\_

Number of Cylinders \_\_\_\_\_

Type of Fuel (gas, gaseous, diesel, dual-fuel, etc.) \_\_\_\_\_

Power Output Rating \_\_\_\_\_

Application (power generation, marine, etc.) \_\_\_\_\_

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### Control/Governor Information

#### Control/Governor #1

Woodward Part Number & Rev. Letter \_\_\_\_\_

Control Description or Governor Type \_\_\_\_\_

Serial Number \_\_\_\_\_

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#### 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 \_\_\_\_\_

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### Symptoms

Description \_\_\_\_\_  
\_\_\_\_\_

*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.*

## Appendix.

# System Troubleshooting Guide

The following is a general troubleshooting guide for areas to check which may present potential difficulties. By making these checks appropriate to your engine/turbine before contacting Woodward for technical assistance, your system problems can be more quickly and accurately assessed.

### Actuators

- Is the oil clean?
- Is the oil level normal?
- Does the actuator have the correct hydraulic pressure (if required)?
- Does the actuator have the correct pneumatic pressure (if required)?
- Does the driveshaft rotate (if required), and in the correct direction?
- Is the actuator wiring correct?
- Is the direction of the stroke correct?
- Has the compensation (if so equipped) been adjusted correctly?
- If there is a mechanical governor, are the speed, droop, and load limit adjusted correctly?
- Is the hydraulic return line free and not clogged?
- Is there back pressure on the hydraulic return line?
- Is the feedback (if any) adjusted correctly and sending the correct signal?

### Linkage

- Is there slop or lost motion?
- Is there misalignment, binding, or side loading?
- Is there visible wear or scarring?
- Does the linkage move smoothly

### Valves

- Does the valve move through it's proper stroke smoothly?
- Does the valve travel it's full stroke?
- Can mid-stroke be obtained and held?
- Does the valve fully seat (close) before the governor reaches full minimum stroke?
- Does the valve fully open before the governor reaches maximum stroke?
- Is the bypass valve(s) (if any) in the proper position?
- If a steam turbine, are there nicks or contamination which allow steam to pass when the valve is closed?

### Oil/Hydraulic System

- Is the oil at the proper operating pressure?
- Is the oil temperature too high for the type of oil being used?
- Is the oil contaminated?
- Does the actuator have sufficient flow of oil?
- Are the accumulators (if any) charged to the correct pressure?
- Are the filters plugged?
- Is the oil pump operating properly?

**Fuel Injection Pumps**

- Are any rack shafts stuck?
- Do all rack shafts move through their full stroke smoothly?
- Are all rack shaft settings equal, cylinder to cylinder, as the governor output shaft is rotated from min to max fuel?
- Are any drain lines clogged?
- Are all injection lines in good condition and free of leaks?

**Fuel/Steam Conditions**

- Is the engine/turbine inlet pressure at design specification?
- Is the fuel/steam pressure in the proper operating range?
- Are pressure transducers (if any) located close to the engine/turbine?
- Are there any pressure regulating devices or valves which may interfere with governor operation or proper fuel/steam flow?

**Control, Alarm, And Fault Indications**

- Does the governor indicate it is in the correct control mode?
- Is the governor issuing any alarms?
- Are any of the components of the governor indicating hardware faults?
- Does the actuator demand agree with the actual valve position?
- Are any shutdown conditions present?
- Have the control dynamics been tuned to match the system response?

**Input Signals**

- Are all input signals properly scaled?
- Are the inputs free of electrical noise and properly shielded?
- Is the wiring correct?
- Have all field input signals to the control been verified?
- Is the polarity of the signals correct?

**Output Signals**

- Are the outputs calibrated?
- Have the actuator drivers been calibrated to the stroke of the fuel injection pump, fuel valves, or turbine valves?
- Are the output signals free of noise and properly shielded?
- Is the wiring correct?

**Transducers**

- Is the transducer calibrated for the proper range?
- Has it been tested by simulating it's input and measuring it's output signal?
- Does the transducer have power?
- Are the sensing lines feeding the transducer clear of obstructions?
- Are all block, bleed, and bypass valves positioned properly?

