WOODWARD

Product Manual 26608
(Revision B, 7/2013)
Original Instructions

733 Load Sharing Control
Cat ADEM

8280-2076
Pon Power Mechanical Load Sharing Damen Shipyard

Woodward manuals 26343 and 26640 are also required.

Application Manual

General Precautions

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

Practice all plant and safety instructions and precautions.

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

Revisions

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

www.woodward.com/publications

The latest version of most publications is available on the *publications page*. If your publication is not there, please contact your customer service representative to get the latest copy.

Proper Use

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

Translated Publications

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

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 Out-of-date translations are marked with ⚠.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

Contents

Illustrations and Tables

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

The Woodward part numbers for the 733 Load Sharing Control are:

- **System:** **8280-2076**
- Hardware: 733: 8237-1177
- Hardware: LINKnet-HT DIN (16 CH) 8200-1204
- Hardware: LINKnet-HT DOUT (16 CH) 8200-1205
- Application Software: 733: 5601-2088

The following drawings belong to the system:

- Functional block diagram: 9989-4123
- Control wiring diagram: 9971-1595

The Woodward 733 Load Sharing Control/Cat ADEM has the following functionality:

- Speed synchronization
- Load sharing control

Features:

- Configurable I/O ranges and assignment to I/O channels
- Use one or individual Speed-Reference inputs.
- Extensive Service and ToolKit Configure Menus for tuning via Woodward ToolKit (733 serial port #1 RS-232)
- Test/Override functionality for I/O signals
- Modbus® * communication available with extensive list of signals (733 serial port #2 RS-485)

*—Modbus is a trademark of Schneider Automation Inc.

Associated Publications

The following publications contain additional product or installation information on Load Sharing and Speed Controls, and related components. These can be ordered from any Woodward office. Manuals can be downloaded from: **www.woodward.com/searchpublications.aspx**.

Manual 26343, *733 and 766 Digital Controls*
Manual 26640, *RTCnet/LINKnet HT Nodes*
Manual 25070, *Electronic Governor Installation Guide*
Manual 26260, *Governing Fundamentals and Power Management*
Manual 82715, *Guide for Handling and Protection of Electronic Controls, Printed Circuit Boards, and Modules*
Application Note 83402, *PID Control*

General Safety Precautions

Obey the following safety precautions when you install the unit:

- Obey all cautions or warnings given in the procedures.
- Never bypass or override machine safety devices.

Chapter 2.
Inputs and Outputs

Speed Sensor Inputs

The following analog input signals have been defined for this control:
- Engine A Speed-Sensor Input #1
- Engine B Speed-Sensor Input #2

These speed sensor inputs can be either passive (MPU) or active (PROXIMITY).

Using the CONFIGURATION menu, the number of teeth for these inputs can be adjusted.

Analog Inputs

The following analog input signals have been defined for this control:
- Engine A Speed-Reference Input
- Engine A Load Input
- Engine B Speed-Reference Input
- Engine B Load Input

Using the CONFIGURATION menu, these inputs can be enabled and assigned to any of the 4 analog inputs available on the 733.

Engine A/B Speed-Reference Input

This input is the nominal Speed-Reference for engine A/B. The Speed Reference Input for both engines can be assigned to the same analog input channel.

Engine A/B Load Input

This input is the load input for engine A/B. This could be based on a real kW measurement, torque measurement, or fuel rack position.

NOTICE **The Load Inputs can also be obtained through the J1939 CAN bus interfaces.**

Analog Outputs

The following analog signals can be output on this control:
- Fixed Value
- Reference To Engine A
- Reference To Engine B
- Total Load
- Analog Input 1
- Analog Input 2
- Analog Input 3
- Analog Input 4
- PID Output
- Speed A = Speed B
- Digital Output 5
- Digital Output 6

Using the CONFIGURATION menu, these signals can be assigned to any of the 4 analog outputs available on the 733.

Fixed Value
Sets the output to fixed value.

Reference To Engine A/B
This outputs engine A/B Speed-Reference, biased from synchronization or load control.

Total Load
This outputs the total load of engine A and B

Analog Input 1 ~ 4
Any of these analog input signals can be output and assigned to any of the analog output signals.

PID Output
This outputs the load sharing control PID value.

Speed A = Speed B
This outputs the digital condition when speed A is equal to speed B.

Digital Output 5
This outputs the digital condition of digital output #5.

Digital Output 6
This outputs the digital condition of digital output #6

Discrete Inputs

The following discrete input signals have been defined for this control:

- Engine A Clutch
- Engine A Raise
- Engine A Lower
- Engine A Unload
- Engine A Stop
- Reset
- Prepare rpm Request
- Engine B Clutch
- Engine B Raise
- Engine B Lower
- Engine B Unload
- Engine B Stop

Using the CONFIGURATION menu, these inputs can be enabled and assigned to any of the 8 discrete inputs available on the 733.

Engine A/B Clutch
When this input contact is closed, the control assumes engine A/B is connected to the common gearbox.

Engine A/B Raise
When this input contact is closed, the control increases engine A/B speed-reference output, when not in load sharing mode. You can assign the Raise command for both engines to the same contact input.

Engine A/B Lower
When this input contact is closed, the control decreases engine A/B speed-reference output, when not in load sharing mode. You can assign the Lower command for both engines to the same contact input.

Engine A/B Unload
When this input contact is closed, the control tries to unload engine A/B, when in load sharing mode.

Engine A/B Stop
When this input contact is closed, the control outputs the minimal Speed-Reference (0%, 4 mA) for engine A/B. You can assign the Stop commands for both engines to the same contact input.

Reset
The reset can be used to reset Minor and Major Alarms. The reset is the same as the “Software Reset” using the ToolKit Service Menus.

Prepare rpm Request
When this input contact is closed, the control will synchronize the speed of the second engine to the speed of the already clutched-in engine. When both engine speeds are equal, the control will give clutch-in permissive for the second engine.

Fixed Discrete Inputs

The following discrete input signals are not configurable and have a dedicated input on the LinkNet-HT DIN Node:

- Engine A FIFI Clutch (DI #1)
- Engine A Separate RPM (DI #3)
- Engine B FIFI Clutch (DI #2)
- Engine B Separate RPM (DI #4)

Engine A/B FIFI Clutch
When this input contact is closed, the control assumes engine A/B is connected to the FIFI (Fire Fighting Pump).

Engine A/B Separate RPM
When this input contact is closed, the control assumes engine A/B is in Separate RPM mode and will follow the speed-reference set by the potentiometer on the Separate RPM panel of the propulsion system.

Relay Driver Outputs

The following discrete signals can be output on this control:

- Fixed Value
- Minor Alarm
- Major Alarm
- Minor/Major Alarm
- Test Mode Active
- Analog Input Fault Channel #1
- Analog Input Fault Channel #2
- Analog Input Fault Channel #3
- Analog Input Fault Channel #4
- Clutch A in
- Clutch B in
- Unloaded A
- Unloaded B
- Load Sharing Active
- Speed A = Speed B
- Clutch A Permissive
- Clutch B Permissive

Using the CONFIGURATION menu, these signals can be assigned to any of the 4 discrete outputs on the 733.

Fixed Value
Sets a fixed output (energized or de-energized) for the respective output.

Minor Alarm
This signal indicates a Minor Alarm is active. A Reset command might reset this, unless the cause of this Minor Alarm persists.

Major Alarm
This signal indicates a Major Alarm is active. A Reset command might reset this, unless the cause of this Major Alarm persists.

Minor/Major Alarm
This signal indicates a Minor or Major Alarm active. A Reset command might reset this,

Test Mode Active
This signal indicates that any of the input or output signals has been forced manually to a test value using the ToolKit Service Menu.

Analog Input Fault Channel #1~4
These signals indicate an out of range failure (wire break) for analog input #1~4.

Clutch A/B in
This signal indicates the engine A/B Clutch status.

Unloaded A
The signal indicates the unload A/B contact is active and the engine's has reached its Unload Load setpoint.

Load Sharing Active
The signal indicates the load sharing control PID is active.

