



723 Generator Control

8280-576/-577

Application and 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.



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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.



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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.

Chapter 1.

General Information

Introduction

This manual describes the 723 Generator Control, part numbers 8280-576/-577 (High & Low Voltage Control).

Application

The control is intended for use in a variety of generator applications; for auxiliary generators and diesel electric propulsion in the marine market, and for island mode systems and for base loading against an infinite bus in the Power Plant market.

The MW Control mode is especially useful for applications where the grid is weak and large frequency excursions are expected. Under these circumstances, operating in droop mode is not practical, as large variations in load would be experienced, due to frequency shifts of the grid. In MW control, the speed of the engine is maintained by the grid, and the load on the generator remains constant throughout the frequency excursion.

Three modes of operation are available:

- Droop control based on a 4–20 mA **MW Transducer** input, or the actuator position.
- Isochronous load sharing with soft loading/unloading, and automatic generator breaker open command once the engine has unloaded.
- MW control with soft loading/unloading, and automatic generator breaker open command once the engine has unloaded. The reference may be adjusted locally (Increase/Decrease contacts) or remotely (analogue reference – 4–20 mA or Modbus® *).

*—Modbus is a trademark of Schneider Automation Inc.

Start and maximum fuel limiters are provided. A load limiter, enabled during KW control, will provide load de-rating during frequency excursions. Additional protection is offered to open the Grid Breaker or the Generator Breaker, should the frequency excursion become too large.

The control can be adjusted/biased for synchronising the generator to the bus by means of the Increase/Decrease contacts, or by the input provided for a Woodward Unit Synchroniser (SPM-A or DSLC™ — Digital Synchroniser & Load Control). The control may also be used for synchronising to the grid using the second synchroniser input (System Synchroniser), for an SPM-A or DSLC.

One LON connection of the 723 may be connected to a DSLC, so that all of the generator parameters may be monitored within the 723, and then also via the Modbus.

One serial port (J3) is available for Modbus communications using RS-232, RS-422, or RS-485. Engine and generator parameters can be monitored, and certain control functions sent to the control via the Modbus.

4–20 mA outputs are available for monitoring various control parameters.

Chapter 2.

723 DCS Installation

Declaration of Incorporation

In accordance with the EMC directive 89/336/EEC and its amendments, this controlling device, manufactured by the Woodward Governor Company, is applied solely as a component to be incorporated into an engine prime mover system. Woodward Governor declares that this controlling device complies with the requirements of EN50081-2 and EN50082-2 when put into service per the installation and operating instructions outlined in the product manual.

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

723 Digital Speed Control Accessories

Hand Held Programmer (Figure 2-2), part number 9907-205, is used for adjusting the 723 control set points/parameters. It plugs into the serial port of the control.

Digital Synchroniser & Load Control (DSLCTM) for synchronising the generator phase & voltage to that of the power bus. The DSLC also provides dead bus closure facility and has real power load sensing using harmonic filtering algorithms (DSLCT manual 02007).

SPM-A Synchroniser (9907-028 [without voltage matching] & 9907-029 [with voltage matching]) for synchronising the generator phase to that of the power bus. The synchroniser generates a generator breaker closure command to connect the unit in with the power bus.

Real Power Sensor (MW Transducer) for generator load monitoring (part number 8272-394).

723 Control Specifications

Part Numbers

8280-576	High Voltage Control
8280-577	Low Voltage Control
9907-205	Hand Held Programmer

Power Supply Rating

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

Power Consumption

40 W nominal

Steady State Speed Band

Magnetic pickup: 400–15 000 Hz
Proximity switch: 7.5–1000 Hz

Digital Inputs (8)

8 mA at 24 Vdc

Analogue Inputs (4)

4–20 mA or 1-5 Vdc

Analogue Outputs (3)4–20 mA or 0–1 mA to meter or computer (2)
20–160 mA or 4–20 mA (1)**Actuator Output (1)**

20–160 mA or 4–20 mA

Programmer Communication Port (J1)

RS-422, 9-pin D connector, 1200 baud, full duplex

Communication Ports (J2 & J3)

RS-232, RS-422, or RS-485, 9-pin D connector, 1200 to 38400 baud, full duplex

Ambient Operating Temperature

–40 to +70 °C (–40 to +158 °F)

Storage Temperature

–55 to +105 °C (–67 to +221 °F)

Humidity

95% at 38 °C

EMI/RFI Susceptibility

US MIL-STD 461C (Parts 5 & 9)

Humidity

US MIL-STD 810D, Method 507.2, Procedure III

Mechanical Vibration24–2000 Hz swept sine, 2.5 Gs constant acceleration, resonant dwells —
1 million cycles, total time—6 hours/axis**Mechanical Shock**

US MIL-STD 810C, Method 526.2, Procedure I (basic design test). Procedure II (transit drop test, packaged). Procedure V (bench handling).

Salt Spray

ASTM B 117-73

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;
- Proximity to high-voltage or high-current devices, or devices which produce electromagnetic interference;
- 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 engine.

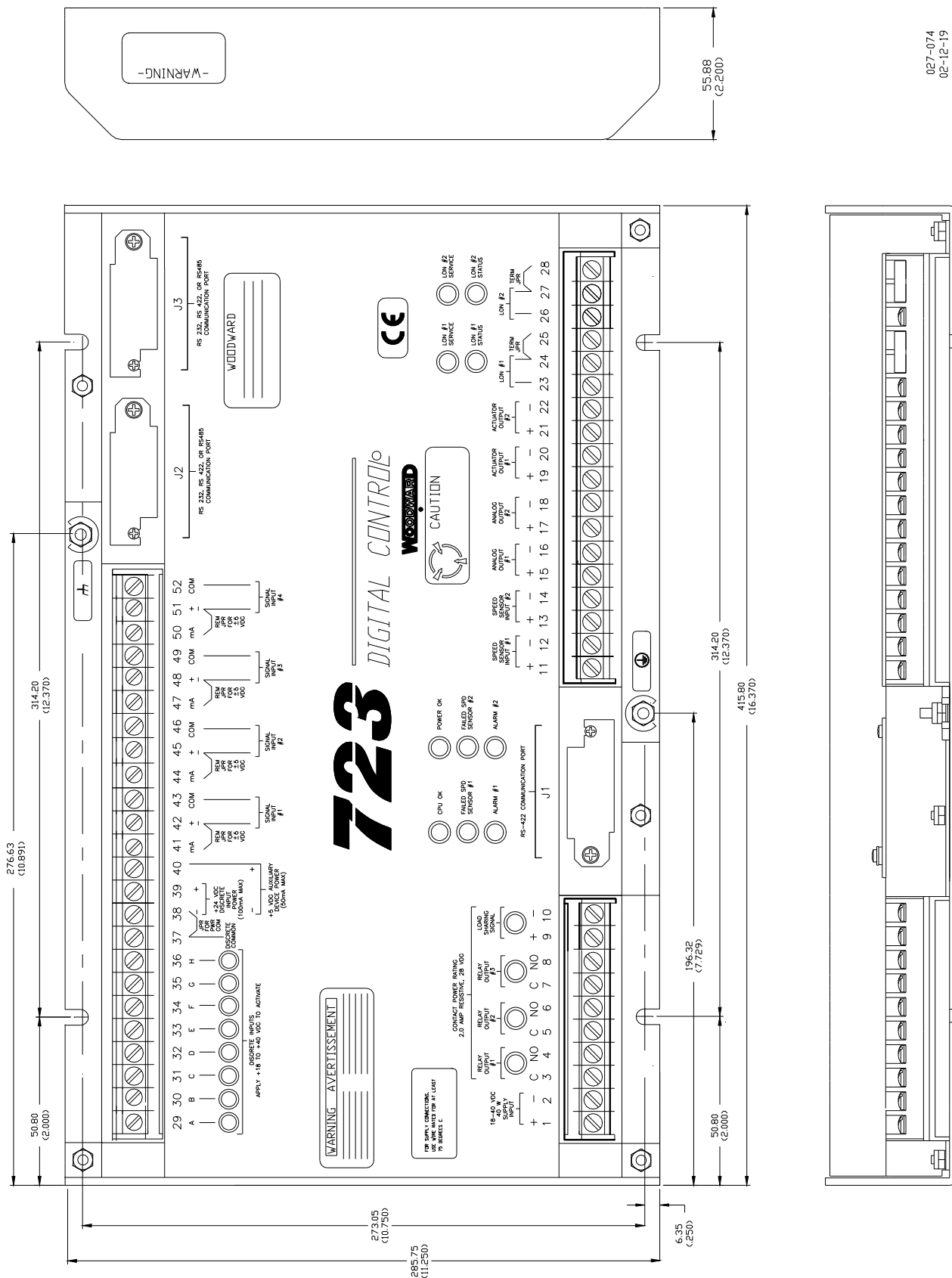


Figure 2-1. 723 Digital Speed Control

Internal Jumpers

The 723 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 the control requirements, and suits the nature of the software, be sure to read Electrostatic Discharge Awareness (page iii).

Ensure that the power to the control is switched off, before removing the cover. Using a small pair of tweezers, carefully remove the appropriate jumper and replace it securely over the proper two connectors (see Figure 2-2).

The jumper connections are listed:

JPR10	analogue output #1	0–1 mA
* JPR9	analogue output #1	0–20 mA
JPR12	analogue output #2	0–1 mA
* JPR11	analogue output #2	0–20 mA
JPR13 & JPR2	analogue output #3	0–200 mA, single
* JPR13 & JPR1	analogue output #3	0–20 mA, single
JPR14 & JPR2	analogue output #3	0–160 mA, tandem
* JPR15 & JPR3	actuator output	0–200 mA, single
JPR15 & JPR4	actuator output	0–20 mA, single
JPR16 & JPR3	actuator output	0–160 mA, tandem
JPR5 & JPR17	speed sensor #1	proximity switch
* JPR6 & JPR18	speed sensor #1	magnetic pickup
JPR7 & JPR20	speed sensor #2	proximity switch
* JPR8 & JPR19	speed sensor #2	magnetic pickup

*—default jumper settings

Electrical Connections

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, *EMI 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.

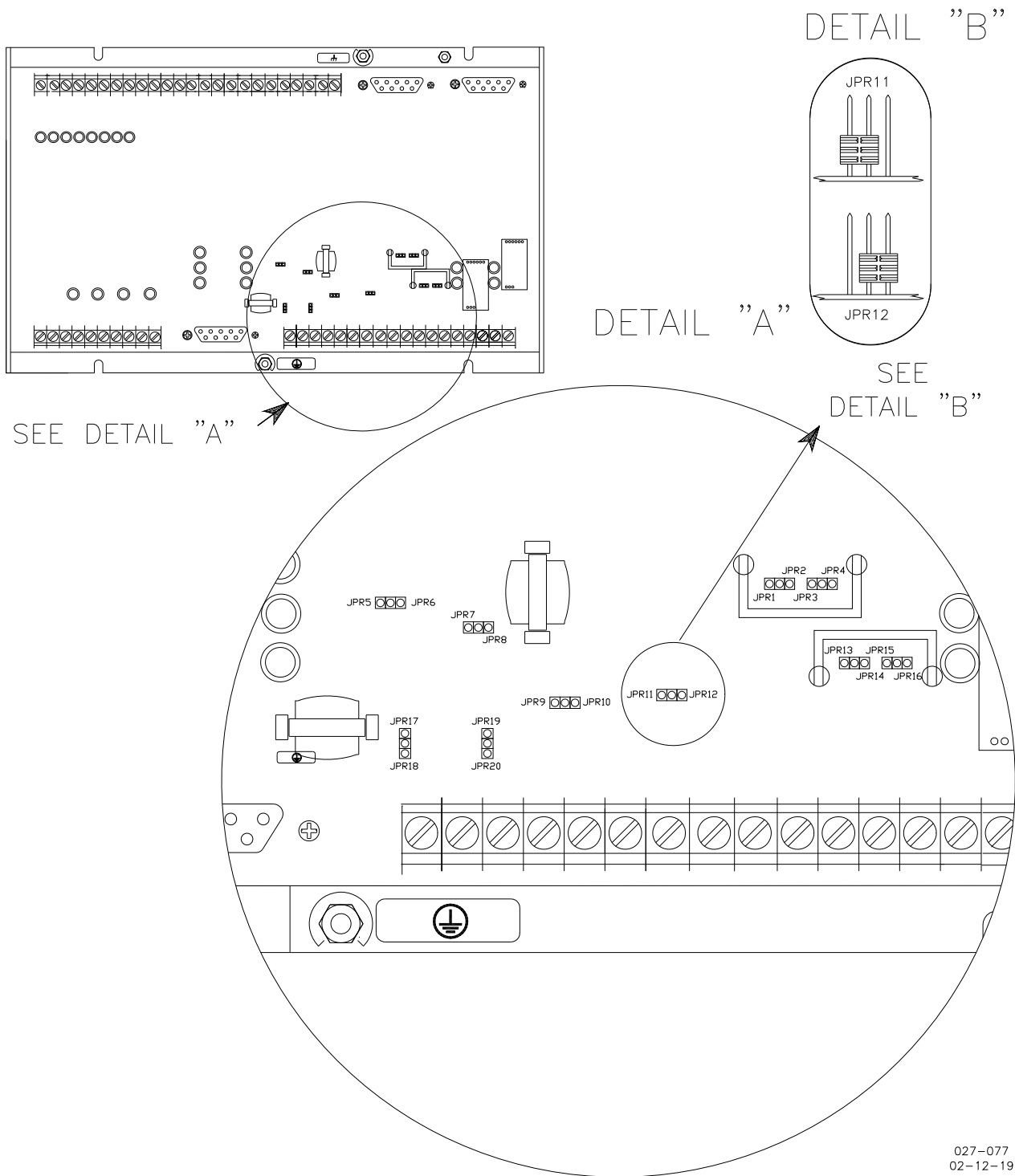


Figure 2-2. 723 Control Internal Jumpers

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 723 control contains a switching power supply which requires a current surge (around 1 Amp) 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. A protection device such as a fuse or MCB (rated 4 Amps for low voltage control and 2 Amps for the High- Voltage control) should be connected to prevent damage to the control. 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.

NOTICE

To prevent damage to the engine, apply power to the 723 control at least twenty five (25) seconds prior to starting the engine. The control must have time to complete its power up diagnostics and become operational. Do not start the engine unless both the green POWER OK and CPU OK indicators on the 723 control cover come on, because test failure turns off the output of the control.

Digital Relay Outputs

Major Alarm (Terminals 3 & 4)

Minor Alarm/Open Grid Breaker Command (Terminals 5 & 6)

Generator Breaker Open Command (Terminals 7 & 8)

Contact ratings for minimum 100 000 operations:
resistive - 2.0 A at 28 Vdc, 0.1 A at 115 Vac 50 to 400 Hz
inductive - 0.75 A at 28 Vdc 0.2 Henry

Load Sharing Lines Input (Terminals 9/10)

Connect the load sharing lines directly to those of another 723 of the same designation, or to the appropriate terminals of another Woodward unit, for isochronous load sharing. Use a shielded twisted-pair cable. The shield should be connected continuously between controls, and grounded at one end only.

Speed Signal Inputs (Terminals 11/12 and 13/14)

Connect a magnetic pickup (MPU) to terminals 11 and 12 (speed sensor #1). If required, connect a second MPU/proximity switch to terminals 13 and 14 (speed sensor #2). 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.

Analogue Outputs (Terminals 15/16, 17/18, 19/20)

Actuator Position
Engine Speed
Engine Load
KW Reference
Speed Input #1
Speed Input #2

Use shielded twisted-pair wires to connect to terminals 15(+) & 16(–), 17(+) & 18(–), and 19(+) & 20(–). For an electrically isolated input device such as a 4 to 20 mA input analogue 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.

The analogue outputs will drive 4–20 mA at 600 ohms maximum.

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 723 control's analogue inputs and outputs are used with non-isolated devices (common ground system). A number of manufacturers offer 20 mA loop isolators. Consult Woodward Governor Company for further information.

Actuator Output (Terminals 21/22)

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

LON #1 (Terminals 23/24/25)

Please read Chapter 7 for the wiring details of the LON networks.

Discrete Inputs (Terminals 29–36)

Discrete inputs are the switch input commands to the 723 control. The discrete inputs should be powered from the 723's own Discrete Input Power. In this case, terminals 37 & 38 should be jumpered. This connects the control's common to the discrete input common. Terminal 39 then supplies 24Vdc to the discrete inputs. Since this 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 DISCRETE INPUT AUX VOLTAGE SOURCE.**

If the discrete input voltage (24 Vdc) is supplied from an external source, connect the voltage source negative (–) to terminal 37. Then run the voltage source positive (+) to the appropriate switch or relay contact and then to the corresponding discrete input.

IMPORTANT

There will be no connection to terminal 38 in this case.

Analogue Inputs

KW Transducer (Terminals 41/42/43)

KW Reference (Terminals 44/45/46)

Unit Synchroniser (Terminals 47/48/49)

System Synchroniser/Charge Air Pressure (Terminals 50/51/52)

Use shielded twisted-pair cable to connect to terminals 42(+) & 43(–), 45(+) & 46(–), 48(+) & 49(–) and 51(+) & 52(–). Ensure that jumpers are installed between terminals 41 & 42, 44 & 45 and 50 & 51.

For 4–20 mA inputs (jumper in), the internal burden resistance is 250 ohms.

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 723 control's analogue inputs and outputs are used with non-isolated devices (common ground system). A number of manufacturers offer 20 mA loop isolators. Consult Woodward Governor Company for further information.

Serial Communications Ports

J2 - ServLink Server, RS-232, RS-422

J3 - Modbus, RS-232, RS-422, RS-485

IMPORTANT

RS-485 is not available for ServLink Server communications.

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 2-5 is an example.

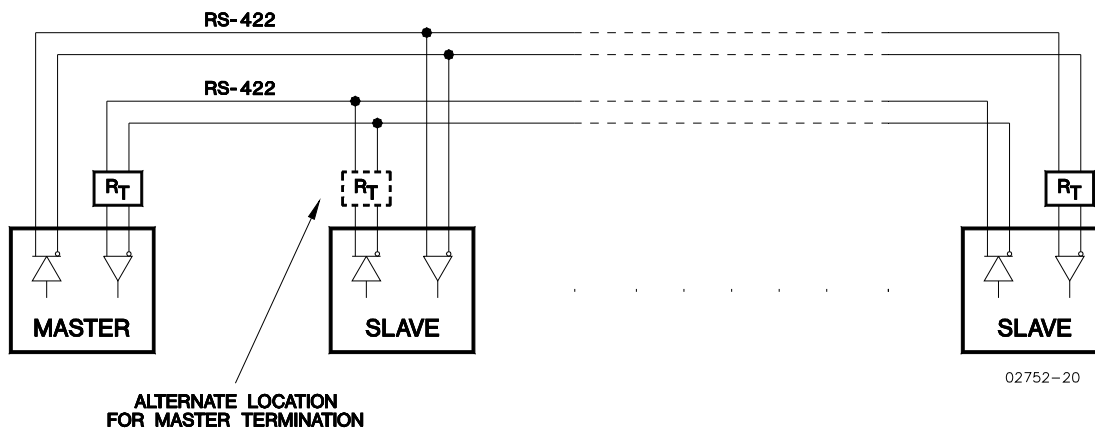


Figure 2-3. RS-422 Terminator Locations

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 2-6 is an example.