### **Magnetic Pickups And Other Speed Sensing Devices**

- Is the wiring between the speed sensing pickup and the control correct?
- Are there any grounding problems or worn shields?
- Is the signal sufficient (at least 1.5 Vrms)?
- Is the signal a clean sine wave or square wave with no spikes or distortions?
- Is the MPU head clean and free of oil or metallic particles?
- Is the MPU head free of any nicks or chips?
- Is the MPU or proximity probe correctly aligned with the gear?
- Is the speed sensing probe adjusted to the correct gap?
- Is the speed sensing probe head the correct size for the toothed wheel it is being used with?

### **Input Voltage/ Power Supplies**

- Is the input power within the range of the control's power supply input?
- Is the input power free of switching noise or transient spikes?
- Is the power circuit dedicated to the governor only?
- Are the control's supplies indicating that they are OK?
- Are the control's supplies outputting the correct voltage?

### **Electrical Connections**

- Are all electrical connections tight and clean?
- Are all signal wires shielded?
- Are shields continuous from the device to the control?
- Are the shields terminated according to Woodward specifications?
- Are there low voltage signal wires running in the same wiring trays as high voltage wiring?
- Are the governor's signal common or grounds not tied to any other devices?
- Have the signals been checked for electrical noise?

### **Voltage Regulator**

- Is the voltage regulator working properly?

### **External Devices**

- Are there external devices the control is dependent on for input signals?
- Are these devices providing the correct signal to the control?
- Is the external device configured or programmed to be compatible with the control?

# 828 Control Specifications

|  |   |
|--|---|
| Low Voltage Model  | 18–40 Vdc (24 or 32 Vdc nominal)  |
| High Voltage Model   | 90–150 Vdc (125 Vdc nominal)  |
| Power Consumption  | 40 W nominal  |
| Inrush Current (Low Voltage Model)   | 7 A for 0.1 ms  |
| Inrush Current (High Voltage Model)  | 22 A for 15 ms  |
| <b>Input Power</b>   |   |
| <b>Inputs</b>  |   |
| Speed Signal Inputs (2)  |   |
| Speed Input Voltage  | 1.0–50.0 Vrms   |
| Speed Input Frequency  | Magnetic Pickup: 400 Hz to 15 kHz<br>Proximity Switch: 30 Hz to 15 kHz  |
| Speed Input Impedance  | 10 k $\Omega$ $\pm$ 15%   |
| Note: EU Directive compliant applications are not currently able to use proximity switches due to the sensitivity of the switches. |   |
| <b>Discrete Inputs (8)</b>   |   |
| Discrete Input   | 24 Vdc, 10 mA nominal, 18–40 Vdc range  |
| Response Time  | 10 ms $\pm$ 15%   |
| Impedance  | 2.3 k $\Omega$  |
| Note: For Lloyd's Register applications, use only control-supplied power.  |   |
| <b>Analog Inputs (4)</b>   |   |
| Analog Input   | $\pm$ 5 Vdc or 0–20 mA, transducers externally powered  |
| Common Mode Voltage  | $\pm$ 40 Vdc  |
| Common Mode Rejection  | 0.5% of full scale  |
| Accuracy   | 0.5% of full scale  |
| <b>Load Sharing Input</b>  |   |
| Analog Input   | 0–4.5 Vdc   |
| Common Mode Voltage  | $\pm$ 40 Vdc  |
| Common Mode Rejection  | 1.0% of full scale  |
| Accuracy   | 1.0% of full scale  |
| <b>Outputs</b>   |   |
| <b>Analog Outputs 0–1 or 4–20 mA (2)</b>   |   |
| Analog Output  | 0–1 mA or 4–20 mA (max. 600 $\Omega$ load)  |
| Accuracy   | 0.5% of full scale  |
| <b>Analog Outputs 0–20 or 0–200 mA (2)</b>   |   |
| Analog Output  | 0–20 mA (max. 600 $\Omega$ load) or 0–200 mA (max. 70 $\Omega$ load)  |
| Accuracy   | 0.5% of full scale  |
| <b>Relay Contact Outputs (3)</b>   |   |
| Contact Ratings  | 2.0 A resistive @ 28 Vdc; 0.5 A resistive @ 125 Vdc   |
| <b>Environment</b>   |   |
| Operating Temperature  | –40 to +70 $^{\circ}$ C (–40 to +158 $^{\circ}$ F)  |
| Storage Temperature  | –55 to +105 $^{\circ}$ C (–67 to +221 $^{\circ}$ F)   |
| Humidity   | 95% at +20 to +55 $^{\circ}$ C (+68 to +131 $^{\circ}$ F)<br>Lloyd's Register of Shipping Specification<br>Humidity Test 1  |
| Mechanical Vibration   | Lloyd's Register of Shipping Specification<br>Vibration Test 1  |
| Mechanical Shock   | US MIL-STD 801C Method 516.2, Proc. I, II, V  |
| EMI/RFI Specification  | Lloyd's Register of Shipping Specification<br>EN 50081–2 and EN 50082–2   |
| <b>Compliance</b>  |   |
| CSA Certified  | Class I, Division 2, Groups A, B, C, & D  |
| Marine Listings  | Lloyd's Register of Shipping (LR), Germanischer Lloyd (GL), American Bureau of Shipping (ABS, Low Voltage Models only), Bureau Veritas (BV), Det Norske Veritas (DNV), Nippon Kaiji Kyokai (NKK), Registro Italiano Navale (RINA) |
| European Union (EU)  | Compliant with EMC Directive 2004/108/EC and Low Voltage Directive 2006/95/EC.  |