Speed A = Speed B
This signal indicates the absolute difference between Speed A and B is less than a tunable threshold [rpm], and stays less for a tunable delay time. The threshold and delay times can be set in the ToolKit Service Menus.

Clutch A/B Permissive
This signal indicates the permissive to clutch in engine A/B.

Conditions clutch-in permissive first engine:
- Engine speed between 800 and 820 rpm.
- Clutch engine A and clutch engine B open.

Condition clutch-in permissive second engine:
- Engine speed A is equal to engine speed B
- Clutch first engine closed and clutch second engine open.

Fixed Relay Driver Outputs

The following discrete output signals are not configurable and have a dedicated output on the LinkNet-HT DOUT Node:
- Idle Alarm Engine A (DOUT #1)
- Stop Engine A (DOUT #3)
- Lamp Clutch Enable Engine A (DOUT #5)
- Lamp Ready to Start Engine A (DOUT #7)
- Clutch Permissive Engine A (DOUT #9)
- Idle Alarm Engine B (DOUT #2)
- Stop Engine B (DOUT #4)
- Lamp Clutch Enable Engine B (DOUT #6)
- Lamp Ready to Start Engine B (DOUT #8)
- Clutch Permissive Engine B (DOUT #10)

Idle Alarm Engine A/B
This signal indicates that the engine is running to long at Idle and when other engine is also running it will be stopped after 5 minutes. Output is normally energized and will de-energize when alarm is active.

Stop Engine A/B
This signal indicates a stop command to the engine.

Lamp Clutch Enable Engine A/B
This signal indicates when the input for the “Clutch Enable lamp” on the propulsion system is activated. This output will be de-energized when engine speed is outside the speed window of 795 to 820 rpm and both engine clutches are open.

Lamp Ready to Start Engine A/B
This signal indicates when the input for the “Ready to Start” lamp on the propulsion system is activated. This output will be energized when engine speed drops below 650 rpm and this output will be de-energized when the engine speed is above 790 rpm.

Clutch Permissive Engine A/B
This signal indicates the permissive to clutch in engine A/B.

Conditions clutch in permissive first engine:
- Engine speed between 800 and 820 rpm.
- Clutch engine A and clutch engine B open.

Condition clutch in permissive second engine:
- Engine speed A is equal to engine speed B
- Clutch first engine closed and clutch second engine open.

Chapter 3.
Description of Operation

Introduction

This chapter provides an overview of the features and operation of the 733 Load Sharing Control/Cat ADEM.

The control defines 4 operation modes:

- Stopped / Bypassed
- Speed-Reference Forward Mode
- Synchronization Mode
- Load Sharing Mode

Stopped / Bypassed

When the Engine A/B Stop command is used, closing of the respective contact forces the control to output minimum (0%, 4 mA) for Engine A/B Speed-Reference Output.

The Engine A/B Stop command will ignore any biases from either synchronization or load sharing control.

Speed-Reference Forward Mode

When both engine clutches are open, the control defaults to output each engine's speed-reference input directly to each engine's speed-reference output.

A CONFIGURE option is available to have just one common speed-reference for both engines. Engine B Speed-Reference will then follow the Engine A Speed-Reference input signal.

Engine A/B Raise and Lower commands are ignored. Engine A/B Load signals are ignored.

Synchronization Mode

When just one engine is clutched in, that is connected to the gearbox, the respective Raise and Lower contacts can be used to synchronize the speed of the other engine which is not clutched in.

The synchronization bias will be added to the nominal speed reference of the clutched out engine. This synchronization bias is volatile; once both engines are either clutched in or clutched out, the bias will be reset to 0.

When just one engine is clutched in, that is connected to the gearbox, the 'Prepare rpm request' input can be used to synchronize the speed of the other engine which is not clutched in. Speed demand of the second engine will be ramped up to the speed demand of the already clutched-in engine. When both engines are clutched in, the control will give both engines a speed demand based on the average of both separate speed demand inputs signals.

When both speed signals from engine A and B are within a certain adjustable window, a Synchronize OK Check relay can be energized, which can be used as a clutch-in permissive.

Load Sharing Mode

When both engines are clutched in, that is, mechanically coupled to the gearbox, the control will try to load share between the two engines.

A PID controller generates speed biases for engine A and engine B such that each engine will load-share according the required ratio which is defined normally as 50% of the total load.

Unequal load sharing is possible by adjusting the LOAD RATIO setting in the ToolKit Service Menu.

In steady state, the PID will have an output of 50%, equaling 0 rpm bias for each engine. An adjustable PID BIAS RANGE defines the absolute bias when the Load Sharing PID is at either 0% or 100%.

The Load Sharing bias for engine A and B are complementary; when engine A gets a positive bias, engine B gets the same bias negatively.

IMPORTANT **Changing the PID BIAS RANGE might require readjustment of the dynamic settings of the Load Sharing PID.**

When the second engine clutches in, the control will soft-load this second engine with an adjustable rate to the required load (normally 50% of both engines total load). When the soft-loading has finished, normal load sharing is operational.

When an unload contact is received for either engine, the load set point for that engine is set to its UNLOAD SETPOINT. The control will unload the engine with an adjustable rate; the other engine will take the remaining load.

Load sharing mode will not be possible and be disabled in the following cases:

- Engine A or B Speed-Reference Input fault
- Engine A or B Load Input fault
- Engine A or B Stop command
- Engine A or B Clutch is open

To prevent gear wheel “hammering” at low loads, when both engines are clutch in, only one engine will take the load, and the other engine will stay at near zero load.

When the total load exceeds an adjustable level, the 2nd engine will start to soft-load and both engines will share the load.

When the total load decreases below another adjustable level, one of the engines shall be unloaded.

There is an option to alternate between engines (equal usage of engines) or always unload the engine that was clutched in last.

Chapter 4.
ToolKit Configure and Service Menus

ToolKit Introduction

This chapter describes the parameters that can be configured, tuned and monitored.

Throughout, the Woodward user interface program ToolKit is used to configure and operate the 733 Mechanical Load Sharing System.

ToolKit can be downloaded from the **www.woodward.com** website. ToolKit has certain software requirements like Windows XP and higher, DOT NET 3.5 and higher etc. Please consult the Woodward download page for detailed instructions.

In order to run the user interface, ToolKit needs to open a .WTOOL file and a corresponding .SID file.

When the .WTOOL file is opened, one can connect to the 733 control on its serial port (RS-232) using a null-modem serial cable.

TX	**←-→**	**RX**
RX	**←-→**	**TX**
GND	**←-→**	**GND**

The communication for the serial port should be left at automatic.
A dedicated serial null-modem cable 5416-614 can be ordered at Woodward.

⚠WARNING **Disconnect/disable Wifi, Bluetooth etc. prior to connecting to ToolKit; Improperly implemented drivers of these devices may cause problems.**

ToolKit will check the software version inside the 733 control with the .SID file which comes with the .WTOOL user interface tool. If these do not match, there is a mismatch between the 733 software version and the ToolKit tool.

For further details, please refer to the embedded Help included with the ToolKit program.

ToolKit Login / User Levels

There are three user login levels defined in the ToolKit tool:

- **Level 1** **Password = 1**
  Monitoring level, freely accessible
- **Level 8** **Password = 1112**
  Configure level, shall be limited to trained personnel.
- **Level 15** **Password = Consult Woodward**
  Highest access level, limited to Woodward personnel.

Level 1 can be used by end-users to monitor parameters. It does not allow changing the configuration.
Level 8 allows changing almost all configuration parameters.
Level 15 is the highest access level. It allows changing any configuration parameter.