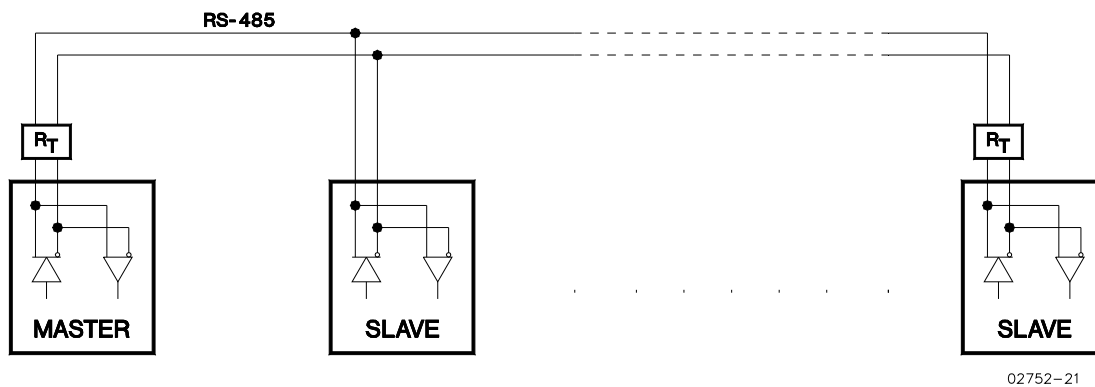


Figure 2-4. RS-485 Terminator Locations

Communicating with a HMI operator interface is a special case of Figure 2-5. Because the HMI master cannot put its transmitter into a high-impedance state, and the bit rate is less than 90k bits/sec, termination is not needed at the slave. Termination is needed at the HMI receiver, but because there is no way to locate it there, it has to be put at the alternate location.

If you don't know if a master can put its transmitter into a high-impedance state, terminate the line as shown in Figure 2-5. It does not hurt to terminate the line even when it's not needed as in the case of the HMI 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; the maximum voltage between the receiver input and circuit ground must be less than 10 volts. There is one termination resistor network for each J2 and J3 port located on the 723. 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.

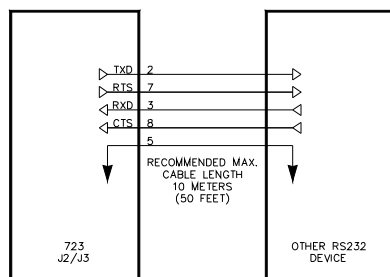


Figure 2-5. 723 RS-232 Connection

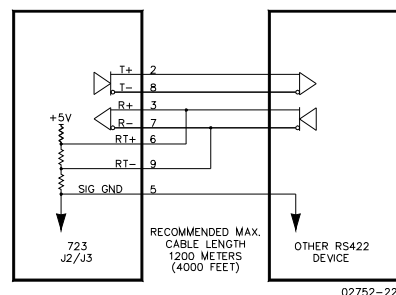


Figure 2-6. 723 RS-422 Connections with Optional Termination at Receiver

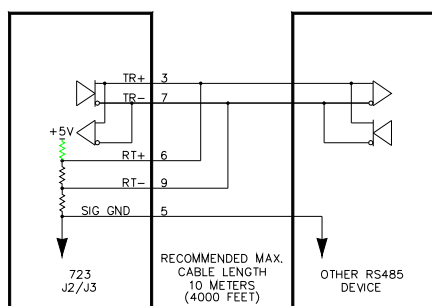


Figure 2-7. 723 RS-485 Connections with Optional Termination

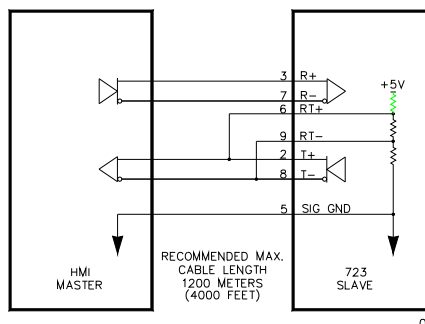


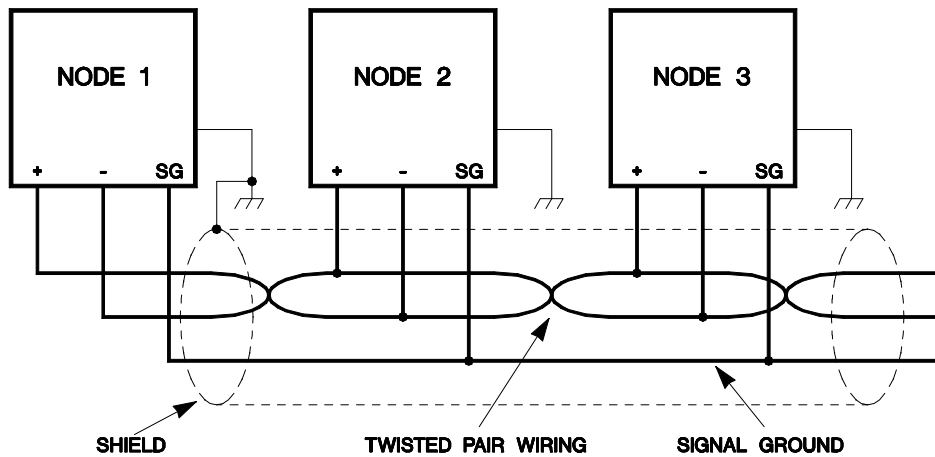
Figure 2-8. 723 RS-422 Connections with Optional Termination at Transmitter

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 an isolated node. Figures 2-9 and 2-10 illustrate these cabling approaches.

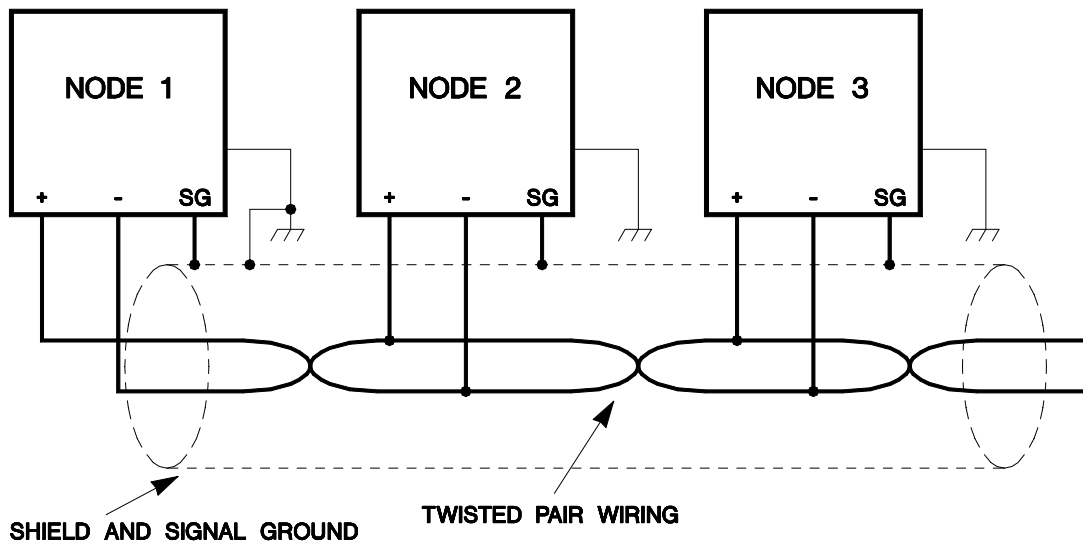
IMPORTANT

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.



02752-24

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



02752-25

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

IMPORTANT

The signal ground connection is not required if signal ground is unavailable.

Figure 2-11. 723 Wiring Notes

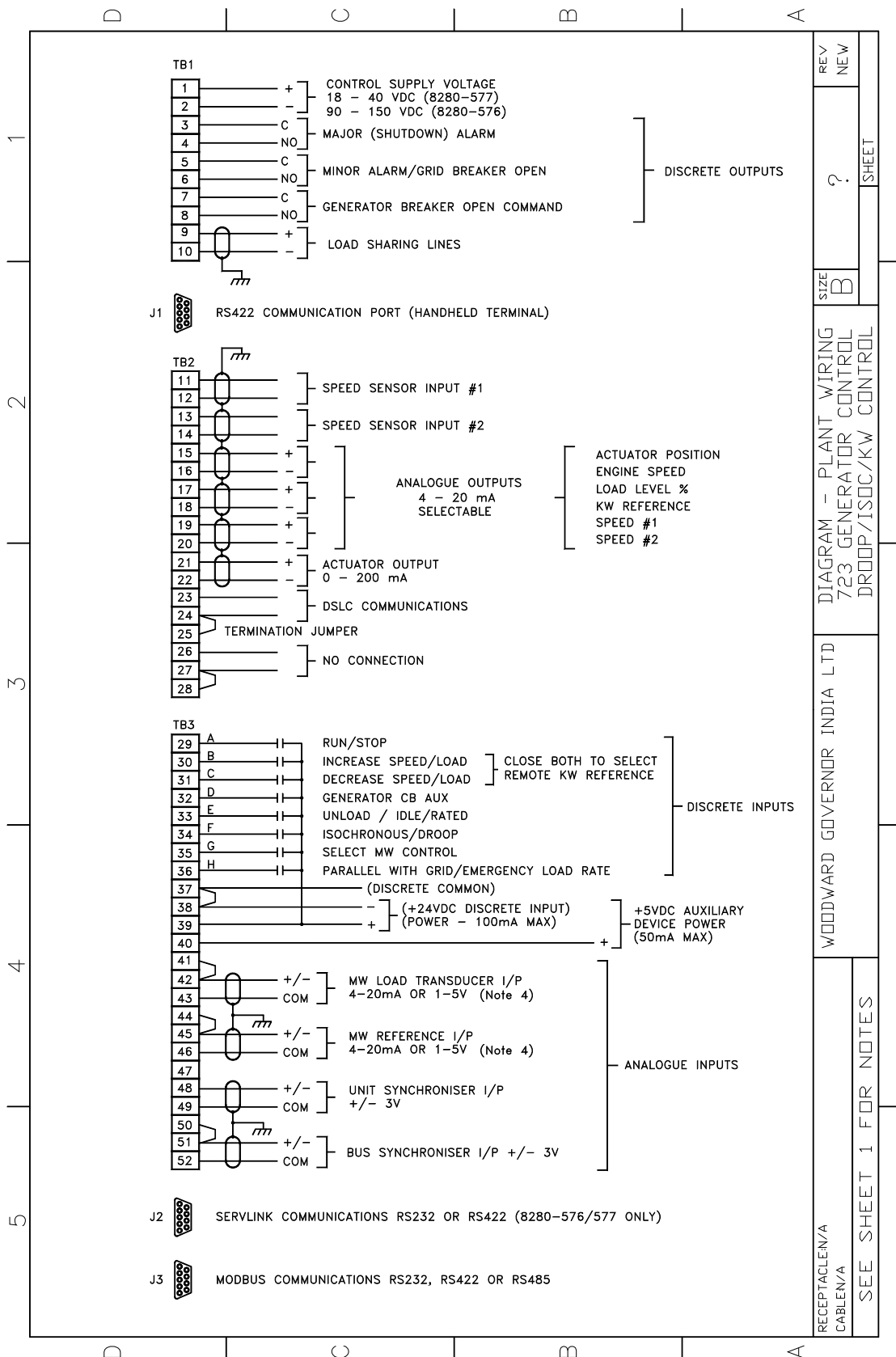


Figure 2-12. 723 Wiring

Installation Checkout Procedure

With the installation complete, carry out 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.



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.
 - 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 run out does not exceed the pickup gap. Refer to the manual 82510 Magnetic Pickups And Proximity Switches For Electric Governors, for information.
2. Check for grounds

Check for grounds by measuring the resistance from all control terminals to chassis. All terminals except terminals 2 and 38 should measure infinite resistance (the resistance of terminals 2 and 38 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.

Chapter 3.

System Description

Engine Speed

Speed Sensing

The control has two speed sensing inputs, and may be configured for torsional filtering, for smoother operation with soft couplings, or high signal select, giving speed sensing redundancy should one signal fail. If the torsional filter has been selected, the speed sensors should be positioned on either side of the coupling; sensor #1 on the engine side, and sensor #2 on the generator side. If the high signal select is utilised, then both speed sensing devices should be located on the same speed sensing disc.

Each speed sensor input has a failed speed detection device, with an override function, which is active during engine start-up. The Failed Spd Sensor #1 and Failed Spd Sensor #2 LED's located on the 723 control, give indication when either input has failed. If a speed sensor fails, it will be switched out until the fault is rectified, and then reset during the next engine start *F.

When the torsional filter is selected, failure of either speed sensor will result in the activation of the Minor Alarm, and control will continue with one speed signal. If the **Generator CB Aux** contact input is closed, the *Propgain Multiplier* will be switched in to decrease the *Proportional Gain* value. If high signal select is chosen, failure of a speed sensor will also give continued control with one speed signal, and the Minor Alarm will be activated.

The option is available to disable the Minor Alarm if one speed sensor fails, for situations where only one speed sensor is utilised. The Alarm LED on the front panel of the 723 will still illuminate if no speed signal is sensed, but the Minor Alarm will not activate.

Failure of both speed sensors will initiate a shutdown, whereby the control will drive the actuator output to zero, and the Major Alarm will be activated.

WARNING

If the engine has been shut down by the 723 control due to both speed sensors failing, do NOT attempt to start the engine until the faults have been located and rectified. Failure of the pickups can only be detected whilst the engine is running, i.e. the signal must already exist for the failure detection to operate. If the 723 cannot detect engine speed during start-up, the actuator output will go to maximum, possibly driving the engine into an overspeed condition. The engine should be equipped with an additional overspeed shutdown device that operates totally independently of this control, to protect against runaway or damage to the engine, with possible personal injury or loss of life.

Electronic overspeed detection and shutdown is integral to the control. The control will drive the actuator output to zero fuel, if the *Overspeed Trip* is exceeded.

WARNING

The engine should be equipped with an additional overspeed shutdown device, that operates totally independently of this control, to protect against runaway or damage to the engine, with possible personal injury or loss of life, should this control fail.

Speed Filtering

Each speed sensor input is fed through a low pass filter which should not need adjustment, but may be used to filter out any undesirable frequencies on the speed pickups.

If enabled, the torsional filter can be used to help prevent the control from reacting to torsionals across a flexible coupling. This works by 'averaging' out the speed sensing signals from either side of the coupling, although this can be weighted more heavily to one side than the other, by adjusting the *Sensor Weight*.

For systems with low frequency oscillatory modes due to engine and generator inertias, and flexible couplings, which can become difficult to control, the Notch/Band-Stop Filter is provided. This filter can reduce the signal transmission through the control, by reducing the signal gain at the resonant frequency, and hence preventing the control from reacting to these unwanted frequencies.

Speed Control & Synchronising

Engine Start

When the **Run/Stop** contact is closed, (or opened if the *Open DI#1 To Run* configurable is selected true*F), the speed reference is at *Idle Speed*. The reference will then remain at idle, until the engine speed exceeds the *Idle/Rated Switch* speed, at which time the speed reference will ramp to *Rated Speed* at the *Accel/Decel Rate*. This ramp to rated may be interrupted by momentarily closing either of the **Increase** or **Decrease** contacts (so freezing the ramp).

If the **Idle/Rated** select contact is required, the *Enable I/R Select* parameter should be set true. When the **Run/Stop** contact is put in the 'run' position, the speed reference will be initially at *Idle Speed*. Once the engine has started, the control will remain at idle, if the contact is in the idle position, or will ramp to *Rated Speed*, at the *Accel/Decel Rate*, if/when the contact is closed. The idle-to-rated ramp may be interrupted by either opening the **Rated/Idle** contact (and so returning the reference back to *Idle Speed* at the *Accel/Decel Rate*), or by momentarily closing either of the **Increase** or **Decrease** contacts (so freezing the ramp).

The rated-to-idle ramp may be interrupted similarly by either closing the **Rated/Idle** contact (and so returning the reference back to *Rated Speed*, at the *Accel/Decel Rate*), or by momentarily closing the **Increase** contact (so freezing the ramp).

The **Idle/Rated** contact input is only functional, whilst the **Generator CB Aux** contact input is open.

Synchronising to a Bus

When the engine reaches *Rated Speed*, and has remained within the *Ready to Synch Limits* for the *Sync OK Delay Time*, the control will issue a 'Run' command via the **LON** to the DSLC™. If the DSLC is not connected using the **LON**, it will have to be enabled by the hardwired contact instead.

The **Unit Synchroniser** Input will bias the speed reference, based on the value of the bipolar voltage input. Once the **Generator CB Aux** contact is closed, the bias is either:

- switched out until the **Generator CB Aux** input is opened, if isoch mode is enabled.
- last value locked in until the **Generator CB Aux** input is opened, if droop mode is enabled.

Alternatively, the unit can be synchronised to the bus using the **Increase/Decrease** contacts, which will cause the speed reference to change at the *Inc/Dec Rate #1*. The *Maximum Speed* determines the limit to which the reference may be increased, and the *Minimum Speed* is the limit to which the reference may be decreased.

Opening the **Generator CB Aux** contact input will set the speed reference instantly to *Rated Speed*.

Synchronising to the Grid

Once the **Generator CB Aux** contact is closed, and the unit is either in droop mode or isochronous load sharing, the system may be synchronised to the utility. This can be done using a Woodward analogue synchroniser (DSLCL or SPM-A), via the bipolar **System Synchroniser** Input. If the control is in droop mode, the **Increase/Decrease** contact inputs may also be used.

Opening the **Parallel With Grid** (if used) contact input will set the speed reference instantly to *Rated Speed*.

Droop Control

To operate in Droop mode, the **Isochronous/Droop** contact input must be open, and the **Generator CB Aux** contact closed.

The speed droop value is calculated based on the Droop percentage, and the load on the engine. The engine load will be derived from the **MW Transducer** input. Should this signal fail, the load will be determined based on the position of the actuator output. Failure of the load signal input will activate the Minor Alarm, which will be reset once the signal is healthy. The speed droop will always be zero, whilst the CB Aux is open.

A 'Droop Pulse' function is provided to help prevent an engine being driven into reverse power, when connected to a bus in droop mode. When the **Generator CB Aux** contact is closed, the speed reference is immediately increased by the *Ref Bias Pulse*. This will cause the generator to immediately take on load from the other sets. This is a permanent bias, whilst the control remains in droop mode. This function can be disabled by tuning the *Ref Bias Pulse* parameter to zero.

Closure of the Increase contact will cause the speed reference to increase at the *Inc/Dec Rate #2*, therefore causing the engine to take on load (if available). Closure of the Decrease contact will cause the speed reference to decrease at the *Inc/Dec Rate #2*, therefore causing the engine to shed load (if possible).