# Declaration

## DECLARATION OF CONFORMITY

**Manufacturer's Name:** WOODWARD GOVERNOR COMPANY (WGC)  
Industrial Controls Group

**Manufacturer's Address:** 1000 E. Drake Rd.  
Fort Collins, CO, USA, 80525

**Model Name(s)/Number(s):** **723, 723 Plus and 828 Digital Control**

**P/N: 9906-130, 9906-619 and similar (18-40Vdc Input)**

**Conformance to Directive(s):** Declared to 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.

**Applicable Standards:** EN61000-6-4, (2007): EMC Part 6-4: Generic Standards - Emissions for Industrial Environments  
EN61000-6-2, (2005): EMC Part 6-2: Generic Standards - Immunity for Industrial Environments

We, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s).

### MANUFACTURER



Signature

Sam Coleman

Full Name

Compliance Engineering Supervisor

Position

WIC, Fort Collins, CO, USA

Place

August 12, 2009

Date

5-09-1183  
00115-04-CE-02-01

**DECLARATION OF CONFORMITY**

**Manufacturer's Name:** WOODWARD GOVERNOR COMPANY (WGC)  
Industrial Controls Group

**Manufacturer's Address:** 1000 E. Drake Rd.  
Fort Collins, CO, USA, 80525

**Model Name(s)/Number(s):** 723, 723 Plus and 828 Digital Control

**P/N: 9906-131, 9906-620 and similar  
(90-150Vdc Input)**

**Conformance to Directive(s):** Declared to 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.

Declared to 2006/95/EC COUNCIL DIRECTIVE of 12 December 2006 on the harmonization of the laws of Member States relating to electrical equipment designed for use within certain voltage limits.

**Applicable Standards:** EN61000-6-4, (2007): EMC Part 6-4: Generic Standards - Emissions for Industrial Environments  
EN61000-6-2, (2005): EMC Part 6-2: Generic Standards - Immunity for Industrial Environments

EN50178, January 1997: Electronic Equipment for Use in Power Installations

**We, the undersigned, hereby declare that the equipment specified above conforms to the above Directive(s).**

**MANUFACTURER**

  
\_\_\_\_\_  
**Signature**

Sam Coleman  
\_\_\_\_\_  
**Full Name**

Compliance Engineering Supervisor  
\_\_\_\_\_  
**Position**

WIC, Fort Collins, CO, USA  
\_\_\_\_\_  
**Place**

August 12, 2009  
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**Date**

5-09-1183  
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We appreciate your comments about the content of our publications.

Send comments to: [icinfo@woodward.com](mailto:icinfo@woodward.com)

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