ToolKit Configure Pages

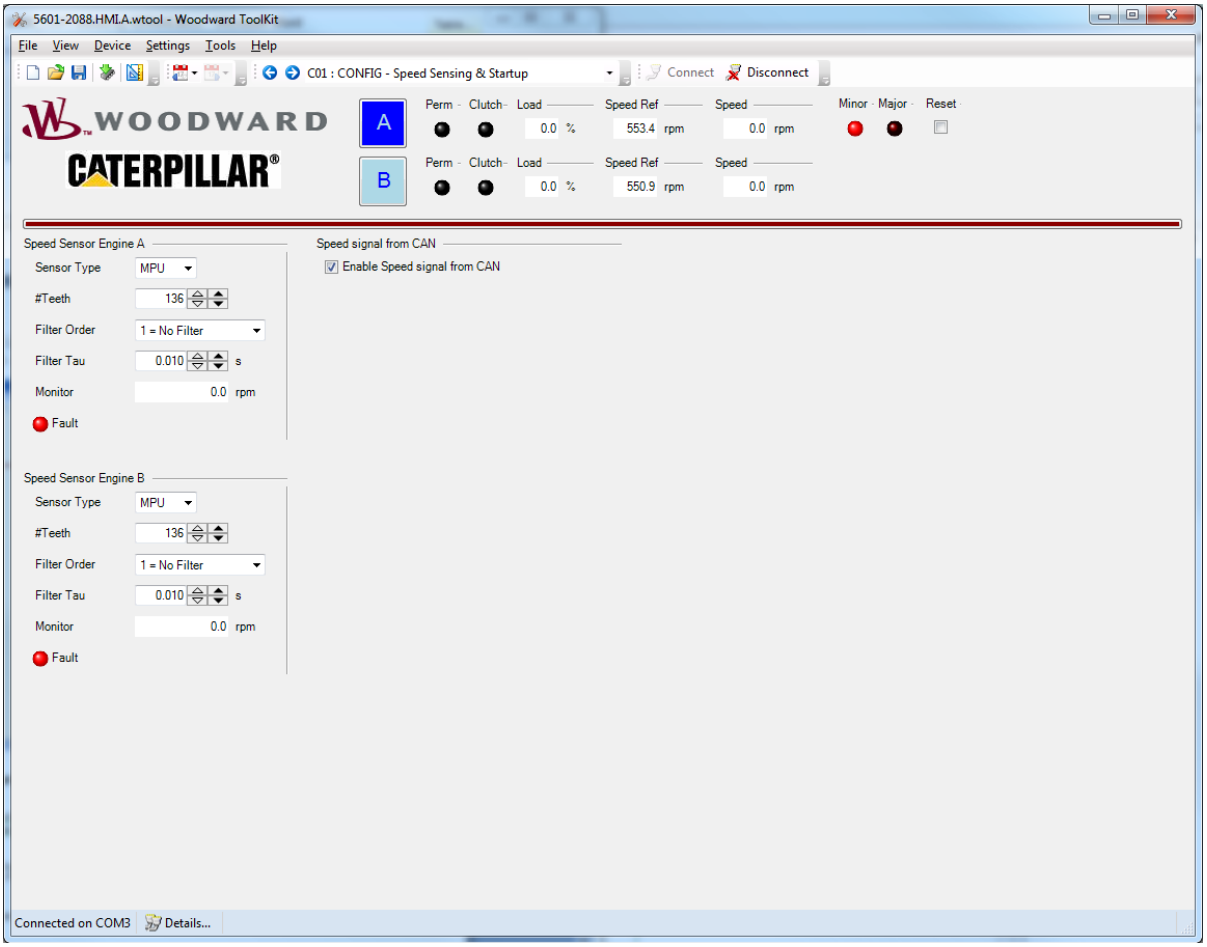
IMPORTANT

Engines must be stopped prior to making changes on the ToolKit Configure pages.

The following ToolKit Configure Pages are available:

- **C01 : CONFIG - Speed Sensing & Start-up**
- **C02 : CONFIG – Discrete Inputs**
- **C03 : CONFIG – Discrete Outputs**
- **C04 : CONFIG – Analog Inputs**
- **C05 : CONFIG – Analog Outputs**
- **C06 : CONFIG – Actuator Outputs**
- **C07 : CONFIG – Alarms**
- **C08 : CONFIG – Serial, Modbus & CAN**

C01 : CONFIG - Speed Sensing & Start-up



Sensor Type
Select between **MPU** or **PROX** for speed sensor engine A/B.

#Teeth
Sets the number of teeth for the gear-wheel for the engine A/B speed sensor, adjustable between 4 and 500 teeth.

Filter Order
Select the type of low-pass filtering for a speed sensor.
1 = No Filter, 2 = 1st Order Filter, 3 = 2nd Order Filter.

Filter Tau
Select the low-pass filter time constant, adjustable between 0 and 10 s.

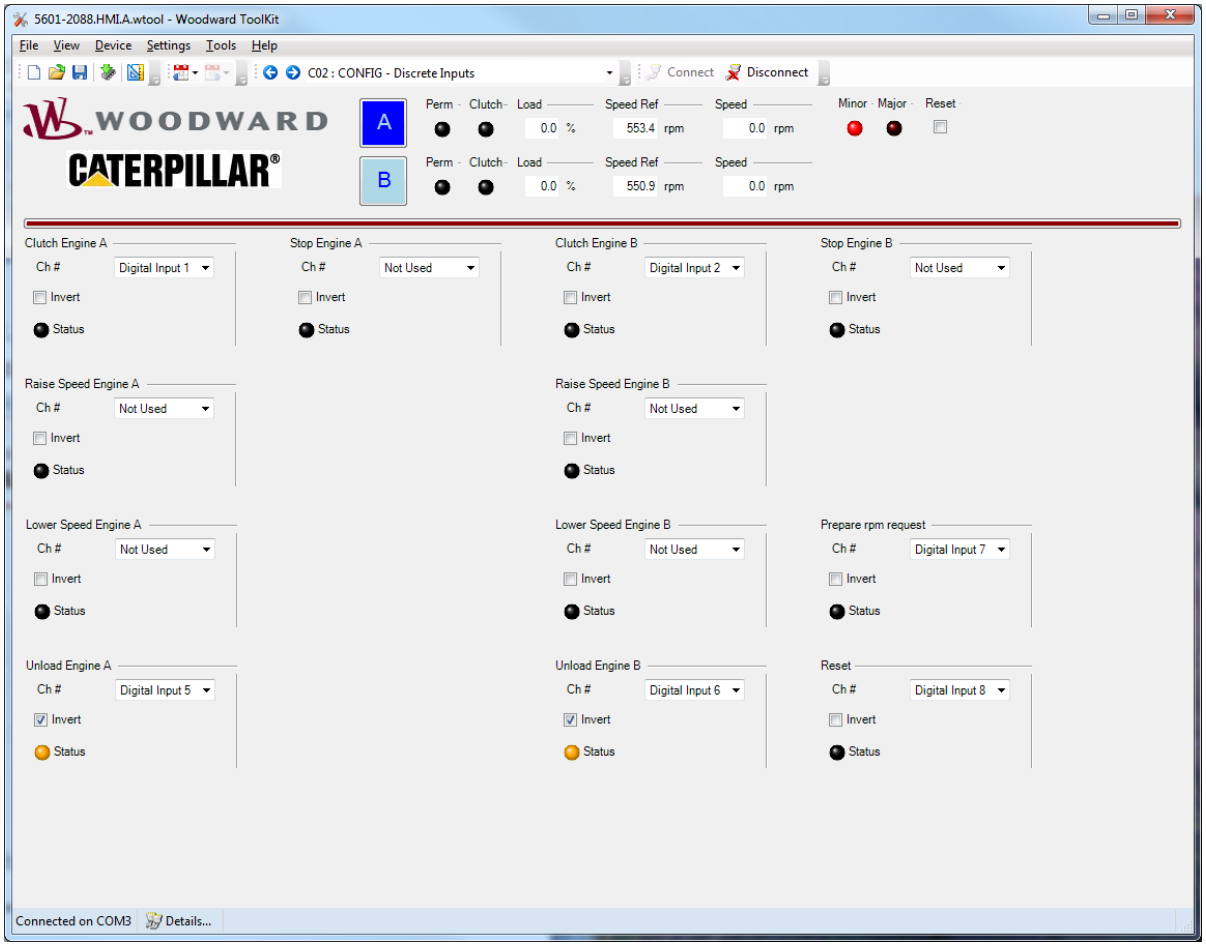
Monitor
Monitor the current speed for each engine [rpm].

Fault
Monitor a speed sensor fault.