Isochronous Load Sharing

Isochronous load sharing is enabled by closing the **Isochronous/Droop** contact, provided that the **Generator CB Aux** contact is also closed, and the load input signal is healthy.

The first machine on-line will close its relay K4 contact on the load sharing lines instantly, connecting to the system load sharing lines, in preparation for isochronous load sharing with other units. Subsequent units selected to isochronous will increase/decrease load softly, according to the *Auto Load/Unload Rates*, until the load on the unit is within the defined *LS Error %*, of the other unit(s) which are already isochronously load sharing. At this time, the relay K4 will be closed to connect the load sharing lines to those of the other unit(s). The error between the system load and each individual unit's load will then be monitored, and the *Rated Speed* reference biased accordingly, to increase/decrease load, to achieve equal load sharing at *Rated Speed*.

The control provides a function for auto soft unloading of the engine. The **Unload** contact should be closed (momentarily) when the control is in isochronous load sharing. The engine load will then be ramped down at the *Auto Unload Rate*, until the *Unload Trip Level* is reached, at which time, the control will issue a **Generator Breaker Open Command**. This output will remain active, until the **Generator CB Aux** contact is opened.

Note: The **Generator Breaker Open Command** is a normally open contact, unless the *Brkr Open Cmd NC?* Set point has been tuned to make the contact normally closed.

The unloading ramp may be stopped, if necessary, by momentarily closing either the **Increase** or **Decrease** contact. At this time, the control will be in droop mode, and will either remain so until the **Isochronous/Droop** contact is toggled open/closed to switch back into isochronous load sharing, or if the *Re-Load to Isoc* set point is tuned true, the control will automatically ramp back to isochronous load sharing.

The **Emergency Load Rate** input may be enabled for fast 'soft' loading/unloading of the engine.

If it is necessary that a machine is required on-line more quickly than usual (i.e. during an emergency situation), the contact should be closed, and once the **Generator CB Aux** contact is closed, the control will load the engine at the *Emergency Load Rate*, rather than the *Auto Load Rate*.

If the Unload function is used whilst the **Emergency Load Rate** contact is closed, the engine will be unloaded at the *Emergency Unload Rate*. The *Emergency Load/Unload Rates* may be disabled at any time, by opening the contact.

If the **MW Transducer** input signal should fail whilst in isochronous load sharing, the control will switch back into droop control, with load based on the actuator output. Once the fault is rectified, and the signal fault reset (either automatically or by using the Modbus Reset), the control will load/unload back into isochronous load sharing.

Whilst the control is operating in isochronous load sharing, the droop reference is continuously tracking, so that if the control is switched into droop mode, the transfer will be bumpless.

Switching into MW Control mode will also be bumpless.

MW Control

To operate in MW Control, the **Generator CB Aux**, **Parallel With Grid** (if used) and **MW Control** contact inputs must be closed.

Switching into MW Control from Isochronous Load Sharing or Droop mode will be bumpless. Once in MW Control, the MW reference can be adjusted by use of the **Increase/Decrease** contact inputs. Closing the **Increase** contact raises the MW reference towards the *Maximum Load* at the *Raise Load Rate*. Closing the **Decrease** contact lowers the MW reference towards the *Minimum Load* at the *Lower Load Rate*.

If the *Select Int MW Ref* parameter has been selected true in Configure, when the control switches into kW Control mode, and digital mode is selected (use of Increase/Decrease inputs to adjust load), the MW reference will automatically ramp to the *Internal MW Ref* at the *Int MW Ref Rate*. It will then remain at this level until the Increase/Decrease contact inputs are used to adjust the load, or if the control is switched into Remote/Analogue mode.

If both the **Increase** and **Decrease** contacts are closed (or Remote Reference selected via the Modbus), the MW reference will ramp to the level determined by the **4–20 mA Remote Reference** input (or Modbus Remote reference), at the *Auto Load Rate*. Once this level has been reached, the reference will continue to follow the input, at the *Raise/Lower Load Rates*. If the remote reference input should fail (i.e. <2mA, >22mA), the MW reference will lock in the last healthy value. The control will then respond to the **Increase/Decrease** contacts, once the remote MW reference is de-selected.

If both the **Increase** and **Decrease** contacts are closed to select the remote reference, opening only one of the contacts will NOT de-select the remote reference. Both contacts must be opened to de-select the remote reference. This is to prevent the reference being driven high or low in the event of a single wire break.

Closing the **Unload** contact (momentarily) will cause the control to decrease the MW reference until the *Unload Trip Level* is reached, at which time the control will issue a **Generator Breaker Open Command**. This output will remain active until the **Generator CB Aux** contact is opened, indicating that the breaker has opened.

The unloading sequence can be interrupted by momentarily closing the **Increase** contact input. The load will then remain at the level it was interrupted at, if in local mode, or will ramp back to the remote reference level, if in remote mode.

Failure of the 4–20 mA **MW Transducer** input (i.e. <1mA, >22mA) will switch the control into droop mode, with load calculated based on the actuator output. Once the fault is rectified, and the signal fault reset (either automatically or by using the Modbus Reset), the control will load/unload back into MW Control.

During normal operation, transferring to droop or isochronous modes will be bumpless.

If the **Parallel With Grid** contact is opened, with the control selected to Isochronous, the load sharing lines relay K4 is closed immediately, to ensure that all units will switch instantly to isochronous load sharing. In this case, the transfer may not be completely bumpless, depending on the imported/exported load, before the grid breaker was opened.

Whilst operating in MW Control, provision is made for opening the Grid and Generator Breakers in the event that the grid frequency has risen too high or fallen too low. If the error between the *Rated Speed* and the actual engine speed exceeds the *Freq Error Set -point #1*, the **Open Grid Breaker Command** will be issued (if this hardware option has been chosen). If the error exceeds the *Freq Error Set point #2*, the **Generator Breaker Open Command** will be issued.

Depending on which method of MW Control is preferred, either Direct MW Control or Compensated KW Control may be chosen.

Direct MW Control:

The PID compares the measured MW to the MW reference, and adjusts the actuator output accordingly.

Compensated MW Control:

The control is effectively in Droop mode. A dead band controller compares the measured MW with the MW reference, and then will increase/decrease the speed reference ramp, and hence increase/decrease the load on the engine.

Operating Modes

Whether the control is in Droop, Isochronous or MW Control mode, is dependent on the status of certain contact inputs, and whether or not certain analogue inputs are healthy. The table below indicates which mode of operation the control will select, based on the status of the relevant digital and analogue inputs.

MODE						KW Control Analogue/R emote	KW Control Digital/Inc- Dec
I/O	Isoch	Droop	Droop	Droop	Droop		
Gen CB (DI)	X	X	X	X	X	X	X
Grid CB (DI)	O	O	X	O	X	X	X
Isoch/Droop (DI)	X	O	X/O	X	X/O	X/O	X/O
MW Control (DI)	X/O	X/O	O	X/O	X	X	X
MW Control (DI)	O	X/O	X/O	X	X	O	O
MW Reference (AI)	X/O	X/O	X/O	X/O	X/O	O	X/O

Limiters & Load Rejection

The LED on the front of the 723, labelled 'Alarm #2', will illuminate if any of the Start, Maximum or Charge Air Pressure fuel limiters are controlling the fuel output, or if an engine shutdown has clamped the output to zero.

Engine Shutdown Limiter

If the control shuts down the engine, due to a major alarm condition, or because the stop command has been issued, the output to the actuator driver will be clamped at zero. A value of '0' will be displayed for the *Actuator Position* in the Service **Display Menu**.

Start & Maximum Fuel Limiter

The *Start Fuel Limit*, for limiting over fuelling or flooding during engine start-up is active when the engine is started. This limit is derived from a four point curve, to give flexibility of the limiting level at different engines speeds, as the engine is started.

When the PID takes control, the *Start Fuel Limit* is switched out until the engine is stopped, and the *Maximum Fuel Limit* is switched in.

Frequency Load Limiter

When operating in MW Control, a load limiter is provided to control the amount of load on the engine, when the grid frequency varies beyond the pre-set limits. A window is established, and within this window the limiter has no effect. Once this window is exceeded, the MW reference will be limited progressively, as the speed deviates further out of the window. If the *Unload Trip Level* is reached, the **Generator Breaker Open Command** will be issued. The purpose of this limiter is to ensure that control is maintained if the speed varies due to an unknown change to the system parameters.

Generator Breaker Load Rejection

In the case of a load rejection due to the generator breaker opening, a load rejection algorithm will come into effect, giving reduced speed overshoot characteristics. This will be activated if the load was above a certain level before the breaker was opened. The actuator output will be driven to zero for a period dependent on the amount of load before the breaker was opened.

Grid Breaker Load Rejection

Similar to the Generator Breaker Load Rejection (above), this algorithm will come into effect when the Parallel With Grid contact is opened, with the load above a certain level.

PID Control & Actuator Output

Speed/Droop/Isochronous/ Deadband MW Control

The output has tuneable PID dynamics, a *Gain Slope* function (which adjusts *Proportional Gain* as the engine load changes), a *Gain Ratio* function (which multiplies the *Proportional Gain* as a function of the speed error), and *Derivative Dynamics* (the PID dynamics are adjusted by a multiplier, as the rate of change of engine speed exceeds a certain level – see tuneable descriptions for more detail).

Two sets of dynamics (*Proportional Gain*, *Integral Gain* & *S.D.R*) are provided:

- Set #1 is active when the **Generator CB Aux** contact is open.
- Set #2 is active when the **Generator CB Aux** contact is closed.

The dynamics can be multiplied individually by a multiplier, which is based on the speed derivative. As the absolute value of the derivative exceeds a set level (according to a two point curve), the P, I & D terms can be increased/decreased, as the derivative value further increases. This option can be chosen instead of the Gain Ratio function, but may be used in conjunction with the Gain Slope function.

When the torsional filter is operational, if one of the speed sensors should fail, the Proportional Gain is multiplied by the PropGain Multiplier, in order to attempt to slow the control down, and prevent it responding to torsionals, for which the torsional filter was enabled to help minimize.

Direct MW Control

A single set of dynamics (*Proportional Gain, Integral Gain & S.D.R.*) for operation in MW Control mode.

Actuator Hit

An 'Actuator Hit' function is provided for testing the dynamics of the control during commissioning of the system. This function can be enabled in Configure mode, and once the control has reset itself, the function is only available for a 30 minute period. When the appropriate parameter is toggled true using the Operator Interface (HHT or PC-based), a tuneable value is subtracted from the actuator output, for a tuneable period of time. This will enable the operator to check that the dynamic settings are suitable. This is a better alternative to physically disturbing the fuel rack to check the response of an engine, as it will provide a consistent means of test.

Run/Stop & Alarms

Closure of the **Run/Stop** contact will release the actuator output from zero to the *Start Fuel Limit* level. The 'Run' signal will also act as a reset to any speed sensor faults, and the 723 electronic overspeed trip latch (unless the Modbus Reset has been enabled).

The **Run/Stop** will only be effective for engine starting, provided that the engine speed has fallen below 350Hz, and the *Rundown Time* period has elapsed.

Putting the **Run/Stop** contact will cause the control to limit the actuator output to zero. If the **Generator CB Aux** is closed at this time, the control will also issue a **Generator Breaker Open Command**.

Major Alarm

The Major Alarm will be activated:

- if the *Overspeed Trip* level is exceeded
- if both speed sensor inputs should fail

The relay contact will be opened continuously, unless the option for *Pulse Alarm* is selected, in which case, the contact will be opened for the *Pulse Alarm Time*, and will then be re-closed.

Minor Alarm

The Minor Alarm will be activated:

- if one speed signal fails
- if the **MW Transducer** input fails - below 1mA, above 22mA
- if the **MW Reference** input fails - below 2mA, above 22mA
- if the **LON** communications to the DSLC fail
- if remote MW reference is selected using the **Increase/Decrease** contacts, and a single signal is lost (wire-break)
- if the **Modbus** serial communications have failed
- if in MW Control, and the Frequency Limiter has come into effect

Rectification and reset of the fault, will reset the Minor Alarm.

Modbus Communications & Control

Instead of the hardwired inputs, the Modbus communication can deliver the following signals from another system, e.g. Power Management

- Run
- Stop
- Increase Speed/Load
- Decrease Speed/Load
- Select Remote MW Reference
- Unload
- Idle Speed Select
- Rated Speed Select
- Droop Mode
- Isochronous Mode
- MW Control Mode
- Emergency Load Rate
- Reset
- Remote MW Reference

In Configure mode, each input which is required via the Modbus instead, should be individually selected.

In addition to the control signals, a number of parameters can also be monitored via the Modbus. A full listing including addresses can be found at the end of this chapter.

DSLCL

The 723 can be interface to the Woodward Digital Synchroniser & Load Control (DSLCL), via the **LON** (Local Operator Network), and via the **Unit and/or Bus Synchroniser** inputs.

The only command given to the DSLCL via the **LON** is the 'Run' synchroniser command. However, via the **LON**, the 723 reads in all of the available generator parameters, measured by the DSLCL. These Boolean and analogue values can be read via the 723 Modbus, or at the Operator Interface.

The speed bias from the DSLCL should be fed into the **Unit Synchroniser** input (or the **Bus Synchroniser** input if used).

The 723 may be configured so that the DSLCL will control all load functions. In this case, once the **Generator CB Aux** contact is closed, the 723 will be switched into speed control mode (zero droop), with the speed reference biased by the DSLCL input (via the **Unit Synchroniser** input) in order to increase/decrease actuator output to control the load on the engine.

Analogue Outputs

Through the 723 4–20 mA analogue outputs, it is possible to monitor any three of the following:

- Actuator Position (0–100%)
- Engine Speed (rpm - 4mA & 20 mA set points configurable)
- Engine Load (0–100%)
- KW Reference (kW - 4mA & 20 mA set points configurable)
- Speed Input #1 (rpm - 4mA & 20 mA set points configurable)
- Speed Input #2 (rpm - 4mA & 20 mA set points configurable)

The analogue outputs are configured under the **ANALOG O/P CONFIG** menu in Service.

Control Options

The following options are available with the 723 Generator Control:

- Bus Synchroniser Input
- Digital O/P #2 configurable for **Minor Alarm** (default) or **Grid Breaker Open Command** - Configured using Operator Interface, all part numbers.
- Digital I/P #8 configurable for **Parallel With Grid** (default) or **Emergency Load Rate** - Configured using Operator Interface, all part numbers.
- MW Control configurable as Direct (default) or Deadband - Configured using Operator Interface, all part numbers.

Ability to select DSLC as load controller instead of 723 - Configured using Operator Interface, all part numbers.

- Ability to enable the Unload contact input for Idle/Rated selection whilst breaker is open - Configured using Operator Interface, all part numbers.
- Digital O/P #1 (Major Alarm) configurable for normally open or normally closed (default) contact - Configured using Operator Interface. *F
- Digital O/P #2 (Minor Alarm or Grid Breaker Open Command) configurable for normally open (default) or normally closed contact - Configured using Operator Interface, all part numbers.
- The **Run/Stop** contact input may be configured such that the contact is opened to and closed to Stop, instead of the default, close to Run, open to Stop.
- Woodward ServLink Server

Operator Interface

The parameters within the control may be configured and monitored using either a Hand Held Programmer, or using the ServLink Server.

Chapter 4.

Configure/Service Value List

Introduction

Configure Prompt	Default Value	Range	Final Value
SPEED SENSORS			
PULSE/REV #1	155	60 TO 360	
MAXIMUM HZ #1	2500	500 TO 10000	
PULSE/REV #2	155	60 TO 360	
MAXIMUM HZ #2	2500	500 TO 10000	
ENGINE SPEED			
IDLE SPEED (rpm)	400.000	0.00 TO 2000.00	
RATED SPEED (rpm)	750.000	0.00 TO 2000.00	
OVERSPEED TRIP (rpm)	860.000	0.00 TO 2500.00	
TORSIONAL FILTER?	FALSE	TRUE TO FALSE	
MW CONTROL			
REMOTE REF @ 4mA (MW)	0.000	0.00 TO 60.00	
REMOTE REF 20 mA (MW)	8.00	0.00 TO 60.00	
SELECT INT kW REF	FALSE	TRUE TO FALSE	
FINAL DRIVER			
REVERSE ACTING?	FALSE	TRUE TO FALSE	
ACTUATOR mA @ 0%	10.000	0.00 TO 200.00	
ACTUATOR mA @ 100%	180.000	20.00 TO 200.00	
ENABLE ACTUATOR HIT	FALSE	TRUE TO FALSE	
STROKE ACTUATOR*F	FALSE	TRUE TO FALSE	
ENGINE LOAD			
RATED LOAD (MW)	6.52	0.00 TO 60.0	
MW @ 4mA	0.000	-60 TO +60	
MW @ 20 mA	8.00	0 TO 60	
MODBUS PORT SETUP			
MODE	2	1 TO 2	
SLAVE ADDRESS	1	1 TO 247	
CONFIGURE			
ENABLE SET POINTS	TRUE	TRUE TO FALSE	
ENABLE CALIBRATION	FALSE	TRUE TO FALSE	
CONF MODBUS I/P'S			
START/STOP	FALSE	TRUE TO FALSE	
INC/DEC/SEL REMOTE	FALSE	TRUE TO FALSE	
UNLOAD & IDLE/RATED	FALSE	TRUE TO FALSE	
DROOP/ISOCHRONOUS	FALSE	TRUE TO FALSE	
SELECT MW CONTROL	FALSE	TRUE TO FALSE	
EMERGENCY LOAD RATE	FALSE	TRUE TO FALSE	
RESET	FALSE	TRUE TO FALSE	
REMOTE kW REFER.	FALSE	TRUE TO FALSE	

Configure Prompt	Default Value	Range	Final Value
CONTROL OPTIONS			
GRID BRKR OPEN CMD?	FALSE	TRUE TO FALSE	
EMERGENCY RATE I/P?	FALSE	TRUE TO FALSE	
MW DEADBAND	FALSE	TRUE TO FALSE	
CONTROL			
ENABLE DSLC PM	FALSE	TRUE TO FALSE	
ENABLE I/R SELECT	FALSE	TRUE TO FALSE	
OPEN DI#1 TO RUN *F	FALSE	TRUE TO FALSE	
DO#1 NC? *F	FALSE	TRUE TO FALSE	

NOTICE

Failure to save set points prior to removing power from the control will cause them to revert to the previously saved settings.

Configure Prompt	Default Value	Range	Final Value
DISPLAY MENU			
ENGINE SPEED (rpm)	(Monitor)		
SPEED REFERENCE (rpm)	(Monitor)		
MW LOAD	(Monitor)		
ACTUATOR POSITION (%)	(Monitor)		
FUEL LIMIT	(Monitor)		
PID OUTPUT	(Monitor)		
ENGINE STOPPED	(Monitor)		
ENGINE RUNNING	(Monitor)		
READY TO SYNC	(Monitor)		
UNIT SYNC BIAS	(Monitor)		
SYS SYNC BIAS	(Monitor)		
DROOP BIAS	(Monitor)		
REF BEFORE BIAS (rpm)	(Monitor)		
GEN BREAKER CLOSED	(Monitor)		
ISOCHRONOUS MODE	(Monitor)		
% LOAD	(Monitor)		
LS LINES %	(Monitor)		
LOAD SHARE ERROR	(Monitor)		
KW CONTROL MODE	(Monitor)		
LOAD REFERENCE (MW)	(Monitor)		
REMOTE REF SELECTED	(Monitor)		
REMOTE REFERENCE (MW)	(Monitor)		
MW LIMIT	(Monitor)		
SPD DYNAMICS #1			
PROPORTIONAL GAIN #1	0.250	0.01 TO 10.00	
INTEGRAL GAIN #1 (1/s)	0.500	0.01 TO 5.00	
S.D.R. #1	10.000	0.01 TO 100.00	
DYN SELECT DELAY (s)	2.500	0.00 TO 10.00	
ENABLE DERIV DYN*F	FALSE	TRUE TO FALSE	
SPD DYNAMICS #2			
PROPORTIONAL GAIN #2	0.350	0.01 TO 10.00	
INTEGRAL GAIN #2 (1/s)	0.630	0.01 TO 5.00	
S.D.R. #2	14.550	0.01 TO 100.00	
PROPGAIN MULTIPLIER	1.000	0.01 TO 1.00	

Configure Prompt	Default Value	Range	Final Value
MW DYNAMICS			
PROPORTIONAL GAIN	0.0100	0.01 TO 10.00	
INTEGRAL GAIN (1/S)	1.300	0.01 TO 5.00	
S.D.R.	20.000	0.01 TO 100.00	
USE LOWER PROP BAND	FALSE	TRUE TO FALSE	
GAIN SLOPE *F			
LOAD BKPT #1 (%)	0.000	0.00 TO 110.00	
MULTIPLIER #1	1.000	0.01 TO 10.00	
LOAD BKPT #2 (%)	100.000	0.00 TO 110.00	
MULTIPLIER #2	1.000	0.01 TO 10.00	
GAIN RATIO *F			
ERROR WINDOW #1 (rpm)	100.000	0.00 TO 110.00	
GAIN RATIO #1	1.000	0.01 TO 10.00	
ERROR WINDOW #2 (rpm)	10.000	0.00 TO 110.00	
GAIN RATIO #2	2.000	0.01 TO 10.00	
DERIV DYNAMICS *F			
P DERIV BKPT #1 (rpm/s)	50.000	0.01 TO 500.00	
P MULTIPLIER #1	1.000	0.01 TO 10.00	
P DERIV BKPT #2 (rpm/s)	500.000	0.01 TO 500.00	
P MULTIPLIER #2	2.000	0.01 TO 10.00	
I DERIV BKPT #1 (rpm/s)	50.000	0.01 TO 500.00	
I MULTIPLIER #1	1.000	0.01 TO 10.00	
I DERIV BKPT #2 (rpm/s)	500.000	0.01 TO 500.00	
I MULTIPLIER #2	1.000	0.01 TO 10.00	
D DERIV BKPT #1 (rpm/s)	50.000	0.01 TO 500.00	
D MULTIPLIER #1	1.000	0.01 TO 10.00	
D DERIV BKPT #2 (rpm/s)	500.000	0.01 TO 500.00	
D MULTIPLIER #2	1.000	0.01 TO 10.00	
ENGINE SPEED			
SPEED FILTER (Hz)	10.000	0.01 TO 16.00	
FILTER FREQUENCY (Hz)	16.000	0.01 TO 16.00	
FILTER Q FACTOR	0.707	0.707 TO 25.00	
SENSOR WEIGHT	0.500	0.00 TO 1.00	
ENGINE RUNNING (rpm)	150.000	0.00 TO 2500.00	
TWO SPEED SENSORS?	TRUE	TRUE TO FALSE	
DIS NOTCH FILTER	FALSE	TRUE TO FALSE	
SPEED REFERENCE			
MINIMUM SPEED (rpm)	700.000	0.00 TO 2000.00	
MAXIMUM SPEED (rpm)	800.000	0.00 TO 2000.00	
ACCEL/DECEL RATE (rpm/s)	10.000	0.00 TO 2000.00	
IDLE/RATED SWITCH (rpm)	400.000	0.00 TO 2500.00	
INC/DEC RATE #1 (rpm/s)	1.000	0.00 TO 2000.00	
INC/DEC RATE #2 (rpm/s)	1.000	0.00 TO 2000.00	
START/STOP			
RUNDOWN TIME (s)	0.000	0.00 TO 300.00	
PULSE/CONT ALARM?	FALSE	TRUE TO FALSE	
ALARM PULSE TIME (s)	1.000	1.00 TO 30.00	
BRKR OPEN CMD NC?	FALSE	TRUE TO FALSE	
DIG O/P #2 NC?	FALSE	TRUE TO FALSE	

Configure Prompt	Default Value	Range	Final Value
SYNCHRONISING			
RDY TO SYNC LIMITS (rpm)	4.000	0.00 TO 20.00	
SYNC OK DLY TIME (s)	2.000	0.00 TO 30.00	
UNIT SYNCH GAIN	2.000	0.00 TO 100.00	
REF BIAS PULSE (rpm)	0.000	0.00 TO 10.00	
SYS SYNCH GAIN	2.000	0.00 TO 100.00	
DISABLE UNIT SYNCH	FALSE	TRUE TO FALSE	
DISABLE SYS SYNCH	FALSE	TRUE TO FALSE	
SYNC FILTER	10.000	0.01 TO 16.00	
LOAD SHARING			
LS ERROR %	4.000	1.00 TO 100.00	
LOAD GAIN	5.000	0.01 TO 100.00	
AUTO LOAD RATE (kW/s)	50.000	0.00 TO 20000.00	
EMERGENCY LOAD RATE (kW/s)	50.000	0.00 TO 20000.00	
AUTO UNLOAD RATE (kW/s)	5.000	0.00 TO 20000.00	
EMRGNCY UNLOAD RATE (kW/s)	50.000	0.00 TO 2000.00	
RE-LOAD TO ISOC?	FALSE	TRUE TO FALSE	
MW CONTROL			
AUTO LOAD RATE (kW/s)	30.00	0.00 TO 30000.00	
AUTO UNLOAD RATE (kW/s)	50.000	0.00 TO 30000.00	
RAISE LOAD RATE (kW/s)	30.00	0.00 TO 30000.00	
LOWER LOAD RATE (kW/s)	30.00	0.00 TO 30000.00	
ENABLE INSTANT RATE	FALSE	TRUE TO FALSE	
INSTANT RATE WINDOW (kW)	300.00	0.00 TO 30000.00	
OVRD REMOTE IP FAIL	FALSE	TRUE TO FALSE	
DEADBAND WINDOW (kW)	50.000	0.00 TO 1000.00	
D/B CTRL RAMP RATE (kW/s)	50.000	0.10 TO 5000.00	
INTERNAL MW REF RATE (kW)	1000	0.00 TO 30000	
INTERNAL MW REF (%)	3	0.00 TO 110.0	
ENGINE LOAD			
DROOP (%)	5.000	0.00 TO 15.00	
FULL LOAD ACT %	80.000	0.00 TO 100.00	
KW FILTER (Hz)	2.000	1.00 TO 10.00	
LOAD FILTER (Hz)	2.000	1.00 TO 10.00	
UNLOAD TRIP LEVEL (Kw)	100.000	-1000.00 TO 30000.00	
OVRD LOAD I/P FAIL	FALSE	TRUE TO FALSE	

Configure Prompt	Default Value	Range	Final Value
FREQUENCY LIMITER			
BUS FREQUENCY	60.000	45.00 TO 65.00	
MW LIMITER HZ #1	0.000	0.00 TO 60.00	
MW LIMITER HZ #2	10.000	10.00 TO 60.00	
MAXIMUM LOAD (1) (MW)	10.000	0.00 TO 50.00	
MW LIMITER HZ #3	90.000	0.00 TO 100.00	
MAXIMUM LOAD (2) (MW)	10.000	0.00 TO 50.00	
MW LIMITER HZ #4	100.000	50.00 TO 100.00	
FREQ ERROR SP#1 (Hz)	5.000	0.00 TO 10.00	
FREQ ERROR SP#2 (Hz)	5.000	0.00 TO 10.00	
TRIP DELAY (s)	0.100	0.00 TO 3.00	
FUEL LIMITERS			
START FUEL LIMIT X1 (rpm)	0.000	0.00 TO 2000.00	
START FUEL LIMIT Y1 (%)	80.000	0.00 TO 100.00	
START FUEL LIMIT X2 (rpm)	100.000	0.00 TO 2000.00	
START FUEL LIMIT Y2 (%)	80.000	0.00 TO 100.00	
START FUEL LIMIT X3 (rpm)	100.000	0.00 TO 2000.00	
START FUEL LIMIT Y3 (%)	50.000	0.00 TO 100.00	
START FUEL LIMIT X4 (rpm)	750.000	0.00 TO 2000.00	
START FUEL LIMIT Y4 (%)	50.000	0.00 TO 100.00	
MAXIMUM FUEL LIMIT (%)	100.000	0.00 TO 100.00	
FINAL DRIVER			
HIT ACTUATOR	FALSE	TRUE TO FALSE	
ACTUATOR HIT PULSE	0.100	0.00 TO 2.00	
ACTUATOR HIT VALUE	0.000	0.00 TO 100.00	
STROKE ACTUATOR (%) ^{*F}	0.000	0.00 TO 100.00	
GEN BRKR LOAD REJ			
LOAD REJ LEVEL (%)	60.000	0.00 TO 100.00	
LOAD LEVEL 1 (%)	0.000	0.00 TO 100.00	
REJECTION PERIOD 1 (s)	0.000	0.00 TO 5.00	
LOAD LEVEL 2 (%)	100.000	0.00 TO 100.00	
REJECTION PERIOD 2 (s)	0.500	0.00 TO 5.00	
GRD BRKR LOAD REJ			
LOAD REJ LEVEL (%)	60.000	0.00 TO 110.00	
LOAD LEVEL 1 (%)	0.000	0.00 TO 100.00	
REJECTION PERIOD 1 (s)	0.000	0.00 TO 5.00	
LOAD LEVEL 2 (%)	100.000	0.00 TO 100.00	
REJECTION PERIOD 2 (s)	0.500	0.00 TO 5.00	
ENABLE LOAD REJ	FALSE	TRUE TO FALSE	
CALIBRATION			
REMOTE I/P OFFSET	0.000	-10.00 TO 10.00	
REMOTE I/P GAIN	1.000	0.00 TO 10.00	
LOAD I/P OFFSET	0.000	-10.00 TO 10.00	
LOAD I/P GAIN	1.000	0.00 TO 10.00	
LS LINES OFFSET	0	0 TO 32767	
LS LINES GAIN	21845	0 TO 32767	
LS LOAD OFFSET	2028	0 TO 32767	
LS LOAD GAIN	8083	0 TO 32767	

Configure Prompt	Default Value	Range	Final Value
AIR I/P OFFSET	0.000	-10.00 TO 10.00	
AIR I/P GAIN	1.000	0.00 TO 10.00	
AN O/P #1 OFFSET *F	0.000	-1000.00 TO 100.00	
AN O/P #1 GAIN *F	1.000	0.5 TO 1.5	
AN O/P #2 OFFSET *F	0.000	-1000.00 TO 100.00	
AN O/P #2 GAIN *F	1.000	0.5 TO 1.5	
AN O/P #3 OFFSET *F	0.000	-1000.00 TO 100.00	
AN O/P #3 GAIN *F	1.000	0.5 TO 1.5	
AN O/P CALIBRATION *F	4.000	0.00 TO 20.00	
MODBUS PORT SETUP			
HARDWARE CONFIG	1	1 TO 3	
BAUD RATE	6	1 TO 7	
STOP BITS	1	1 TO 3	
PARITY	1	1 TO 3	
TIMEOUT	1.000	0.00 TO 10.00	
ENABLE MODBUS ALMS	FALSE	TRUE TO FALSE	
SERVLINK SETUP			
HARDWARE CONFIG	1	1 TO 2	
BAUD RATE	9	1 TO 12	
DSLC COMMS SETUP			
DSLC SERVICE PIN	FALSE	TRUE TO FALSE	
DSLC TIMEOUT (s)	5.000	0.00 TO 100.00	
DSLC XMIT TIME (s)	0.500	0.05 TO 100.00	
RESET LON	FALSE	TRUE TO FALSE	
ANALOG O/P CONFIG			
ANALOGUE OUTPUT #1	1	1 TO 7	
ANALOGUE OUTPUT #2	1	1 TO 7	
ANALOGUE OUTPUT #3	1	1 TO 7	
ENG SPEED O/P @4mA	0.000	0.00 TO 2000.00	
ENG SPEED O/P @20 mA	750.000	0.00 TO 2000.00	
MW REF O/P @ 4mA	0.000	0.00 TO 60.00	
MW REF O/P @ 20 mA	1.00	0.00 TO 60.00	
SPEED 1 O/P @ 4mA	0.000	0.00 TO 2000.00	
SPEED 1 O/P @ 20 mA	750.000	0.00 TO 2000.00	
SPEED 2 O/P @ 4mA	0.000	0.00 TO 2000.00	
SPEED 2 O/P @ 20 mA	750.000	0.00 TO 2000.00	
MAJOR ALARM			
OVERSPEED	(Monitor)		
BOTH SPD SEN FAILED	(Monitor)		
MINOR ALARM			
KW SENSOR FAILURE	(Monitor)		
REM REF FAILURE	(Monitor)		
SPEED SENSOR FAULT	(Monitor)		
MODBUS COMMS	(Monitor)		
KW LIMITING	(Monitor)		
REM SEL WIRE BREAK	(Monitor)		
DSLC COMMS FAULT	(Monitor)		

Configure Prompt	Default Value	Range	Final Value
DSLC ANALOGUES			
GEN A-PHASE VOLTAGE (Volts)	(Monitor)		
GEN B-PHASE VOLTAGE (Volts)	(Monitor)		
GEN C-PHASE VOLTAGE (Volts)	(Monitor)		
BUS A-PHASE VOLTAGE (Volts)	(Monitor)		
GEN A-PHASE CURRENT (Amps)	(Monitor)		
GEN B-PHASE CURRENT (Amps)	(Monitor)		
GEN C-PHASE CURRENT (Amps)	(Monitor)		
POWER FACTOR	(Monitor)		
REAL POWER (kW)	(Monitor)		
REACTIVE POWER (kVAR)	(Monitor)		
APPARANT POWER (kVA)	(Monitor)		
GENERATOR	(Monitor)		
FREQUENCY (Hz)			
BUS FREQUENCY (Hz)	(Monitor)		
DSLC BOOLEANS			
DSLC ALARM OUTPUT	(Monitor)		
VOLTAGE LOWER OUTPUT	(Monitor)		
VOLTAGE RAISE OUTPUT	(Monitor)		
BREAKER CLOSE O/P	(Monitor)		
SYNC TIMEOUT ACTIVE	(Monitor)		
SYNC RECLOSE ACTIVE	(Monitor)		
LOAD HIGH LIMIT	(Monitor)		
LOAD LOW LIMIT	(Monitor)		
VOLTAGE RANGE	(Monitor)		
VOLTAGE LOW LIMIT	(Monitor)		
VOLTAGE HIGH LIMIT	(Monitor)		
SS OFF	(Monitor)		
SS CHECK	(Monitor)		
SS PERMISSIVE	(Monitor)		
SS RUN	(Monitor)		
SS CLOSE TIMER	(Monitor)		
SS SYNC TIMER	(Monitor)		
SS SYNCHRONISED	(Monitor)		
SYNCH CHECK I/P	(Monitor)		
SYNCH PERM I/P	(Monitor)		
SYNCH RUN I/P	(Monitor)		
CB AUX I/P	(Monitor)		
VOLTS RAISE I/P	(Monitor)		
VOLTS LOWER I/P	(Monitor)		

Configure & Service Descriptions

Configure

SPEED SENSORS

Pulse/Rev #1 & #2

is the number of teeth (or holes) on the speed sensing disc, for the speed sensors connected to the 723. If the torsional filter is enabled, #1 refers to the speed sensor on the engine side of the flexible coupling, and #2 refers to the speed sensor on the generator side.

Maximum Hz #1 & #2

allows tuning of the speed sensing algorithm, to obtain the optimum resolution for sensing speed. It is important that the following instructions for tuning these parameters is adhered to.

The Maximum Hz should be calculated based on both the minimum and maximum controlling speeds:

Maximum Speed x Pulse/Rev x 1.3 = A

60

Minimum Speed x Pulse/Rev x 4 = B

60

If B > A then use A as the Maximum Hz. Calculate separately for each speed sensor input, if Pulse/Rev #1 & Pulse/Rev #2 are different.

If B < A then use B as the Maximum Hz, provided that B is greater than 1.1 x Overspeed Trip Frequency. If not, then contact Woodward Governor for further assistance.

ENGINE SPEED

Idle Speed (rpm)

is provided for engine start-up or cooldown. It is independent of the minimum speed set point and may be set to a lower value. Idle Speed is selected when the Rated/Idle contact is opened, if this function is enabled.

Rated Speed (rpm)

is the nominal engine speed.

Overspeed Trip (rpm)

is the speed at which a shutdown is initiated, to prevent over- speed. Please see Engine Manufacturer's recommendation for the value of this parameter.

MW CONTROL

Remote Ref @ 4mA, Remote Ref @ 20 mA (MW)

is the MW reference required at 4mA and 20 mA by the remote reference input.

Select Int kW Ref

if selected true, will enable the use of an internal MW reference value (if the remote reference is not selected.)

FINAL DRIVER

Reverse Acting?

if selected true, will reverse the actuator output signal to 200-0 mA for 0-100%.

Actuator mA @ 0%

sets the mA output required to the actuator at 0% control (PID) output.

Actuator mA @ 100%

sets the mA output required to the actuator at 100% control (PID) output.

Enable Actuator Hit if selected true, will enable the function to hit the actuator down by a certain amount, for a certain period of time. This is for testing and proving the dynamic set-up of the control. Once this parameter has been selected true, it will only remain activated for 30 minutes. After this time, to re-enable the function, the parameter will have to be re-set to true.

Stroke Actuator if true, allows the actuator output to be driven by adjusting the Service tuneable Stroke Actuator, whilst the engine is stopped, and the Run/Stop contact is in the Stop position. This will enable the calibration and testing of an electric actuator.

ENGINE LOAD

Rated Load (MW) is the rated generator load.

MW @ 4mA, MW @ 20 mA is the value of the MW transducer input at 4mA & 20 mA.

MODBUS PORT SETUP

Mode sets the communications protocol of the J3 port. 1=ASCII, 2=RTU.

Slave Address sets the network address of the control. This will always be set to 1 for Point-to-Point communications.

CONFIGURE

Enable Set Points if selected false, will prevent all Service set point menus from being displayed, and therefore prevents adjustment. This parameter would normally be set false, once the control has been commissioned.

Enable Calibration if selected true, the *CALIBRATION* menu will be displayed under Service.

CONF MODBUS I/P'S

Start/Stop, Inc/Dec/Sel Remote, Unload & Idle/Rated, Droop/Isochronous, this menu is for configuring whether certain control inputs are received via the standard hardware, or via the Modbus. To select that they are received via the Modbus, set the parameter true.