Enable Speed Signal from CAN
Mark check box if speed signal for engine A and B is coming via CAN communication bus.

IMPORTANT **Most of these settings require a reboot of the control for them to take effect. SAVE tunables prior to rebooting the control!**

C02 : CONFIG – Discrete Inputs

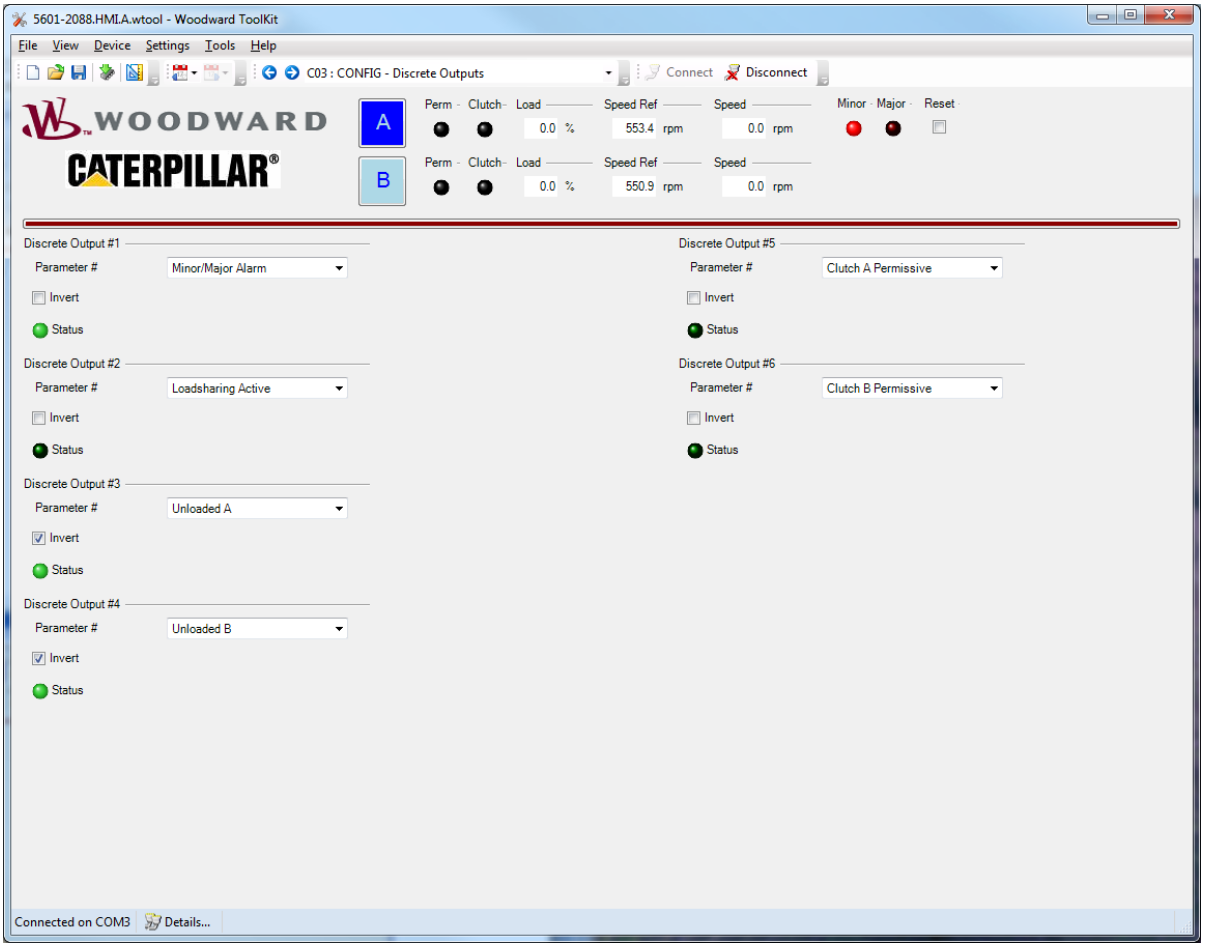


Ch#
Select between **Not Used, Digital Input 1 .. 8** for each of the defined functions.

Invert
Check **Invert** to change the operation from Normally Open, Close for Action into Normally Closed, Open for Action for a digital input.

Status
LED is lit for an active function.

C03 : CONFIG – Discrete Outputs



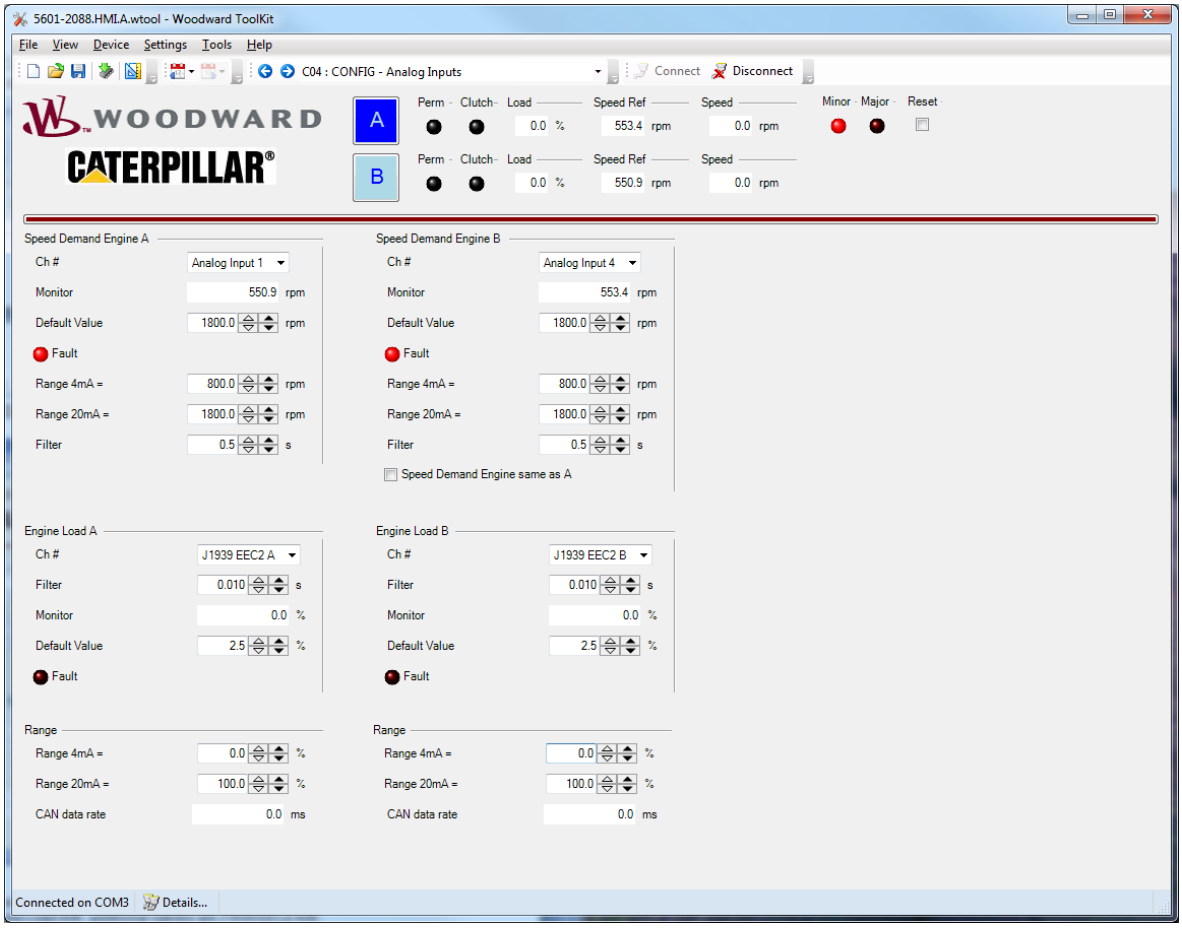
Parameter #
For each Discrete Output, select from following list:

- Fixed Value
- Minor Alarm
- Major Alarm
- Minor/Major Alarm
- Test Mode Active
- Analog Input Fault Channel #1
- Analog Input Fault Channel #2
- Analog Input Fault Channel #3
- Analog Input Fault Channel #4
- Clutch A in
- Clutch B in
- Unloaded A
- Unloaded B
- Load Sharing Active
- Speed A = Speed B
- Clutch A Permissive
- Clutch B Permissive

Invert
Check **Invert** to change the operation from Normally De-energized into Normally Energized.