Select KW Control Emergency Load Rate, Reset, Remote KW Reference

CONTROL OPTIONS

Grid Brkr Open Cmd? if selected true, digital output #2 will be configured as the Grid Breaker Open Command output, instead of the Minor Alarm.

Emergency Rate I/P? if selected true, digital input #8 (H) will be configured as the Emergency Load Rate selection input, instead of the Parallel with Grid breaker status.

KW Deadband Control	if selected true, kW control will be as compensated droop via the speed reference (see description in system description text).
Enable DSLC PM	if selected true, disables the power management of the 723, and allows the 723 to follow the 'Unit Synchroniser' input after the breaker has closed. This will enable the DSLC to handle the isochronous load sharing and base loading of the system, without interference from the 723.
Enable I/R Select	if selected true, allows the Unload contact input to be utilised as an Idle/Rated contact whilst the CB Aux input is open.
Open DI#1 to Run	if true, digital input #1 is configured Open to Run, Close to Stop.
DO#1 NC?	if true, digital output #1 will be normally closed, i.e. contact will open when a major alarm occurs.

Service

DISPLAY MENU

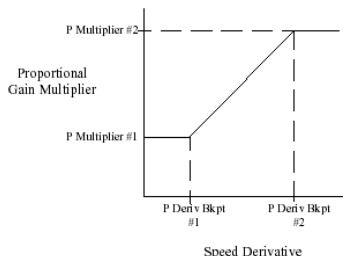
Engine Speed (rpm)	displays the current speed of the engine.
Speed Reference (rpm)	is the rpm reference, after the droop has been taken into account, if in droop mode, or taking into account the error bias if in isochronous mode.
MW Load	is the generator load in MW.
Actuator Position (%)	is the % actuator output demanded by the control.
Fuel Limit (%)	is the % level of the closest fuel limiter.
PID Output	is the % level output from the PID.
Engine Stopped	indicates that the engine speed is below 350Hz.
Engine Running	indicates that the engine speed is above the Engine Running speed switch.
Ready To Sync	indicates that the engine has reached Rated Speed and has remained within the window for the required time.
Unit Sync Bias	is the rpm bias from the unit synchroniser input.
Sys Sync Bias	is the rpm bias from the system synchroniser input.
Droop Bias	is the rpm bias calculated for droop.
Ref Before Bias (rpm)	is the rpm speed reference before any biases (synch or droop) are taken into account.
Gen Breaker Closed	indicates that the Generator CB Aux input is closed.

Isochronous Mode	displays the status of the load sharing lines relay, which connects the unit load sharing lines to the system load sharing lines. If true is displayed, the control is in Isochronous mode.
% Load	is the engine load, expressed as a % of the Rated Load.
LS Lines %	is the % load represented on the load sharing lines.
Load Share Error	is the error calculated between the % load on the load sharing lines, and the % unit load.
KW Control Mode	indicates that the control is in MW Control mode.
Load Reference (MW)	is the MW reference value.
Remote Ref Selected	indicates that the remote MW reference has been selected.
Remote Reference (MW)	is the MW reference demanded by the remote reference input.
MW Limit	is the MW limit as determined by the frequency limiter curve.
SPD DYNAMICS #1	
Proportional Gain #1	PID proportional gain adjustment for the dynamics gain. Increasing the P term increases the gain, a value for P that is too large will cause oscillation, if P is too small the offset from a transient will be too large.
Integral Gain #1 (1/s)	PID integrator rate adjustment for the dynamics, affects kW recovery rate after a transient. A value for I that is too small will change the actuator current slowly and speed will take a long time to return to set speed after a transient, giving overdamped response. If I is too large the actuator current will move too fast and speed will overshoot and response will be underdamped.
S.D.R. #1	PID derivative ratio adjustment for the dynamics, when the Generator CB Aux input is open. Set the amount of derivative (or lead) action the control will have. Increasing the derivative ratio value above 1 will decrease the derivative function giving the control a PI type action. A value too large will make the system less responsive. A value too small will make the system oscillate, and cannot be compensated for with the proportional gain or the integrator rate.
Dyn Select Delay (s)	is the delay period for switching from Dynamics #2 to Dynamics #1, after the Generator CB Aux contact input is opened.
Dyn Select Delay (s)	is the delay period for switching from Dynamics #2 to Dynamics #1, after the Generator CB Aux contact input is opened.

Enable Deriv Dyn

If true, the Gain Ratio function will be switched out, and the Derivative Dynamics function will be switched in. Both functions are multiplying, and will work on whichever dynamics is switched in at the time (#1 or #2). The Gain Ratio multiplies the Proportional Gain, based on the speed error, whilst the Derivative Dynamics multiplies all three PID terms (individually tuneable), based on the rate of change of engine speed.

Example:

***SPD DYNAMICS #2***

Proportional Gain #2

PID proportional gain adjustment for the dynamics gain, when the Generator CB Aux input is closed. Increasing the P term increases the gain, a value for P that is too large will cause oscillation, if P is

too small the offset from a transient will be too large.

Integral Gain #2 (1/s)

PID integrator rate adjustment for the dynamics, affects recovery rate after a transient, when the Generator CB Aux input is closed. A value for I that is too small will change the actuator current slowly and speed will take a long time to return to set speed after a transient, giving overdamped response. If I is too large the actuator current will move too fast and speed will overshoot and response will be underdamped.

SDR #2

PID derivative ratio adjustment for the dynamics, when the Generator CB Aux input is closed. Set the amount of derivative (or lead) action the control will have. Increasing the derivative ratio value above 1 will decrease the derivative function giving the control a PI type action. A value too large will make the system less responsive. A value too small will make the system oscillate, and cannot be compensated for with the proportional gain or the integrator rate.

Propgain Multiplier

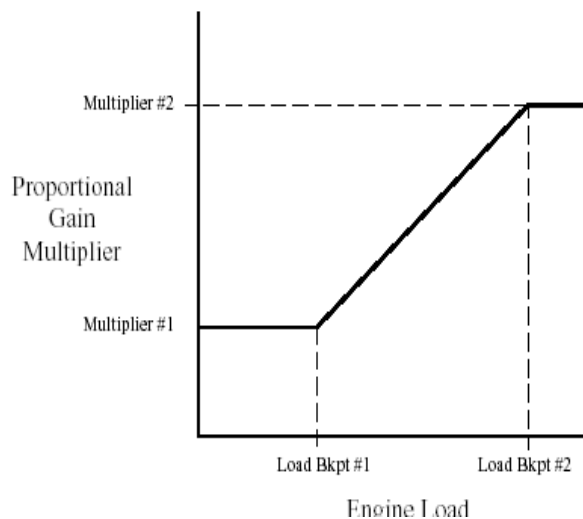
This value of this parameter determines the value of gain in the control, should a speed sensor fail when the torsional filter is enabled, and the Generator CB Aux input closed. The purpose of this parameter is to slow the PID down in the event of the torsional filter being disabled, when a speed sensor fails. Gain Value = Propgain Multiplier * Proportional

***KW DYNAMICS*
(For MW control)**

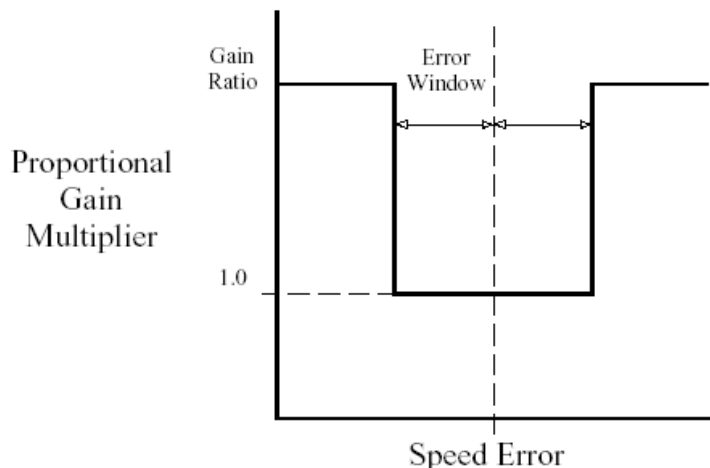
Proportional Gain

PID proportional gain adjustment for the dynamics gain, when in MW control mode. Increasing the P term increases the gain, a value for P that is too large will cause oscillation, if P is too small the offset from a transient will be too large.

Integral Gain (1/s)	PID integrator rate adjustment for the dynamics, affects recovery rate after a transient, when in MW Control mode. A value for I that is too small will change the actuator current slowly and speed will take a long time to return to set speed after a transient, giving over damped response. If I is too large the actuator current will move too fast and speed will overshoot and response will be under damped.
SDR	PID derivative ratio adjustment for the dynamics when in MW Control mode. Set the amount of derivative (or lead) action the control will have. Increasing the derivative ratio value above 1 will decrease the derivative function giving the control a PI type action. A value too large will make the system less responsive. A value too small will make the system oscillate, and cannot be compensated for with the proportional gain or the integrator rate.
Use Lower Prop. Band	If selected true proportional value of kW dynamics is divided by 10 internally.

GAIN SLOPE

Load Bkpt #1 (%)	This is the load breakpoint associated with 'Multiplier #1', for the curve set up to calculate a proportional gain multiplier, which is dependent on the engine load. At loads between points #1 & #2, the multiplier is increased/decreased linearly between these two points. For values of load at, or less than, breakpoint #1, the multiplier will be 'Multiplier #1'.
Multiplier #1	This is the multiplier, associated with 'Load Bkpt #1', for the calculation of the gain multiplier.
Load Bkpt #2 (%)	This is the load breakpoint associated with 'Multiplier #2', for the curve set up to calculate a proportional gain multiplier, which is dependent on the engine load. At loads between points #1 & #2, the multiplier is increased/decreased linearly between these two points. For values of load at, or greater than, breakpoint #2, the multiplier will be 'Multiplier #2'.
Multiplier #2	This is the multiplier, associated with 'Load Bkpt #2', for the calculation of the gain multiplier.

GAIN RATIO

- Error Window #1 (rpm)** This value is the magnitude of a speed error at which the control automatically switches to fast response, whilst the Generator CB Aux input is open. The control does not use the absolute value of speed error, but 'anticipated' speed error to make this switch. This method provides for quick switching to the low gain value when recovering from the speed transient. This provides smoother switching than if the absolute speed error was used for the window.
- Gain Ratio #1** This sets the ratio of the gain setting at steady state to the gain setting during transient conditions, whilst the Generator CB Aux input is open. The Gain Ratio operates in conjunction with the Error Window and Proportional Gain adjustments, by multiplying the Proportional Gain set point by the Gain Ratio when the speed error is greater than the Error Window. This makes the control dynamics fast enough to minimize engine speed overshoot on start-up and to reduce the magnitude of speed error when loads are changing. This allows a lower gain at steady state for better stability and reduced steady-state actuator linkage movement. The Gain Ratio function is disabled, if the Derivative Dynamics are enabled, and vice versa.
- Error Window #2 (rpm)** This value is the magnitude of a speed error at which the control automatically switches to fast response, whilst the Generator CB Aux input is closed. The control does not use the absolute value of speed error, but 'anticipated' speed error to make this switch. This method provides for quick switching to the low gain value when recovering from the speed transient. This provides smoother switching than if the absolute speed error was used for the window.
- Gain Ratio #2** This sets the ratio of the gain setting at steady state to the gain setting during transient conditions, whilst the Generator CB Aux input is closed. The Gain Ratio operates in conjunction with the Error Window and Proportional Gain adjustments, by multiplying the Proportional Gain set point by the Gain Ratio when the speed error is greater than the Error Window. This makes the control dynamics fast enough to minimize engine speed overshoot on start-up and to reduce the magnitude of speed error when loads are changing. This allows a lower gain at steady state for better stability and reduced steady-state actuator linkage movement. The Gain Ratio function is disabled, if the Derivative Dynamics are enabled, and vice versa.

DERIV DYNAMICS

P Deriv Bkpt #1 (rpm/s)	This value is breakpoint #1 which relates to 'P Multiplier #1' of the curve to determine the Proportional Gain multiplier, based on the engine speed derivative (rate of change of speed). (rpm/s)
P Multiplier #1	This value is the multiplier #1 which relates to 'P Deriv Bkpt #1' of the curve to determine the Proportional Gain multiplier, based on the engine speed derivative (rate of change of speed).
P Deriv Bkpt #2 (rpm/s)	This value is the breakpoint #2 which relates to 'P Multiplier #2' of the curve to determine the Proportional Gain multiplier, Based on the engine speed derivative (rate of change of speed). (rpm/s)
Multiplier #2	This value is the multiplier #2 which relates to 'P Deriv Bkpt #2' of the curve to determine the Proportional Gain multiplier, based on the engine speed derivative (rate of change of speed).
I Deriv Bkpt #1 (rpm/s)	This value is breakpoint #1 which relates to 'I Multiplier #1' of the curve to determine the Integral Gain multiplier, based on the engine speed derivative (rate of change of speed). (rpm/s)
I Multiplier #1	This value is the multiplier #1 which relates to 'I Deriv Bkpt #1' of the curve to determine the Integral Gain multiplier, based on the engine speed derivative (rate of change of speed).
I Deriv Bkpt #2 (rpm/s)	This value is the breakpoint #2 which relates to 'I Multiplier #2' of the curve to determine the Integral Gain multiplier, based on the engine speed derivative (rate of change of speed). (rpm/s)
I Multiplier #2	This value is the multiplier #2 which relates to 'I Deriv Bkpt #2' of the curve to determine the Integral Gain multiplier, based on the engine speed derivative (rate of change of speed).
D Deriv Bkpt #1 (rpm/s)	This value is breakpoint #1 which relates to 'D Multiplier #1' of the curve to determine the S.D.R. multiplier, based on the engine speed derivative (rate of change of speed). (rpm/s)
D Multiplier #1	This value is the multiplier #1 which relates to 'D Deriv Bkpt #1' of the curve to determine the S.D.R. multiplier, based on the engine speed derivative (rate of change of speed).
D Deriv Bkpt #2 (rpm/s)	This value is the breakpoint #2 which relates to 'D Multiplier #2' of the curve to determine the S.D.R. multiplier, based on the engine speed derivative (rate of change of speed). (rpm/s)
D Multiplier #2	This value is the multiplier #2 which relates to 'D Deriv Bkpt #2' of the curve to determine the S.D.R. multiplier, based on the engine speed derivative (rate of change of speed).

ENGINE SPEED

Speed Filter (Hz)	Normally, this value should not need to be adjusted, but can be used to filter any undesirable frequencies on the speed pickups. If tuned above 15.9Hz, the filter will automatically be disabled.
Filter Frequency (Hz)	should be set to the resonant frequency of the speed signal which requires filtering by the band-stop (notch) filter.

Filter Q Factor	adjusts the attenuation of the signal frequency, filtered by the band-stop filter. The minimum value of 0.707 results in zero attenuation, and as the value is increased, the attenuation is increased, and the range of frequencies affected broadens.
Sensor Weight	When using the torsional filter, it is possible to weight one speed sensor input more heavily than the other. If this value is set between 0.5 and 1, sensor #1 will be weighted more heavily than sensor #2. Between 0 and 0.5, sensor #2 will be more heavily weighted.
Engine Running (rpm)	is the speed above which the engine is assumed to be running, for monitoring purposes.
Two Speed Sensors?	if selected false, the minor alarm relay will not be activated, should a speed sensor input fail. The Alarm LED on the front of the 723 however, will still illuminate, as the failure is continuously detected. The purpose of this parameter, is to prevent the minor alarm activating, when only one speed pickup is used.
Dis Notch Filter	if selected true will disable the Notch Filter.
SPEED REFERENCE	
Minimum Speed (rpm)	is the lowest rpm value to which the speed reference may be driven by closing the Decrease Speed/Load contact input.
Maximum Speed (rpm)	is the maximum value to which the speed reference may be driven by closing the Increase Speed/Load contact input.
Accel/Decel Rate (rpm/s)	is the rate at which the speed reference ramps from Idle Speed to Rated Speed, and from Rated Speed to Idle Speed.
Idle/Rated Switch (rpm)	The speed reference will start to ramp to the Rated Speed when this switch speed is exceeded. It is recommended that this parameter is tuned to a value slightly lower than the Idle Speed.
Inc/Dec Rate #1 (rpm/s)	is the rate at which the speed reference is increased/decreased using the Increase/Decrease contacts, when the Generator CB Aux contact is open.
Inc/Dec Rate #2 (rpm/s)	is the rate at which the speed reference is increased/decreased using the Increase/Decrease contacts, when the Generator CB Aux contact is closed.
START/STOP	
Rundown Time (s)	After a shutdown, this is the period for which the engine speed must be below 350Hz, before the control will recognize the 'run' command.
Pulse/Cont Alarm?	if selected true, the major alarm relay will de-energize for the Alarm Pulse Time if a shutdown condition occurs. If false, the alarm will remain latched, until the next 'run' command is received.

Alarm Pulse Time (s)	If the above option is selected true, this is the period for which the major alarm relay output is de-energized.
Brkr Open Cmd NC?	if selected true will set the output relay for the Breaker Open Command as normally energised, and so when the breaker open command is issued by the control, the relay is de-energised and hence the contact opened.
Dig O/P #2 NC?	if selected true will set the Digital Relay Output #2 as normally energised, and so when the function for this output is activated (Minor Alarm or Open Grid Breaker) by the control, the relay is de-energised and hence the contact opened.
SYNCHRONISING	
Rdy To Sync Limits (rpm)	is the synchronising speed window that the engine speed must be within.
Sync OK Dly Time (s)	is the time duration that the engine must be running within the synchronising speed window before the ready to synchronise command is given.
Unit Synch Gain	Adjustment of this value will increase or decrease the effect of the analogue unit synchroniser input to the speed reference.
Ref Bias Pulse (rpm)	is the value added to the speed reference, instantly, when the generator breaker is closed. This is for a droop system, to ensure that the generator is not driven into reverse power as soon as the breaker is closed.
Sys Synch Gain	Adjustment of this value will increase or decrease the effect of the analogue bus tie synchroniser input to the speed reference.
Disable Unit Synch	Select true if not using a Woodward Analogue synchroniser for synchronisation between the generator and the bus.
Disable Sys Synch	Select true if not using a Woodward Analogue synchroniser for bus synchronisation.
Sync Filter (Hz)	is for filtering the unit synchroniser input to the control.
LOAD SHARING	
LS Error %	When soft loading/unloading into isochronous load sharing, the control will not establish isochronous load sharing, until the load share error is within the limits determined by this parameter.
Load Gain	sets the sensitivity to the load share error.
Auto Load Rate (kW/s)	is the rate at which load is increased when soft loading into isochronous load sharing.
Emergency Load Rate (kW/s)	is the rate at which load is increased when soft loading into isochronous load sharing, with the Emergency Loading Rate contact closed.

Auto Unload Rate (kW/s)	is the rate at which load is decreased when soft unloading into isochronous load sharing, from droop control. Also when using the Unload feature to shed load and open the generator breaker.
Emergency Unload Rate (kW/s)	is the rate at which load is decreased when soft unloading into isochronous load sharing, from droop control, with the Emergency Loading Rate contact closed. Also using the Unload feature to shed load, with the Emergency Loading Rate contact closed.
Re-Load To Isoc?	When operating in Isochronous Load Sharing mode, if the Raise/Lower contacts are momentarily closed following the Unload command (to abort the unload sequence), the setting of this value will determine the course of action. If it is set true, the control will re-load back into Isoch mode. If it is set false, the control will remain at the load level it was aborted at, and remain in Droop mode.

MW CONTROL

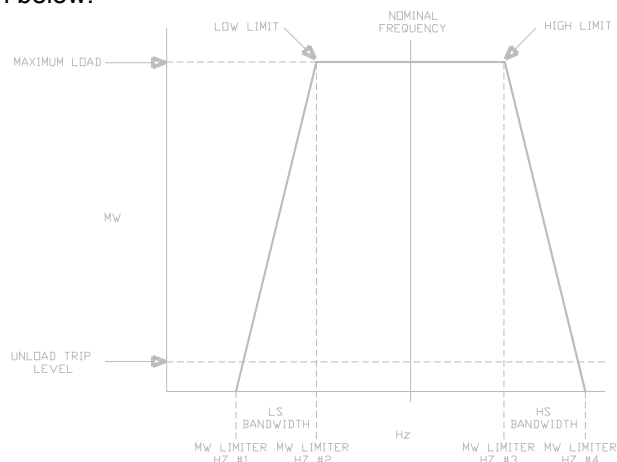
Auto Load Rate (kW/s)	is the rate at which load is increased when soft loading into remote kW control.
Auto Unload Rate (kW/s)	is the rate at which load is decreased when the Unload function is used to shed load and open the generator breaker.
Raise Load Rate (kW/s)	is the rate at which the kW reference is increased when in kW control.
Lower Load Rate (kW/s)	is the rate at which the kW reference is decreased when in kW control.
Enable Instant Rate	if selected true, when using the remote kW reference, once the error between the kW and the kW reference is within the window, the kW reference will change instantly as the remote reference changes, all ramp rates will be overridden. This is useful when the remote reference input is utilised to adjust the kW reference to control Import/Export levels.
Instant Rate Window (kW)	is the window applied to the Instant Rate function above.
Ovrd Remote I/P Fail	if selected true, will override the failed signal detection of the remote kW reference input. When the remote reference input is disabled, it is not possible to select remote reference kW control.
Deadband Window (kW)	If the kW error is within this window, and Deadband KW Control is enabled, no action will be taken to correct the error.
D/B Ctrl Ramp Rate (kW/s)	If Deadband KW Control is enabled, this is the rate at which the speed reference is increased/decreased to control the MW level.
Int MW Ref Rate (kW/s)	If the internal MW reference is selected, this is the rate at which the reference is ramped to the 'Internal MW Ref' level.
Internal MW Ref (%)	This is the level to which the MW reference will ramp, when the control is switched into MW Control mode, and the remote reference is not selected, if the option has been selected in Configure.

ENGINE LOAD

Droop (%)	is the % of rated speed by which the speed reference is drooped at zero to full load.
Full Load Act %	is the actuator % output at full load.
KW Filter (Hz)	is the filter value. This value should not need to be adjusted, but can be used to filter any undesirable frequencies picked up by the MW transducer.
Load Filter (Hz)	is the filter value. This value should not need to be adjusted, but can be used to filter the internally derived position feedback.
Unload Trip Level (kW)	When the control is in isochronous load sharing or MW control mode, and the Unload command is given, the load will be decreased to this level before the generator breaker open command is issued.
Ovrd Load I/P Fail	if selected true, will override the failed signal detection of the MW transducer input. When the load input is disabled, isochronous load sharing is not possible, and droop control is based on the actuator position.

FREQUENCY LIMITER

Bus Frequency (Hz)	selects the frequency of the bus, normally set at 50 or 60Hz.
KW Limiter Hz #1, #2, #3 & #4, Maximum Load 1 & 2 (MW).	These tuneable set-up the curve for the frequency limiter. See diagram below:

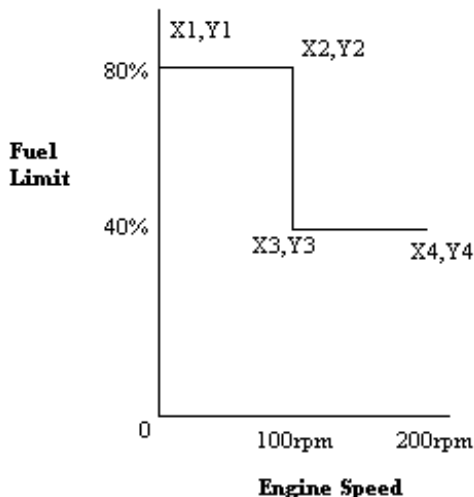


Freq Error SP#1	is the frequency error (difference between actual bus frequency and normal bus frequency) above which the Grid Breaker Open command is issued.
Freq Error SP#2	is the frequency error (difference between actual bus frequency and normal bus frequency) above which the Generator Breaker Open command is issued.
Trip Delay (s)	is the period of delay between detection and breaker open command, if Freq Error SP#2 is exceeded.

FUEL LIMITERS

Start Fuel Limit X1..X4 (rpm), Start Fuel Limit Y1..Y4 (%)

is the maximum % actuator output during engine start-up. This should be set to value which gives optimum start characteristics, while minimizing smoke emissions due to over fuelling. A four point curve is provided to allow different fuel limiting levels at different speeds. e.g.



Maximum Fuel Limit (%)

is the maximum % actuator output during normal engine operation. This limit should normally be set just above the output at full load.

FINAL DRIVER

Hit Actuator, Actuator Hit Pulse (s), Actuator Hit Value (%)

If the Actuator Hit has been enabled, when the Hit Actuator parameter is tuned TRUE, the Actuator Hit Value will be subtracted from the % actuator output, for a period of time (Actuator Hit Pulse). This function is available for the purpose of testing and proving dynamic set-up.

Stroke Actuator (%)

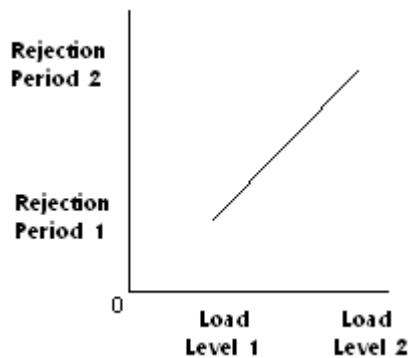
If the configurable Stroke Actuator has been selected true, the engine is stopped, and the Run/Stop contact is in the Stop position, by adjusting this value, the actuator output can be increased and decreased in order to calibrate an electric actuator.

GEN BRKR LOAD REJ

Load Rej Level (%)

If the CB Aux contact is opened whilst the load is above this value, the actuator will be forced to 0% for the Load Rej Period, as determined by the curve set-up below.

Load Level 1..2 (%),
Rejection Period 1..2 (s)

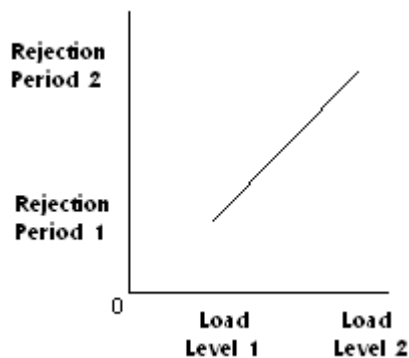


GRD BRKR LOAD REJ

Load Rej Level (%)

If the Parallel with Grid contact is opened whilst the load is above this value, the actuator will be forced to 0% for the Load Rej Period, as determined by the curve set-up below.

Load Level 1..2 (%),
Rejection Period 1..2 (s)



Enable Load Rej

if selected true, will enable the load rejection pulse function, caused by the grid breaker opening.

CALIBRATION

Remote I/P Offset

If it is necessary to calibrate the Remote Analogue input, adjustment of this parameter will alter the offset. To calibrate the input, set the mA to zero, and ensure that the control is measuring zero. If not, adjust the offset until it does. Then set the mA input to 20 mA. Ensure that the control measuring 20. If not, adjust the gain until it does. Return the mA input to zero, and check that the control is still measuring zero. If not, repeat the calibration process.

Remote I/P Gain.

If it is necessary to calibrate the Remote Analogue input, adjustment of this parameter will alter the gain

Load I/P Offset

If it is necessary to calibrate the MW transducer input, adjustment of this parameter will alter the offset. To calibrate the input, set the mA to zero, and ensure that the control is measuring zero. If not, adjust the offset until it does. Then set the mA input to 20 mA. Ensure that the control is measuring 20. If not, adjust the gain until it does. Return the A input to zero, and check that the control is still measuring zero. If not, repeat the calibration process.

Load I/P Gain	If it is necessary to calibrate the MW transducer input, adjustment of this parameter will alter the gain.
LS Lines Offset	If it is necessary to calibrate Load Share Lines input, adjustment of this parameter will alter the offset. To calibrate the load sharing lines, contact Woodward Governor for further information.
LS Lines Gain	If it is necessary to calibrate the Load Share Lines input, adjustment of this parameter will alter the gain.
LS Load Offset	If it is necessary to calibrate load output to the load sharing lines, adjustment of this parameter will alter the offset. To calibrate the load output to the load sharing lines, contact Woodward Governor for further information.
LS Load Gain	If it is necessary to calibrate the load output to the load sharing lines, adjustment of this parameter will alter the gain.
Air I/P Offset	<p>If it is necessary to calibrate the input, adjustment of this parameter will alter the offset.</p> <p>To calibrate the input, set the mA to zero, and ensure that the control is measuring zero. If not, adjust the offset until it does. Then set the mA input to 20 mA. Ensure that the control is measuring 20. If not, adjust the gain until it does. Return the mA input to zero, and check that the control is still measuring zero. If not, repeat the calibration process.</p>
Air I/P Gain	If it is necessary to calibrate the input, adjustment of this parameter will alter the gain.
An O/P #1 Offset	This parameter is the offset term, for calibration of analogue output #1 (terminals 15 & 16). If it is necessary to calibrate the output, set the parameter 'Analogue Output #1' (in menu *ANALOG O/P CONFIG*) to 7. Then adjust the 'An O/P Calibration' term to zero, and measure the current from output #1. If it is not zero, then adjust the offset term. Then adjust the 'An O/P Calibration' term to 20, and check the current again. If it does not read 20, then adjust the gain term. Return to zero, and check again, and work through the calibration process again if necessary.
An O/P #1 Gain	This parameter is the gain term, for calibration of analogue output #1 (terminals 15 & 16).
An O/P #2 Offset	This parameter is the offset term, for calibration of analogue output #2 (terminals 17 & 18). If it is necessary to calibrate the output, set the parameter 'Analogue Output #2' (in menu *ANALOG O/P CONFIG*) to 7. Then adjust the 'An O/P Calibration' term to zero, and measure the current from output #2. If it is not zero, then adjust the offset term. Then adjust the 'An O/P Calibration' term to 20, and check the current again. If it does not read 20, then adjust the gain term. Return to zero, and check again, and work through the calibration process again if necessary.
An O/P #2 Gain	This parameter is the gain term, for calibration of analogue output #2 (terminals 17 & 18).

An O/P #3 Offset	This parameter is the offset term, for calibration of analogue output #3 (terminals 19 & 20). If it is necessary to calibrate the output, set the parameter 'Analogue Output #3' (in menu *ANALOG O/P CONFIG*) to 7. Then adjust the 'An O/P Calibration' term to zero, and measure the current from output #3. If it is not zero, then adjust the offset term. Then adjust the 'An O/P Calibration' term to 20, and check the current again. If it does not read 20, then adjust the gain term. Return to zero, and check again, and work through the calibration process again if necessary.
An O/P #3 Gain	This parameter is the gain term, for calibration of analogue output #3 (terminals 19 & 20).
An O/P Calibration	For any analogue output selected to Option 7 (calibration), adjustment of this value between 0 & 20 will allow checking and adjustment of the calibration of the output/metering device, between 0 and 20 mA.

MODBUS PORT SETUP

Hardware Config	sets the communications hardware configuration, 1=RS-232, 2=RS-422, 3=RS-485
Baud Rate	sets the desired baud rate, an integer number in the range 1 to 7 is to be used representing: 1=1200, 2=1800, 3=2400, 4=4800, 5=9600, 6=19200, 7=38400. The preferred baud rate is 9600. If the chosen baud rate is 38400, then both J2 and J3 must be set identical.
Stop Bits	sets the desired number of stop bits, an integer number in the range 1 to 3 is to be used representing: 1=1, 2=1.5, 3=2
Parity	sets the desired parity, an integer number in the range 1 to 3 is to be used representing: 1=OFF, 2=ODD, 3=EVEN
Timeout (s)	If no communication is received within the Timeout period, a communications error will occur.
Enable Modbus Alms	If set false, communications errors are ignored by the control.

SERVLINK SETUP

Hardware Config	sets the communications hardware configuration, 1=RS-232, 2=RS-422, 3=RS-485
Baud Rate	sets the desired baud rate, an integer number in the range 1 to 10 is to be used representing: 1=110, 2=300, 3=600, 4=1200, 5=1800, 6=2400, 7=4800, 8=9600, 9=19200, 10=38400. The preferred baud rates are 9600 and 19200.

DSLC COMMS SETUP

DSLC Service Pin	must be toggled true/false when prompted, during LON binding procedure. This should only be required during initial commissioning.
DSLC Timeout	If no communication is received within the Timeout period, a communications error will occur.

DSLCL Xmit Time	is the time period between transmissions from the 723 to the DSLC.
Reset LON	is available for manually re-setting the LON in the event that it becomes necessary.

ANALOG O/P CONFIG

Analogue Output #1..#3	These will select the parameters which are output through the three analogue output channels of the 723. 1=Actuator Position, 2=Engine Speed, 3=Percentage Load, 4=KW Reference, 5=Speed #1, 6=Speed #2.
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Eng Speed O/P @4mA, Eng Speed O/P @ 20 mA, KW Ref O/P @ 4mA, KW Ref O/P @ 20 mA, Speed 1 O/P @4mA, Speed 1 O/P @20 mA, Speed 2 O/P @ 4mA, Speed 2 O/P @ 20 mA	are for scaling the parameters output via the analogue 4–20 mA outputs.
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MAJOR ALARM

Overspeed	this menu will only be displayed, if a Major Alarm has occurred. if true, the engine speed has reached the Overspeed Trip level.
Both Spd Sen Failed	if true, both speed sensors have failed, i.e. below the Low Set - point.

MINOR ALARM

KW Sensor Failure	this menu will only be displayed, if a Minor Alarm has occurred. if true, the analogue load input has failed, i.e. below 1mA, above 22mA.
Rem Ref Failure	if true, the analogue remote reference input has failed, below 2mA, above 22mA
Speed Sensor Fault	if true, a speed sensor has failed, i.e. below the 250Hz
Modbus Comms	if true, a communications failure has occurred with Modbus.
KW Limiting	if true, the MW reference is being limited by the frequency limiter curve.
Rem Sel Wire Break	if true, following the selection of remote MW reference (closure of both Increase & Decrease contacts), a single wire has been disconnected or broken. Both contacts must be broken to de-select remote kW reference.
DSLCL Comms Fault	if true, there has been a communications failure between the 723 and the DSLC.

DSLCL ANALOGUES

this menu will display all of the necessary and relevant analogue parameters, read in from the DSLC.

DSLCL BOOLEANS

this menu will display all of the necessary and relevant Boolean parameters, read in from the DSLC.

NOTICE

Failure to save set points prior to removing power from the control will cause them to revert to the previously saved settings.

Modbus Communications Address List

Boolean Writes

Address	Description
0:0001	Run/Start Engine
0:0002	Stop Engine
0:0003	Increase Speed/Load
0:0004	Decrease Speed/Load
0:0005	Select Remote Reference
0:0006	Unload
0:0007	Droop
0:0008	Isochronous
0:0009	Emergency Loading Rate
0:0010	Reset
0:0011	Select KW Control
0:0012	Voltage Raise
0:0013	Voltage Lower
0:0014	Select Rated Speed
0:0015	Select Idle Speed

Boolean Reads

Address	Description
1:0001	*MAJOR/SHUTDOWN ALARM*
1:0002	*MINOR ALARM*
1:0003	
1:0004	
1:0005	
1:0006	OVERSPEED - SD
1:0007	BOTH SPEED SENSORS FAILED - SD
1:0008	
1:0009	
1:0010	KW SENSOR FAILURE - MINOR
1:0011	REMOTE REFERENCE FAILURE - MINOR
1:0012	SPEED SENSOR FAILURE - MINOR
1:0013	KW LIMITING - MINOR
1:0014	REMOTE SELECT, WIRE BREAK - MINOR
1:0015	DSLCL COMMS FAULT
1:0016	
1:0017	
1:0018	
1:0019	ENGINE STOPPED
1:0020	ENGINE RUNNING
1:0021	READY TO SYNCHRONISE
1:0022	GENERATOR BREAKER CLOSED
1:0023	ISOCHRONOUS MODE
1:0024	KW CONTROL MODE
1:0025	REMOTE REFERENCE SELECTED
1:0026	
1:0027	
1:0028	
1:0029	DSLCL ALARM OUTPUT
1:0030	DSLCL VOLTAGE LOWER OUTPUT

1:0031	DSLCL VOLTAGE RAISE OUTPUT
1:0032	DSLCL BREAKER CLOSE OUTPUT
1:0033	DSLCL SYNC TIMEOUT ACTIVE
1:0034	DSLCL SYNC RECLOSE ACTIVE
1:0035	DSLCL LOAD HIGH LIMIT
1:0036	DSLCL LOAD LOW LIMIT
1:0037	DSLCL VOLTAGE RANGE
1:0038	DSLCL VOLTAGE LOW LIMIT
1:0039	DSLCL VOLTAGE HIGH LIMIT
1:0040	DSLCL SYNCH STATE OFF
1:0041	DSLCL SYNCH STATE CHECK
1:0042	DSLCL SYNCH STATE PERMISSIVE
1:0043	DSLCL SYNCH STATE RUN
1:0044	DSLCL SYNCH STATE CLOSE TIMER
1:0045	DSLCL SYNCH STATE SYNC TIMER
1:0046	DSLCL SYNCH STATE SYNCHRONISED
1:0047	DSLCL SYNCH CHECK I/P
1:0048	DSLCL SYNCH PERM I/P
1:0049	DSLCL SYNCH RUN I/P
1:0050	DSLCL CB AUX I/P
1:0051	DSLCL VOLTS RAISE I/P
1:0052	DSLCL VOLTS LOWER I/P

Analogue Reads

Address	Description
3:0001	ENGINE SPEED (rpm)
3:0002	ENGINE SPEED #1 (rpm)
3:0003	ENGINE SPEED #2 (rpm)
3:0004	SPEED REFERENCE (rpm)
3:0005	KW LOAD
3:0006	ACTUATOR POSITION (%)
3:0007	FUEL LIMIT
3:0008	PID OUTPUT
3:0009	% LOAD
3:0010	LS LINES %
3:0011	LOAD SHARE ERROR
3:0012	LOAD REFERENCE (kW)
3:0013	REMOTE REFERENCE (kW)
3:0014	KW LIMIT
3:0015	UNIT SYNCH BIAS (rpm)
3:0016	SYSTEM SYNCH BIAS (rpm)
3:0017	DROOP BIAS (rpm)
3:0018	SPEED REFERENCE BEFORE BIASES
3:0019	CHARGE AIR PRESSURE (bar)
3:0020	
3:0021	
3:0022	

Analogue Writes

Address	Description
4:0001	Remote KW Reference (kW)

Chapter 5.