Status
LED is lit when the selected parameter is active.

C04 : CONFIG – Analog Inputs



Ch#
Select between Fixed Value, Analog Input 1 .. 4 for a function.
For Engine Load A/B, additional options are J1939 EEC2 A/B.

Monitor
Monitor the Speed Demand or Engine Load.

Fault
LED will be lit when a 4–20 mA input is out of range or the J1939 CAN fails.

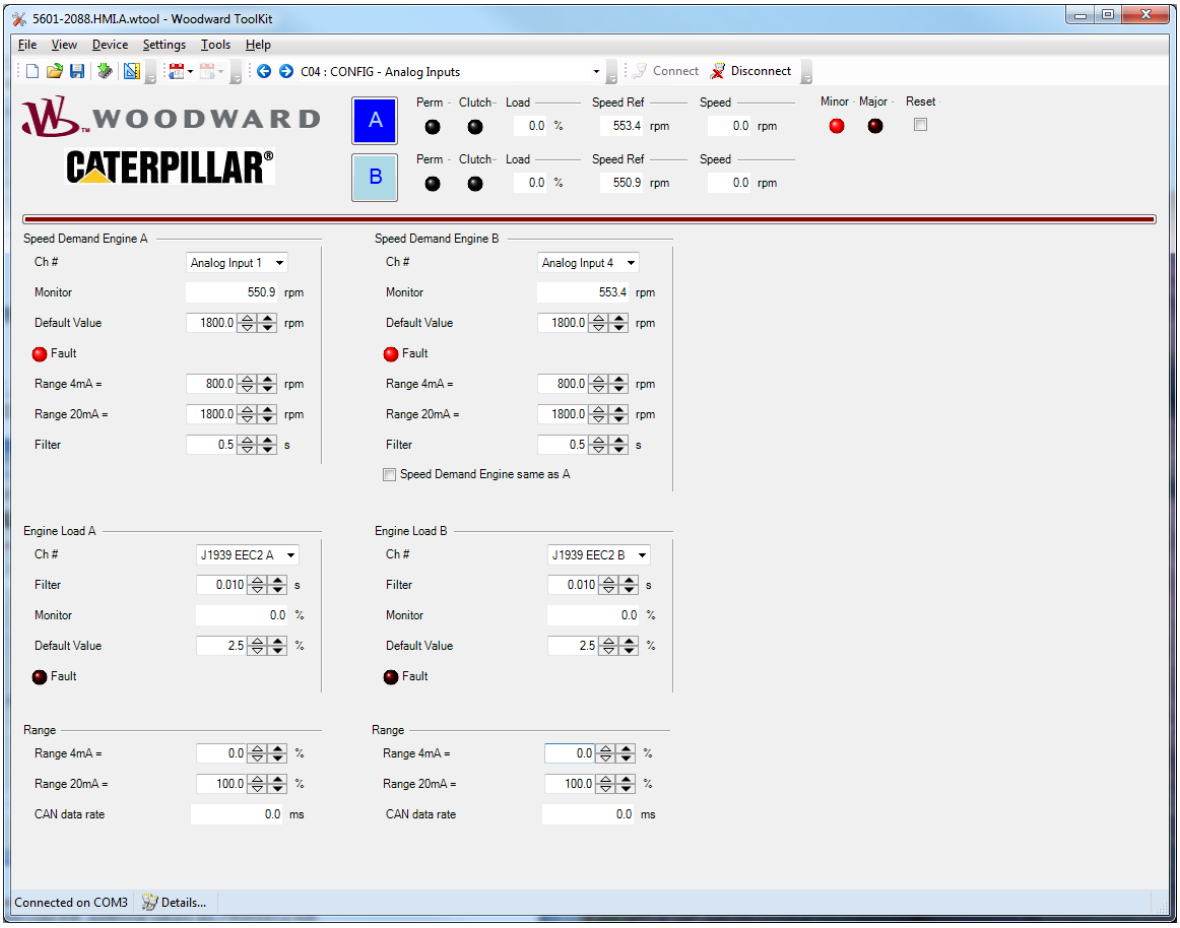
Range 4–20 mA =
Set the Speed Demand or Engine Load 4–20 mA value in engineering units.

Default Value
Default/backup value for Speed Demand or Engine Load when the input fails.

Speed Demand Engine same as A
Check to use a single speed demand input for both engine A and B.

CAN Data Rate
Shows the cyclic update time for J1939 message EEC2 A/B.
J1939 specification lists 50 ms for J1939 message EEC2

C05 : CONFIG – Analog Outputs



Parameter #
For each Analog Output, select from following list:

- Fixed Value
- Reference To Engine A
- Reference To Engine B
- Total Load
- Analog Input 1
- Analog Input 2
- Analog Input 3
- Analog Input 4
- PID Output
- Speed A = Speed B
- Digital Output 5
- Digital Output 6

Monitor AO
Displays the selected output value as a percentage of the 4–20 mA output range.

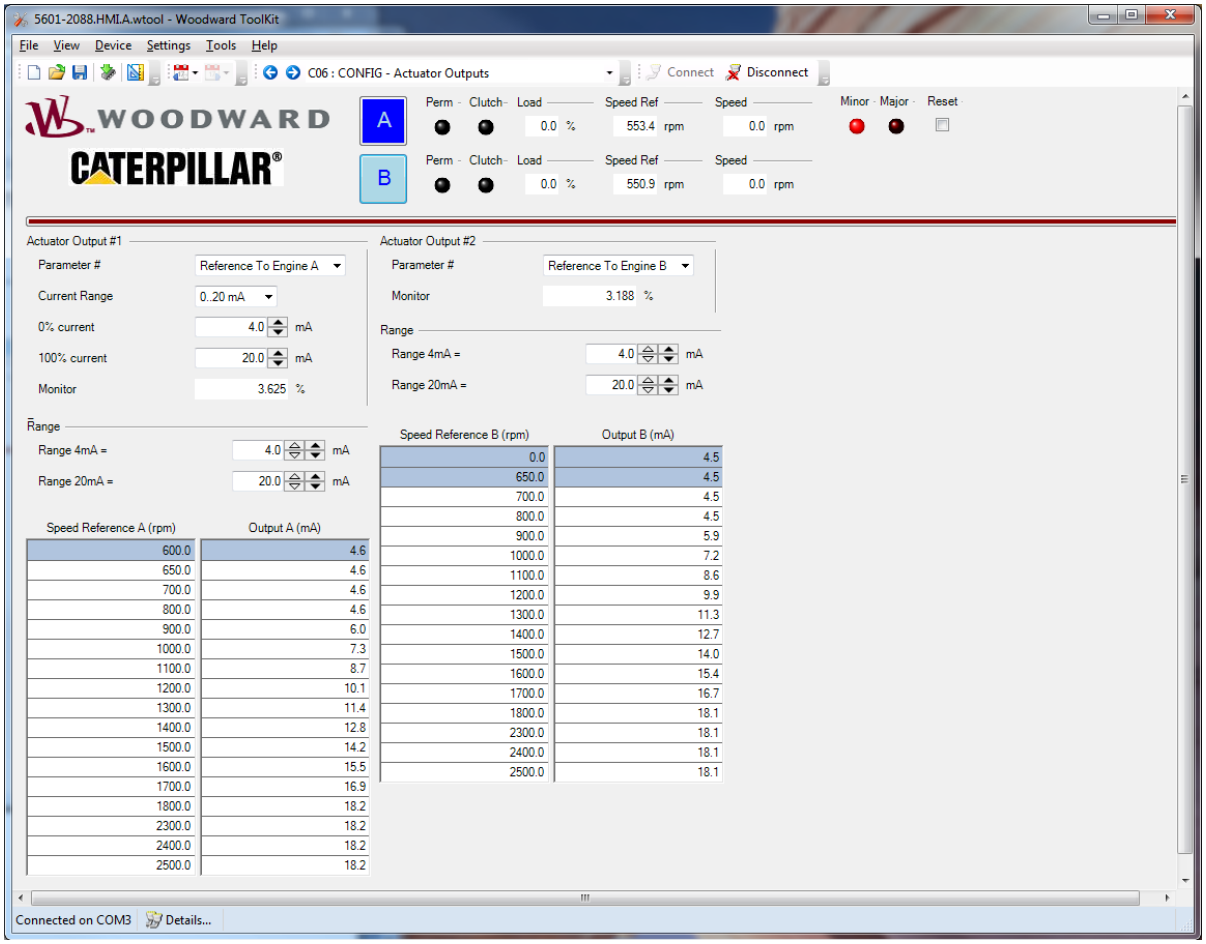
Range 4–20 mA =
Set the engineering units for the selected analog output.