Application Programming

Graphical Application Programmer

When designing a new control system, much time may be spent re-writing, re-testing and re-drawing documentation for software which has already been proven in a similar application. The Woodward Governor Company has developed a Graphical Application Programmer (GAP™), which allows the applications engineer to efficiently re-use existing software with a minimum of re-writing, re-testing and re-generating documentation. This application software generating system is self-documenting so that the engineer who develops the application will not be the only person who is able to efficiently modify the software.

The GAP software allows the applications engineer to design the control system logic with an integrated drawing package, which runs on a PC under the Windows environment. Once the control software has been graphically entered, the GAP/PC system automatically generates code which is loaded into the 723 to control the engine.

The GAP software blocks are written in C, a transportable language, which means that it can be used on different hardware platforms. Because of this, the same proven blocks which have been utilised in the past in various applications, with different control platforms, will be used in future controls, without introducing system bugs.

Similarly, just as the same blocks are re-used, the applications engineers using the GAP software, build on a Woodward library of GAP software functions which may be re-used from control to control, with little code generation and testing time, and again, without introducing errors.

All changes and additions to the GAP software are generated, tested and documented by an integrated team of software experts, so that the improvement of the GAP software is an ongoing process. This process minimizes the amount of time spent re-writing specific control functions, whilst giving the applications engineer flexibility for design changes or special requirements.

Run Time Performance

When more and more complex algorithms are implemented in a digital control, the result can be a less than robust controller. One of the main advantages of the GAP software is that all the blocks have been written as efficiently as possible without jeopardising code stability. Blocks are written in one standard language, and the interface between blocks is well defined. Unwanted interactions between unrelated pieces of software have virtually been eliminated with the GAP software.

The timing requirements of the code generated by the GAP software have also been rigidly defined and adhered to. Variable execution time blocks have been avoided. The non-variability in the execution times of the blocks means that a control that runs efficiently during testing, is currently exercising the entire control program. The user does not have to worry that under an unanticipated set of conditions, the processor will become overburdened, and will not have enough time to complete its assigned tasks. Only with predictable execution times, can a multi-tasking operating system have a guaranteed update rate. Software tasks may be programmed to run every 10 ms, 20 ms, 40 ms and 80

ms. The GAP software guarantees that a task programmed to run every 10 milliseconds will run exactly every 10 milliseconds, regardless of what other functions the control system is presently exercising.

System Support and Modification

During system support and modification, the advantages of the GAP software become readily apparent. Because of the structure of the GAP software, and because it generates its own documentation, changes to the control software can be easily supported by field service personnel, and the original engineer is not necessarily required for system support, or further modifications to the software. If the control software were written with only the aid of a software compiler like C or Pascal, any errors introduced in this code, might be almost impossible to identify and repair. The GAP system generates its own documentation that is guaranteed to match the control code generated.

The GAP system, because of its rigidly defined nature, allows Woodward to exercise the same engineering change and revision control system procedures used to control the manufacture of any control system part. This ISO 9001 approved engineering change system guarantees software compatibility, as well as documentation that makes it possible to reproduce, diagnose, and repair control logic bugs. If any bugs do escape, they will be well documented, and the affected systems will be readily located and fixed.

GAP Process/Logic Blocks

The following table shows the range of process/logic blocks which are available for application programming. Some of the blocks represent Woodward defined functions (e.g. PID_ENGA), while others may be recognized as standard logic functions (e.g. NOT).

ABSOLUTE	B_FEEDBACK	LAG	PID_2
ADD	B_FIRST	LAG_2	PID_ENGA
AND	B_MUX_N_1	LAG_3	PID_ENGALG
A_2_RM	B_NAME	LATCH	PID_RECIP
A_3_RM	B_SW	LATCH1	PID_SAMPLE
A_COMPARE	B_SW_REV	LEAD	PROP
A_FEEDBACK	B_TO_INT	LEADLAG_2	RAMP
A_FIRST	CMD_TRIM	LEAD_2	SAMP_HOLD
A_MONITOR	CURVE_2D	LEAD_LAG	SQRT
A_MUX_N_1	CURVE_3D	LSS_BUS	SUBTRACT
A_MUX_S_N	CURVE_OD	MANCAL_AI	SW_TIMER
A_NAME	DEADBAND	MANCAL_AO	SYS_PERF
A_SW	DELAY	MULTIPLY	TC_MON
A_SW_REV	DIVIDE	NAND	T_FLIPFLOP
A_TO_INT	EVENT_CORR	NEGATE	T_NAME
A_TO_TIME	FLT_DIAG	NOR	T_TO_AN
BG_TESTS	HSS_BUS	NOT	WGSPL
B_2_RM	I_NAME	ONE_SHOT	XNOR
B_3_RM	I_TO_AN	OR	XOR
B_ALARM	JMP_RATE	PID	

Table 5-1. Process/Logic Program Blocks Examples

Chapter 6.

Power Management Network

Network Architecture

A special Serial LonTalk® * Adapter (SLTA) is needed to make a network 'binding' between the DSLC™ and the 723 DCS.

*—LonTalk is a trademark of Echelon Corp.

An SLTA is a network interface that enables any PC to connect to a LonWorks® * network. An SLTA enables the attached PC to act as an application node on a LonWorks network. When used with a PC and the LonManager LonMaker Installation Tool, the SLTA can also be used to build sophisticated network management, monitoring and control tools for the LonWorks network.

*—LonWorks is a trademark of Echelon Corp.

IMPORTANT

Once a DSLC has been 'bound' to a 723, the DSLC is no longer able to automatically communicate via the LON, to other DSLCs. If it is required for the DSLCs to communicate with each other, as well as a 723, the whole network will have to be taken into consideration. Each 723 and DSLC on the network will have to be entered into a database, and identified and bound individually, therefore becoming part of the communicating network.

Hardware

The network consists of one channel of the 723 and a DSLC.

More information regarding the DSLC (Digital Synchronizer & Load Control) may be found in the manual number 02007.

The DSLC communicates with the 723 through shielded twisted pair wiring. The specifications for the system require that listed level V type cable be used. For systems where more than one 723/DSLC pair are installed, the network may be wired directly from unit to unit, as shown in Figure 6-1, or each unit may be connected to the network via stubs as in Figure 6-2. The network must be terminated at both ends; each end is terminated by placing a jumper between terminals 24 & 25 (723), and/or 41 & 42 (DSLC). There is no polarity associated with the network wiring.

For optimum EMC performance, the network cable shield should be landed at each unit, and the exposed wire length limited to 25 mm. At each end, the outer insulation should be stripped and the bare shield tie-wrapped to the chassis.

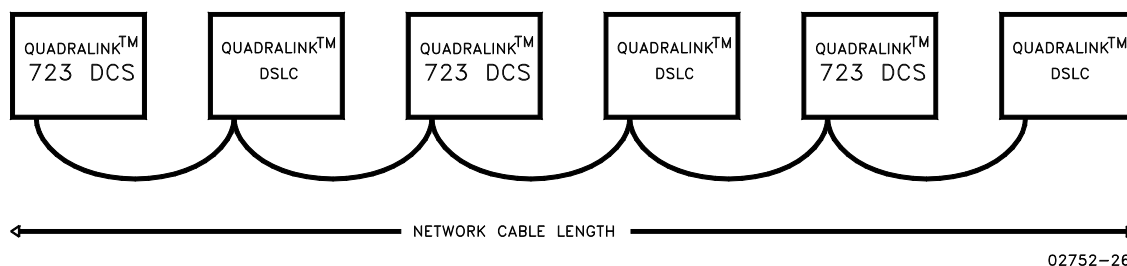


Figure 6-1. Direct Wired Network

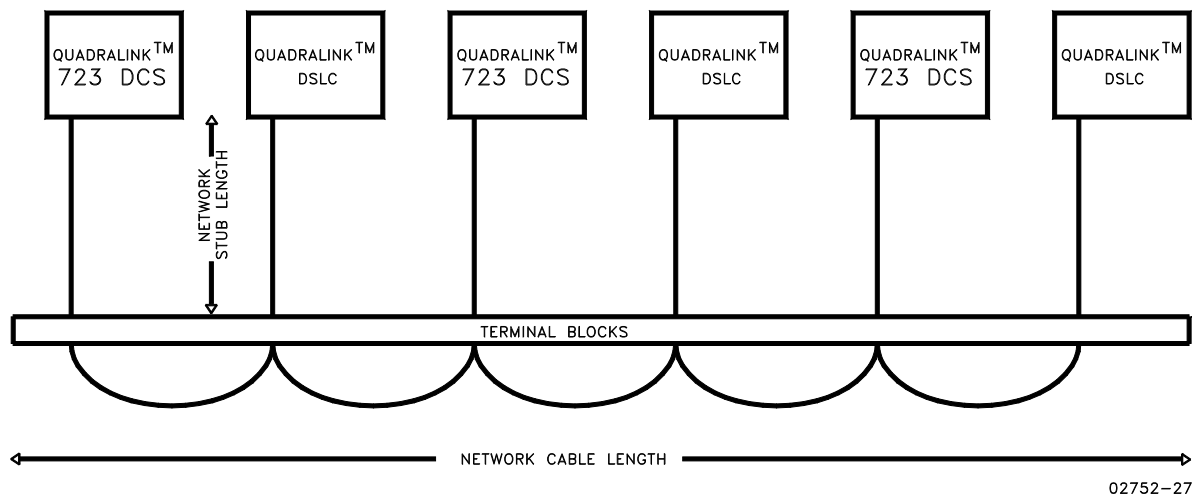


Figure 6-2. Network Wired Via Stubs

The cable used for the network will affect the overall system performance with respect to distance, stub length, and total number of nodes supported on a single channel. Echelon recommends the use of UL Level IV, 0.325 mm² (22 AWG) twisted pair cable for the network bus as defined in UL's LAN Cable Certification Program, UL document number 200-120 20 M/11/91.

Proper LonWorks network wiring is critical to assure that the network operates correctly. Figure 6-3 illustrates an example typical system. The system may include other LonWorks compatible devices, such as a DSLC, Digital Synchronizer & Load Control. The following requirements must be met:

1. Use only recommended shielded twisted pair cabling for the LonWorks network. Correct cable is available from Woodward, Belden, or other suppliers providing an equivalent cable.

Woodward part number **2008-349**

Belden
PO Box 1980
Richmond, IN 47375
(1) 317 983 5200

Belden part number

P/N	Description
9207	PVC 0.52 mm ² (20 AWG) shielded. NC Type CL2, CSA Cert. PCC FT 1.
89027	Teflon 0.52 mm ² (20 AWG) shielded, Plenum version. NEC Type CMP, CSA Cert. FT 4.
YR28867	PVC 0.325 mm ² (22 AWG) shielded.

2. Maximum cable length is dependent on temperature.
3. Stubs, or wiring drops, connecting intermediate devices to the main cable are limited to 300 mm in length.
4. Shields must be carried through all breakout boxes to provide a continuous shield throughout the network.

5. The network must be properly terminated at each end of the cable. Internal components are provided in the 723 DCS & DSLC, which provide proper network termination with the installation of a jumper on the controls at each end of the cable. Intermediate nodes should not have the termination jumper installed.

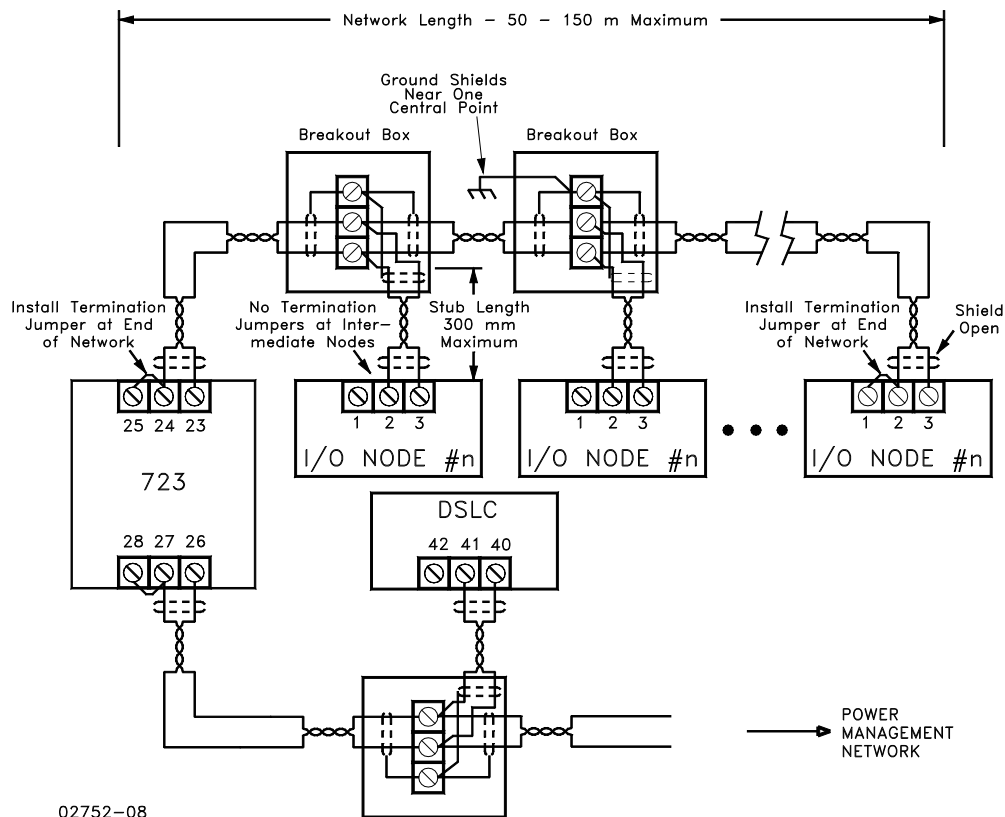


Figure 6-3. Typical LON Set-up

Chapter 7.

Modbus Communication

The 723 Digital Control utilizes AEG-Modicon Inc's MODBUS protocol. The Modbus protocol determines how the master and slaves establish and break off contact, how the sender and receiver are identified, how messages are exchanged in an orderly manner, and how errors are detected. The protocol also controls the query and response cycle which takes place between the master and slave devices.

The protocol provides for one master and up to 247 slaves on a common line. Each slave is assigned a fixed unique device address in the range of 1 to 247. Only the master can initiate a transaction. A transaction consists of a message from the master to one of the slaves and a response from that slave to the master.

The control supports two modes of transmission for Modbus. The mode defines the individual units of information within a message, and the numbering system used to transmit the data. Only one mode of transmission may be used per Modbus system; mixing of modes is not possible. The two transmission modes are ASCII (American Standard Code for Information Interchange) and RTU (Remote Terminal Unit). The modes are defined in Table 7-1. The 723 DCS uses either the ASCII or the RTU transmission mode.

	ASCII	RTU
CODING SYSTEM	HEXADECIMAL	8 BIT BINARY
BITS PER CHARACTER	7	8
PARITY	EVEN, ODD, NONE	EVEN, ODD, NONE
STOP BITS	1 OR 2	1 OR 2
DATA TRANSMITTED PER CHARACTER	4 BITS	8 BITS
ERROR CHECKING	LRC (LONGITUDINAL REDUNDANCY CHECK)	CRC (CYCLICAL REDUNDANCY CHECK)

Table 7-1. Modbus Transmission Modes

In RTU mode, the data is sent in 8-bit binary characters. In ASCII mode, each RTU character is first divided into two 4-bit parts (high order and low order) and then represented by their hexadecimal equivalent. The ASCII characters representing the hexadecimal characters are used to construct the message. ASCII mode uses twice as many characters as RTU mode. Additionally, in RTU mode, message characters must be transmitted in a continuous stream. In ASCII mode, breaks of up to 1 second can occur between characters.

There are two communication ports available in the 723. Both ports may be configured for RS-232, RS-422 or RS-485 communications. If the communication utilizes an RS-232 link, the distance between devices is limited to a maximum distance of 15 meters (50 feet). It should be noted that the J3 port can communicate using either ASCII or RTU mode, whereas the J2 port is only able to communicate using ASCII.

The 723 can be programmed as either a master or slave unit. When programmed as a slave unit, it responds only after being asked for a set of parameters. Typically the 723 will communicate as a slave with a Modbus Master device utilizing a separate link to each device. However, if multi dropping is used, one or two 723's can be connected to one Master device on a single link.

The data is passed between the Master and the 723 in the form of message frames (see Table 7-2). On any single multi drop link, each slave address must be unique.

BEGINNING OF FRAME	SLAVE ADDRESS	FUNCTION CODE	DATA	ERROR CHECK CODE	END OF FRAME
	2 CHARS 8 BITS	2 CHARS 8 BITS	4 BITS DATA PER CHAR	2 CHAR 8 BITS	CR LF
3-CHAR DEAD TIME	1 CHAR 8 BITS	1 CHAR 8 BITS	8 BITS DATA PER CHAR	2 CHAR 16 BITS	3 CHAR DEAD TIME

Table 7-2. Modbus Frame Definition

The function code portion of the message frame tells the addressed slave what function to perform. Table 7-3 and Figure 7-1 define and list the function codes supported by the 723.

Code	Description	Modbus Reference Address
1	Read digital outputs	0XXXX
2	Read digital inputs	1XXXX
3	Read analogue outputs	4XXXX
4	Read analogue inputs	3XXXX
5	Write single digital output	0XXXX
6	Write single analogue input	4XXXX
8	Loop back test - returns the query (Sub function 0 only)	
15	Write digital outputs	0XXXX
16	Write analogue outputs	4XXXX

Table 7-3. Modbus Function Codes

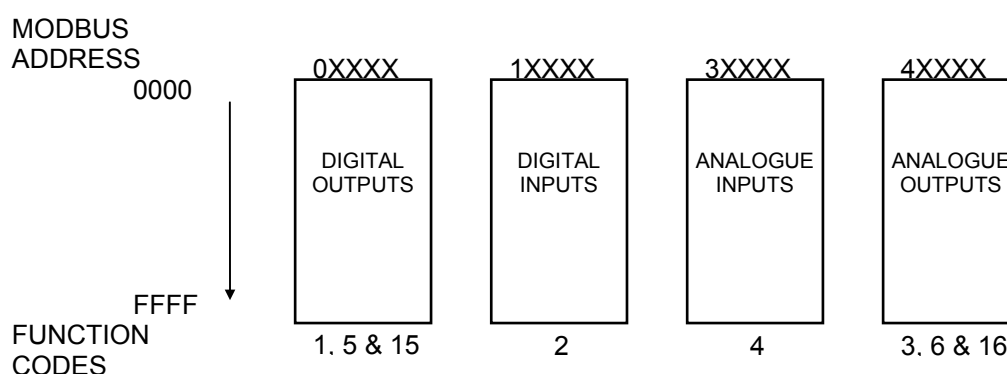


Figure 7-1. Modbus Function Codes

Table 7-6 shows typical Modbus frames for the various function codes. If a slave detects an error in a message, it will not act on or respond to that message. For any requested data that is undefined, the slave will respond with a value of zero. The slave will respond with an exception response if it detects illegal data in a message. Tables 7-4 and 7-5 list the exception errors displayed by the 723 control.

Code	Name	Meaning
1	Illegal Function	The message function is not an allowable action
2	Illegal Data Address	The message start address is not allowable address
9	Checksum Error	The received message had an incorrect error check code
10	Garbled Message	The received message could not be decoded

Table 7-4. Modbus Slave Exception Error Codes

Code	Name	Meaning
1	Illegal Function	This exception response received from a slave
2	Illegal Data Address	This exception response received from a slave
9	Checksum Error	The received message had an incorrect error check code
10	Garbled Message	The received message could not be decoded
20	Unsolicited Message	A message was received without being requested
21	Function Mismatch	Received message had a function code different from the command
22	Slave Address Mismatch	Received message had an address different from the command
23	No Response	The slave did not respond within 1.5 seconds

Table 7-5. Modbus Master Exception Error Codes

Function Code	Message Type						
1,2,3,4	Query	SLAVE ADDRESS	FUNCTION CODE	START ADDRESS	NUMBER OF POINTS	ERROR CHECK	
1,2,3,4	Response	SLAVE ADDRESS	FUNCTION CODE	BYTE COUNT	ANALOGUE OR DIGITAL DATA		ERROR CHECK
5,6	Query or Response	SLAVE ADDRESS	FUNCTION CODE	DATA ADDRESS	ANALOGUE OR DIGITAL VALUE		ERROR CHECK
15,16	Query	SLAVE ADDRESS	FUNCTION CODE	START ADDRESS	NUMBER OF POINTS	ANALOGUE OR DIGITAL DATA	ERROR CHECK
15,16	Response	SLAVE ADDRESS	FUNCTION CODE	START ADDRESS	NUMBER OF POINTS	ERROR CHECK	
ALL	Response	SLAVE ADDRESS	FUNCTION CODE	ERROR CODE	ERROR CHECK		

Table 7-6. Modbus Messages

The pertinent serial port communications parameters are adjustable. The following table defines these parameters, and their ranges.

Parameter	Typical Value	Adjustment Range
Baud Rate	9600	1200 to 38400
Parity	None	None, Odd, Even
Stop Bits	1	1, 1.5

Table 7-7. Communication Port Adjustments

The Modbus communication ports in the 723 are custom programmed for each application, and have unique Modbus addresses. The Modbus address listing consists of Boolean Writes, Boolean Reads, Analogue Reads, and Analogue Writes. The Boolean reads and writes are also referred to as input and holding coils. The analogue reads and writes are also referred to as input registers and holding registers.

All values that can be addressed by Modbus are considered to be discrete and numeric. The discretes are a 1 bit binary, on or off value and the numerics are 16 bit values. Registers are interpreted by the 723 as signed 16 bit integers. The maximum number of analogues in a single message is 59 for ASCII mode and 118 for RTU mode. The maximum number of digitals in a single message is 944 for ASCII mode and 1888 for RTU mode.

Boolean Writes (Holding Coils)

Holding coils are logical signals that are both readable from and writable to the 723. An example of a Boolean write value would be 'raise' or 'lower' commands. A logical true denoted by the value 1 will cause the command listed in the description to be executed. The 723 control supports function codes 1, 5 and 15. These correspond to reading selected holding coils, writing to a single holding coil, and writing to a multiple holding coils, respectively.

Boolean Reads (Input Coils)

Input Coils are logical signals that are readable from, but not writable to, the 723. An example of a Boolean read value would be an alarm indication. The '1:' term in the address identifies an input coil. The 723 supports Modbus function code 2, which involves reading selected input coils.

Analogue Reads (Input Registers)

Input registers are analogue values that are readable from, but not writable to, the 723. An example of an analogue read value would be engine speed. The value of the input registers are stored internal to the control as floating point numbers representing engineering units (i.e. rpm or Hz). The values that are transmitted are integer values ranging from -32767 to +32767. Since Modbus can only handle integers, values that have a decimal point should be multiplied by a constant before being sent by Modbus. The 723 supports Modbus function code 4, which involves reading selected input registers.

Analogue Writes (Holding Registers)

Holding registers are analogue values that are writable to, but not readable from, the 723. An example of an analogue write value would be a kW load reference. The value of the holding registers are also stored in the control as numbers representing engineering units. The 723 supports Modbus function codes 3, 6 and 16. These correspond to reading selected holding registers, writing to a single holding register, and writing to multiple holding registers, respectively.

Chapter 8.

Set Point Programming

Introduction

This chapter contains information on how to enter control set points, using either a Hand Held Programmer or a PC Interface, (whichever is provided for the application).

Hand Held Programmer and Menus

The Hand Held Programmer is a hand-held computer terminal that gets its power from the 723 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 control.

The programmer screen is a four-line, back lighted 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 19 characters.

The 723 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 only be entered if the I/O is shutdown, and hence the engine stopped.

Hand Held Programmer Keys

The programmer keys do the following functions (see Figure 8-1):

◀ (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)	Decreases set point values by one step at a time.
+ (plus)	Increases set point values by one step at a time.
■ (solid square)	Not used.
ID	Displays the 723 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.

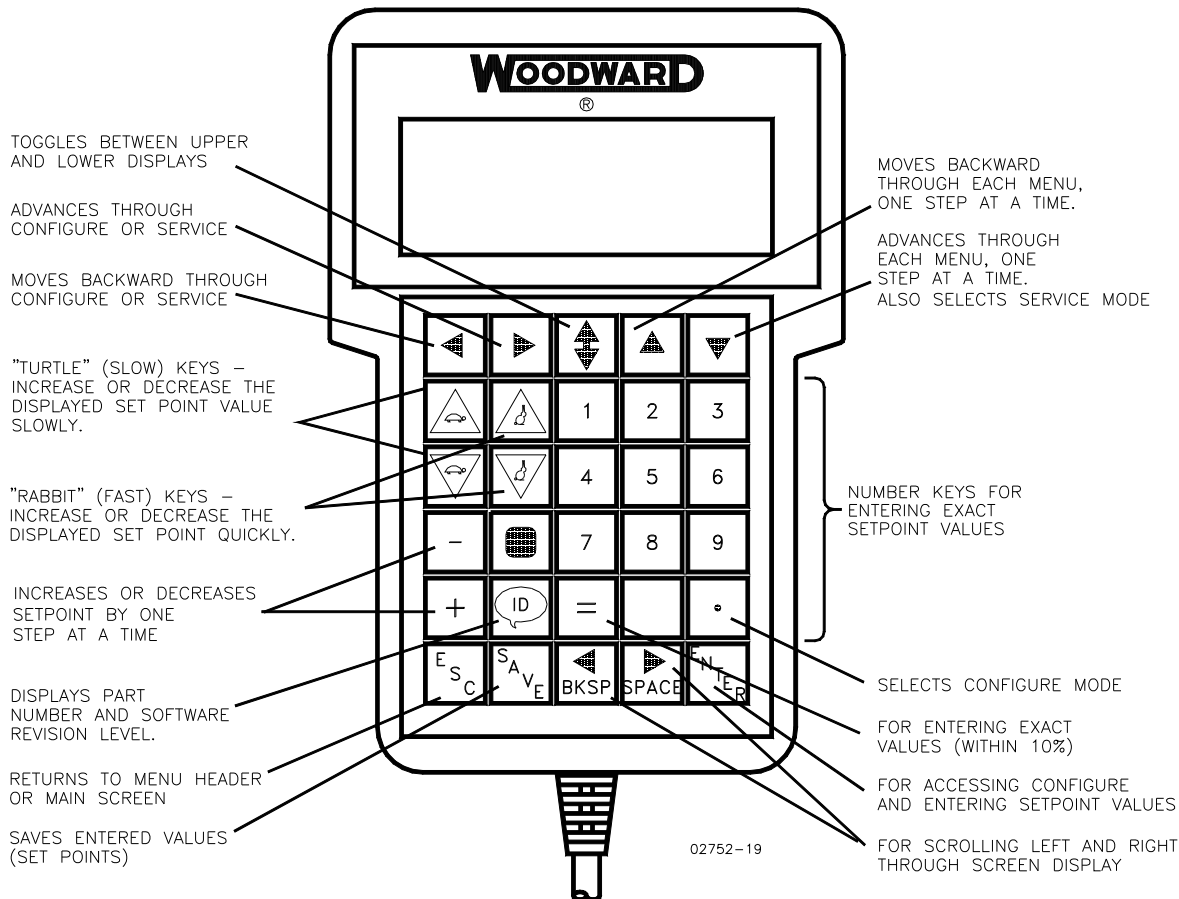


Figure 8-1. Hand Held Programmer Functions

Service Menus

To access the Service menus press the \square 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 Down" 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 set-up 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.

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

IMPORTANT

This may only be done if the figure is within 10% of the existing value, or for any adjustments made in Configure.

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.

NOTICE

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.

PC Interface

A PC Interface may be provided for tuning parameters, instead of the Hand Held Programmer. This will consist of the ServLink Server, which acts as the interface between the PC and the 723. The hardware communication link is configurable for RS-232 or RS-422 (RS-422 only if using the 723 J1 port), and the communications protocol is the Woodward developed ServLink.

The Woodward Watch Window can be used to interface with the ServLink Server, as a Means for displaying the Service & Configure tuneable/monitors, with the ability for tuning the parameters. Watch Window also offers the ability to upload the tuneable parameters from the control, into a file, and also to download the parameters stored in the file, into a control (of the same type/application).

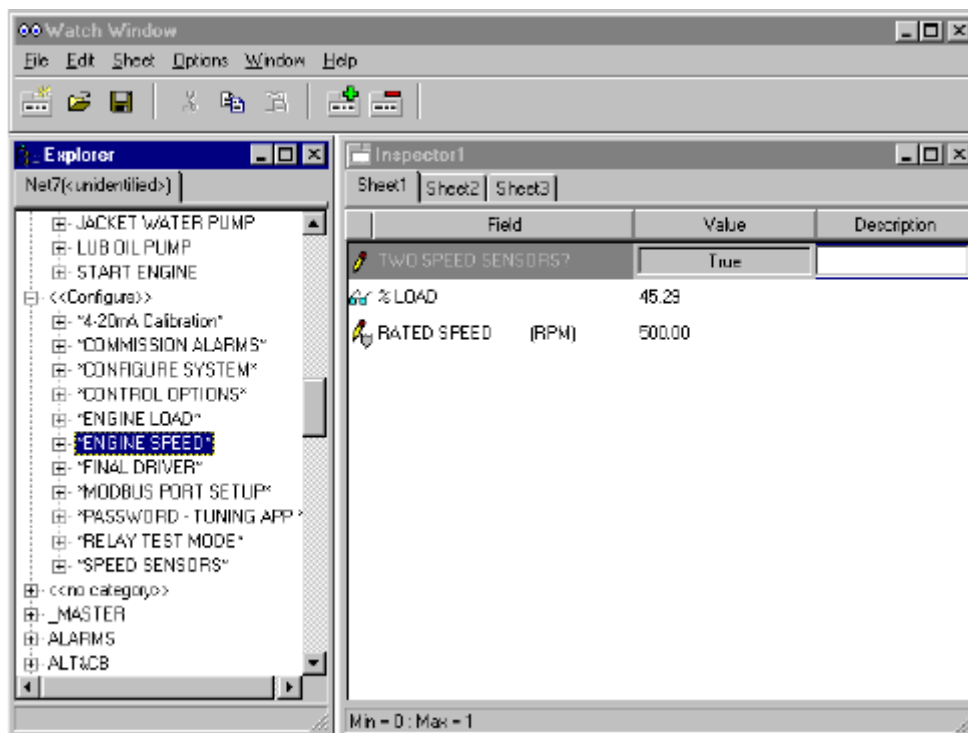
With each application manual, a list of each of the tuneable parameters will be provided along with a description of each. Also, a listing of each of the tuneable with the default values and the range of adjustment will be included.

The PC Interface should be installed on a PC running a Windows 32 bit operating system (e.g. Windows 95 or NT).

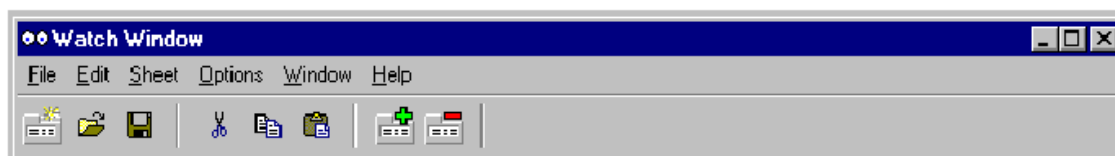
Watch Window

Watch Window is a tool for viewing and adjusting the parameters of the 723 Control. An application can be quickly and easily developed by the user, by assembling a number of tabbed sheets, onto which are 'dropped', the parameters that are required for monitoring/adjusting. Watch Window is made up of three types of window; Main Window, ServLink Explorer and ServLink Inspector.

Following is an example of Watch Window:



Main Window



The Main Window is the application controlling window, and provides the standard menus for opening/closing/saving files, Cut/Copy/Paste of parameters, and also for Adding /removing/rename tabbed sheets to the application.

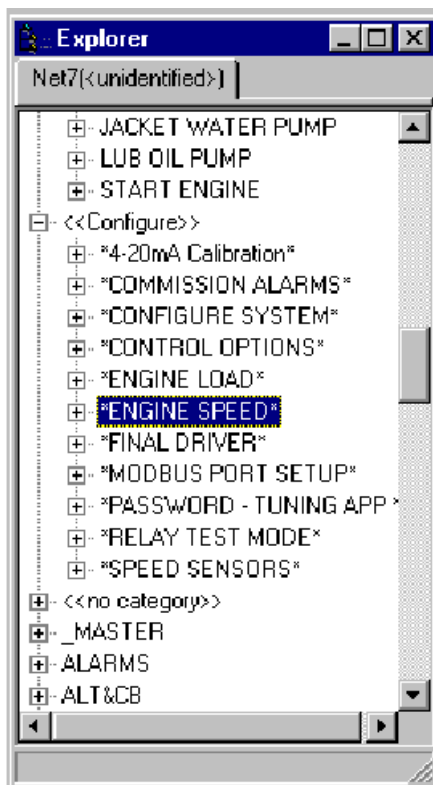
ServLink Explorer

The Explorer is used to browse the set of variables available through the ServLink Server.

The Explorer is composed of a set of tabbed sheets. Each sheet is associated with a single control from a ServLink network. The sheet's tab is labelled with the associated control's identifier.

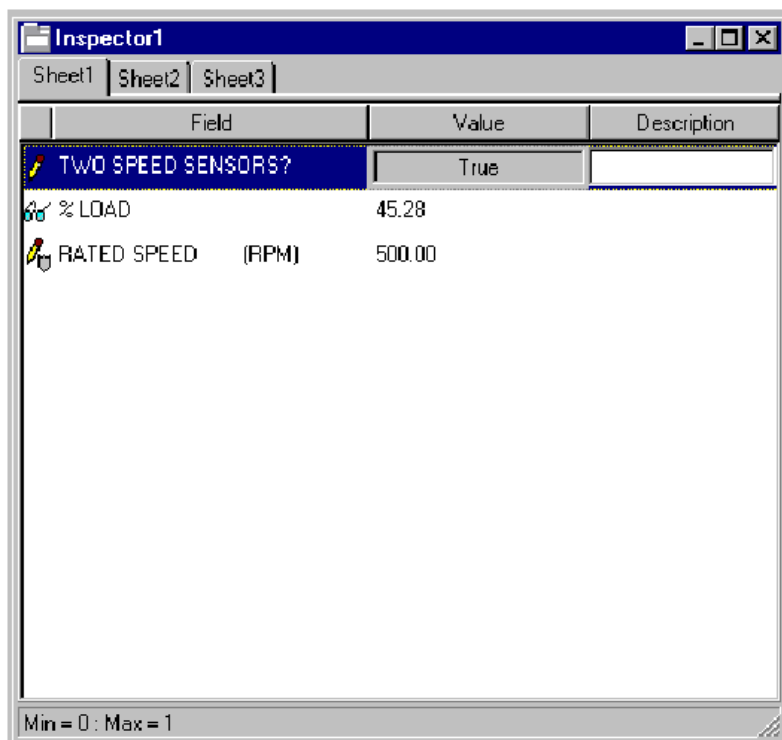
Each sheet contains a tree view. The tree view displays the names of the categories and blocks in a control's application program in a hierarchical structure. The names at each level in the tree are listed in alphabetical order. Watch Window, which is normally supplied, will display the Configure and Service menus only.

Selected variables can be used in Copy & Paste or Drag & Drop operations in order to add a variable to an Inspector. Variables can be selected using the mouse (left click) or keyboard (arrow keys). Selecting categories or blocks selects all of the fields underneath them.



ServLink Inspector

The Inspector is used to monitor and edit variables available through the ServLnk Server. The Inspector is composed of a set of tabbed sheets. Each sheet contains a grid (the grid shown in the following example is reduced - other fields headers are available to define which control a variable relates to, and if relevant, which category and block name. Each sheet's tab is labelled with a user-definable name. The user has the ability to add and remove sheets using menu items and/or tool bar buttons in the Main Window.



An icon to the left of the variable defines whether it is a monitor value, configure tuneable or service tuneable (or debug tuneable if relevant):

- Service Tuneable
- Monitor Value
- Configure Tuneable

One or more variables can be selected using the mouse (left click) or keyboard (arrow keys). If the user wishes to select multiple variables, they can do so by performing one of these sequences:

- Select a variable, hold down the shift key, and arrow up or down until all of the variables are selected.
- Click on a variable, hold down the shift key, and click on the last variable in the series that the user wishes to select.

Selected variables can be used in Cut, Copy & Paste or Drag & Drop operations in order to add a variable to an Inspector. If the selected variable is tuneable or configurable the status bar will display the minimum and maximum value for that variable. If multiple variables are selected, the minimum and maximum will not be displayed for any of the selected variables.

The Inspector can have its configuration saved and restored. The Inspector can be closed by using the Main Window or by clicking the standard windows close button.

Chapter 9.

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) 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.

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.

Contacting Woodward's Support Organization

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory published at www.woodward.com/directory.

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.

Products Used In Electrical Power Systems		Products Used In Engine Systems		Products Used In Industrial Turbomachinery Systems	
<u>Facility</u>	<u>Phone Number</u>	<u>Facility</u>	<u>Phone Number</u>	<u>Facility</u>	<u>Phone Number</u>
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				

For the most current product support and contact information, please visit our website directory at www.woodward.com/directory.

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.) _____

Control/Governor Information

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 _____

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.

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication **37807.**



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1000 East Drake Road, Fort Collins CO 80525, USA
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Email and Website—www.woodward.com

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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.