With Fixed Value, the output signal can be set in percentage of the 4–20 mA output.

With Reference To Engine A/B, the output signal can be set according to a curve based on the speed reference.

With Digital Output 5/6, the output signal can be set to the correct mA to drive the external relay.

C06 : CONFIG – Actuator Outputs



Parameter #
For each Analog Output, select from following list:

- Fixed Value
- Reference To Engine A
- Reference To Engine B
- Total Load
- Analog Input 1
- Analog Input 2
- Analog Input 3
- Analog Input 4
- PID Output
- Speed A = Speed B
- Digital Output 5
- Digital Output 6

Monitor AO
Displays the selected output value as a percentage of the 4–20 mA output range.

Range 4–20 mA =
Sets the engineering units for the selected analog output.

Actuator Output #1 can be selected to have a range of **0–20 mA** or as **0–200 mA**.

Range 0% current
Sets engineering units for the analog output, corresponding to **0% current**.

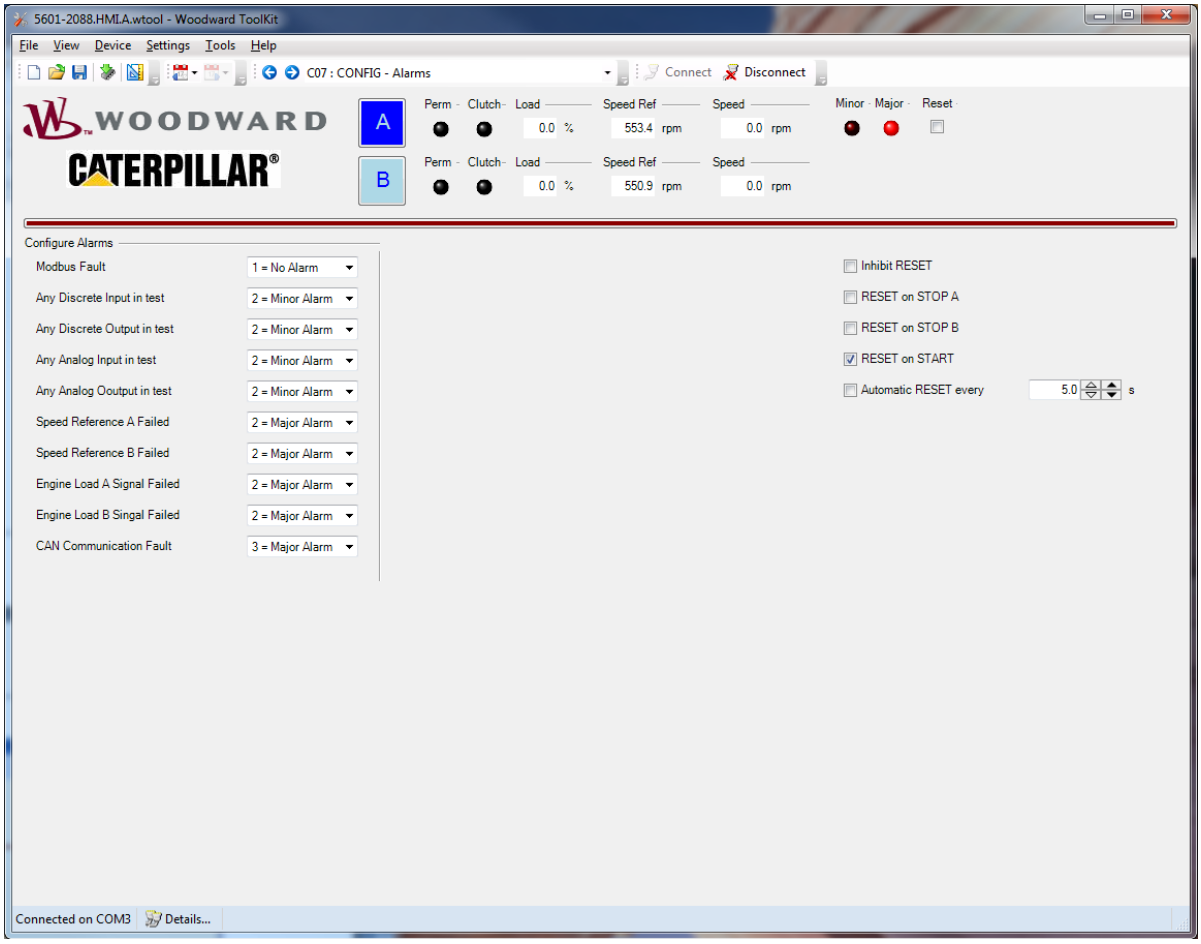
Range 100% current
Sets engineering units for the analog output, corresponding to **100% current**.

With Fixed Value, the output signal can be set in percentage of the 4–20 mA output.

With Reference To Engine A/B, the output signal can be set according to a curve based on the speed reference.

With Digital Output 5/6, the output signal can be set to the correct mA to drive the external relay.

C07 : CONFIG – Alarms



Select either:
1 = No Alarm, **2 = Minor Alarm**, **3 = Major Alarm** for the defined alarm events.

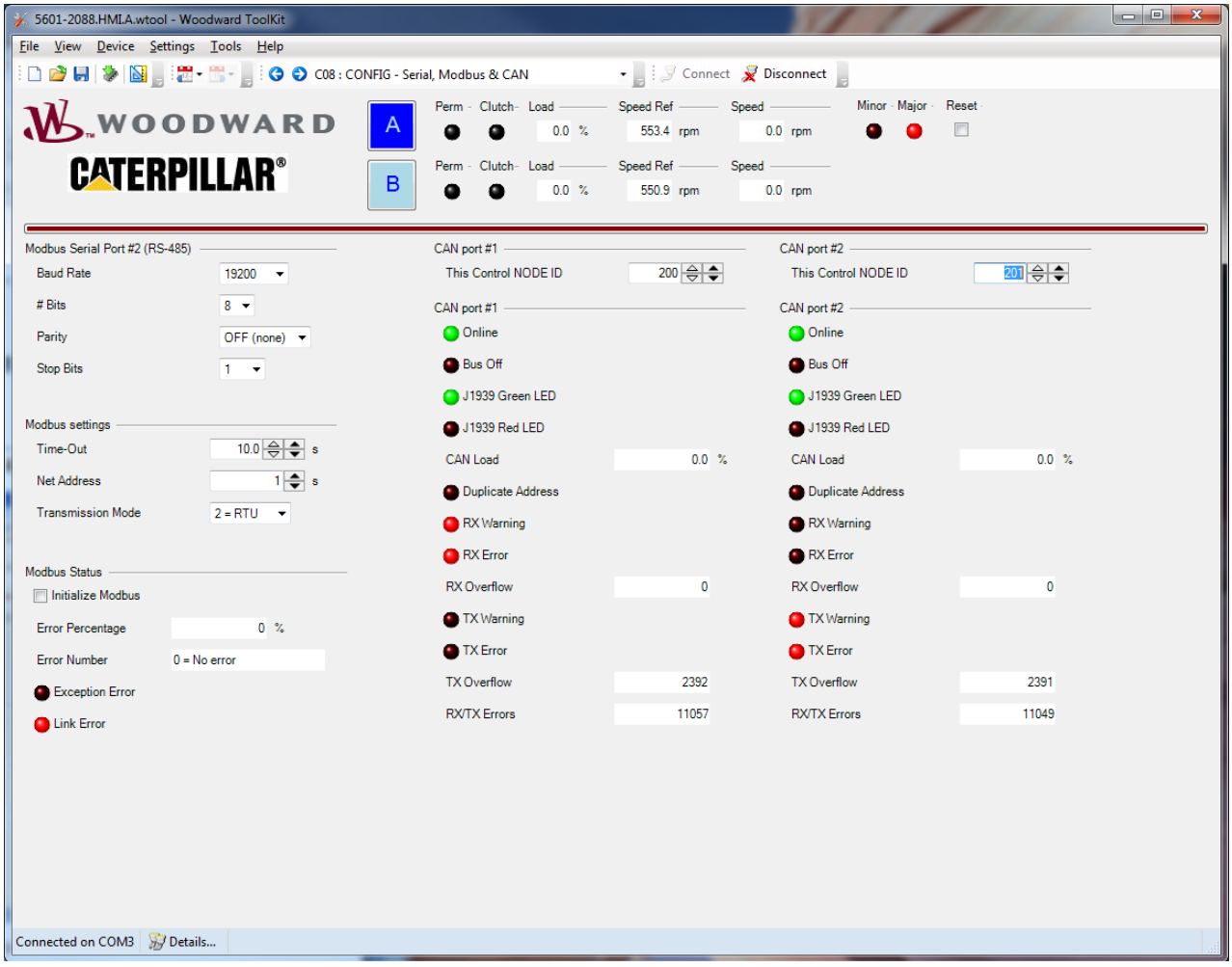
Inhibit RESET
When checked, any reset command (ToolKit, Contact Input) will be disabled.

RESET on STOP A/B
When checked, will issue a reset command on a **STOP A/B** command.

RESET on START
When checked, will issue a reset command when engine speed A or engine speed B is detected above certain threshold.

Automatic RESET every XX s.
When checked, a reset command will be automatically issued every **XX** seconds.

C08 : CONFIG – Serial, Modbus & CAN



For the Modbus serial Port, the following parameters can be set:

Baud Rate Adjustable between 110 and 115200 bits/s
 # Bits 7 or 8
Parity OFF (none), ODD or EVEN
Stop Bits 1, 1.5 or 2
Time-Out Time-Out between 0 and 100 s.
When expired, a Modbus alarm will be active
Net Address Select the Modbus Net Address between 1 and 247
Transmission Mode Select either **1 = ASCII** or **2 = RTU**
Initialize Modbus Check and uncheck to reset the Modbus communications

For the CAN ports #1 & #2, the following parameters can be set:

Control NODE ID Sets the J1939 CAN node ID for the 733 for each CAN network port.

IMPORTANT **Most of the CAN settings require a reboot of the control for them to take effect. SAVE tunables prior to rebooting the control!**

ToolKit Operation & Service Pages

The following ToolKit Operation & Service Pages are available:

- **A01 : Monitoring & Control**
- **A02 : Load Sharing & Clutch**

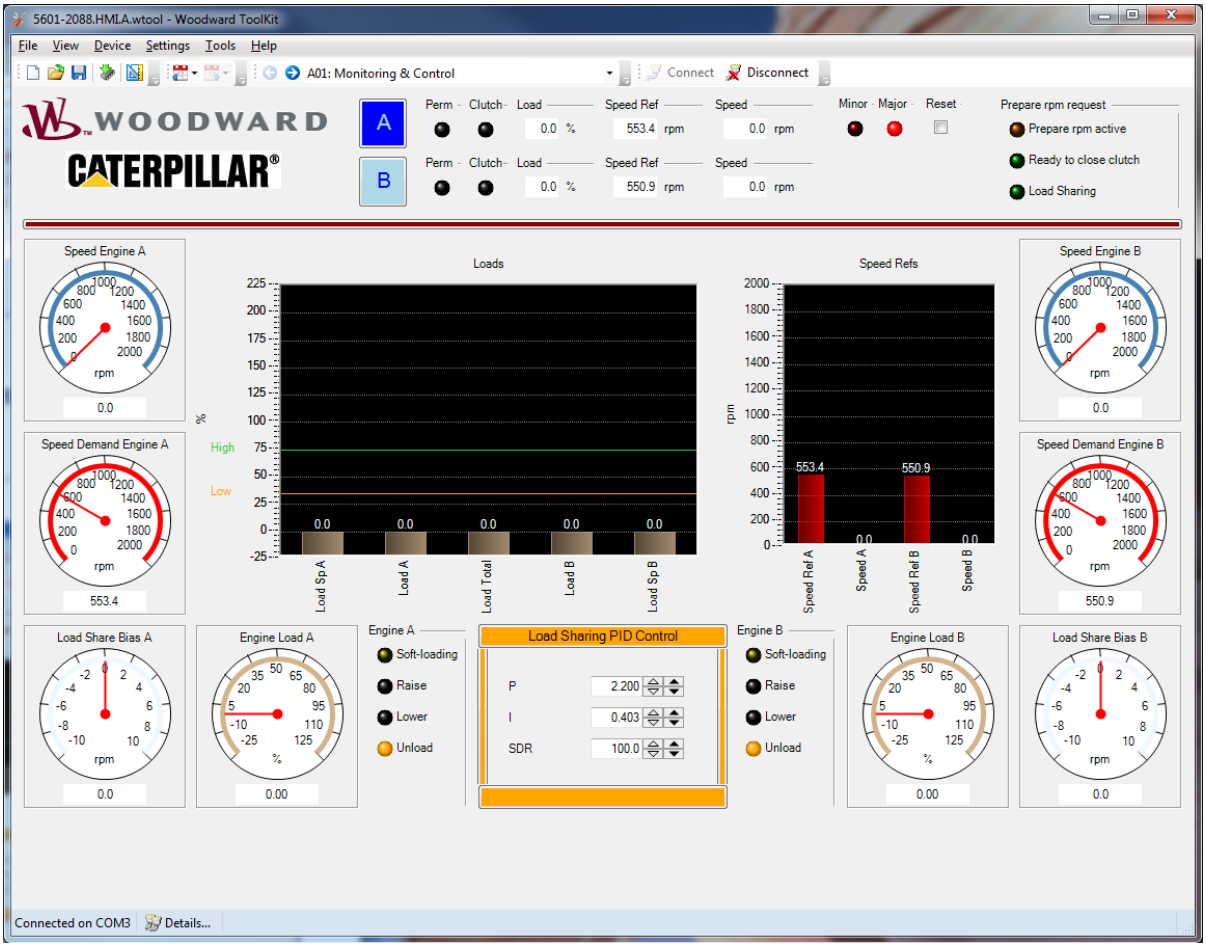
- **B01 : Diagnostics - Alarms**
- **B02 : Diagnostics – System Information**

- **M01 : Monitor – LINKnet HT**

- **F01 : FORCE – Analog Inputs**

- **T01 : TREND**

A01 : Monitoring & Control



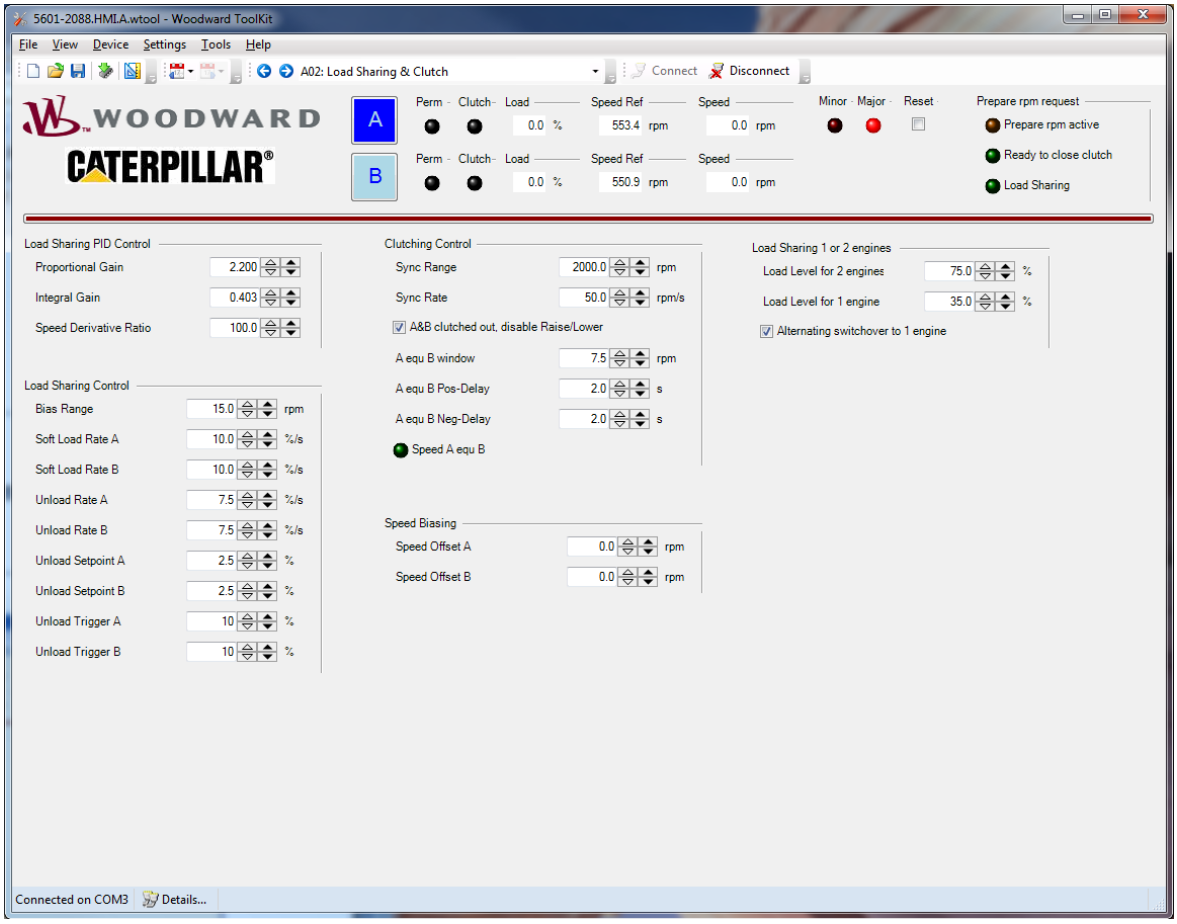
This is the main page showing details for both engines, clutches & load sharing.

Load Sharing PID control:

P	Proportional Gain	[0 … 100]
I	Integral Gain	[0 … 50]
SDR	Speed Derivative Ratio	[0 … 100%]

Application Note 83402, PID Control gives more information how to adjust a PID.

A02 : Load Sharing & Clutch

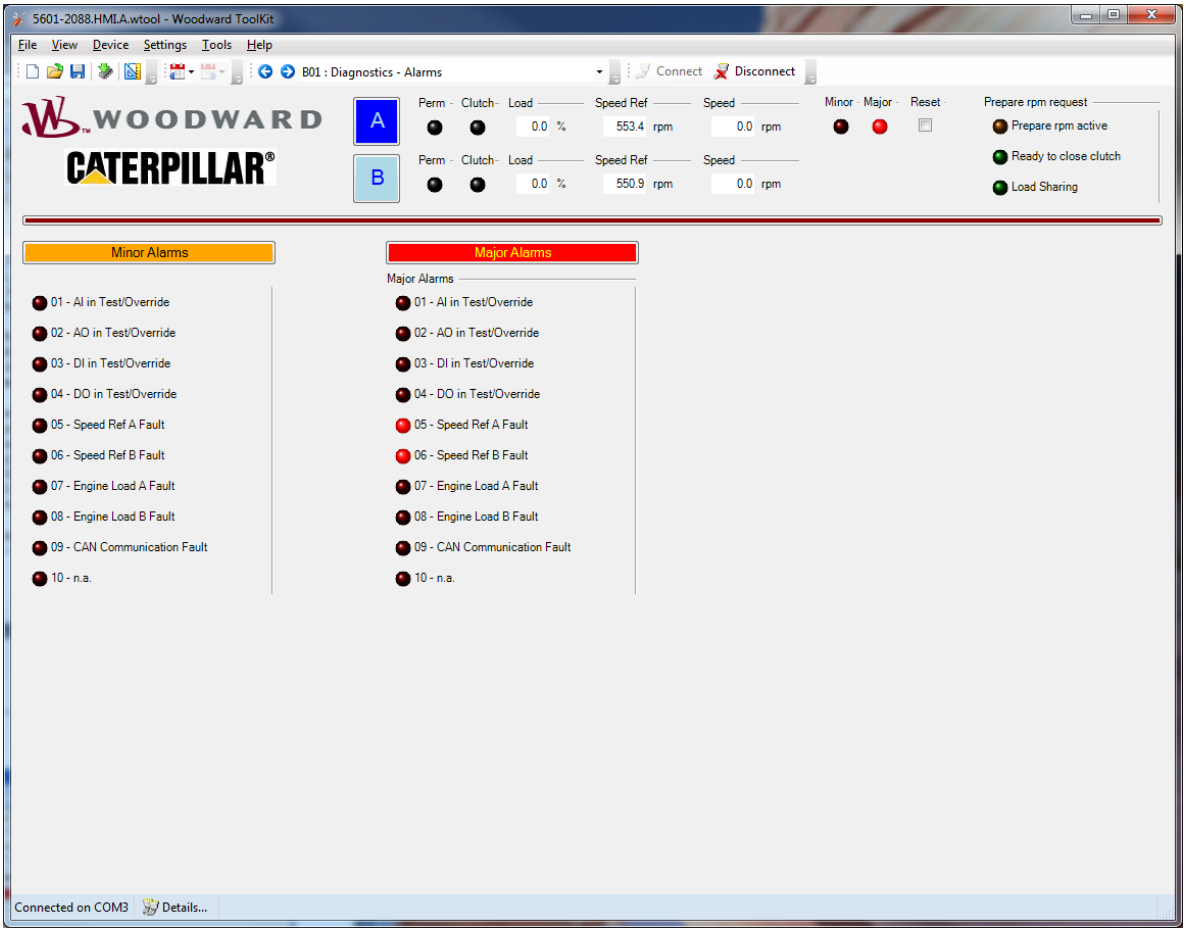


P Proportional Gain [0 … 100]
I Integral Gain [0 … 50]
SDR Speed Derivative Ratio [0 … 100%]
Application Note 83402, PID Control gives more information how to adjust a PID.

Bias Range Maximum load-sharing bias +/- that will be applied to each engine's speed reference output [0 … 2000 rpm]
Soft Load Rate Loading rate for loadsharing [0-200%/s]
Unload Rate A/B Unload rate [0 … 200%/s]
Unload Setpoint A/B Unload setpoint [0 … 100%]
Unload Trigger A/B Load level for Unloaded indication [0 … 100%]
Sync Range Synchronization Raise/Lower range for engine to be clutched in [0 … 2000 rpm]
Sync Rate Synchronization Raise/Lower rate for engine to be clutched in [0 … 200 rpm/s]
A&B Clutched out, disable Raise/Lower When checked no speed bias is allowed when both engines are clutched out.
A equ B window Speed difference window for engine A and B for clutch permissive [0 … 250 rpm]
A equ B Pos/Neg-Delay Time delays for clutch permissive On/Off delays [0 … 60 s]
Speed Offset A/B Speed Ref A/B output offset [–250 … 250 rpm]
Load Level for 2 engines Above this total load level, both engines will load-share together [0.. 200%]
Load Level for 1 engine Below this total load level, only one engine will take all load, other will unload [0.. 200%]

Alternating switchover to 1 engine Check to enable the last engine that clutched in, to take all load when the total load drops below the **Load Level for 1 engine** value. Uncheck to enable the first engine that clutched in, to take all load when total load drops below the **Load Level for 1 engine** value.

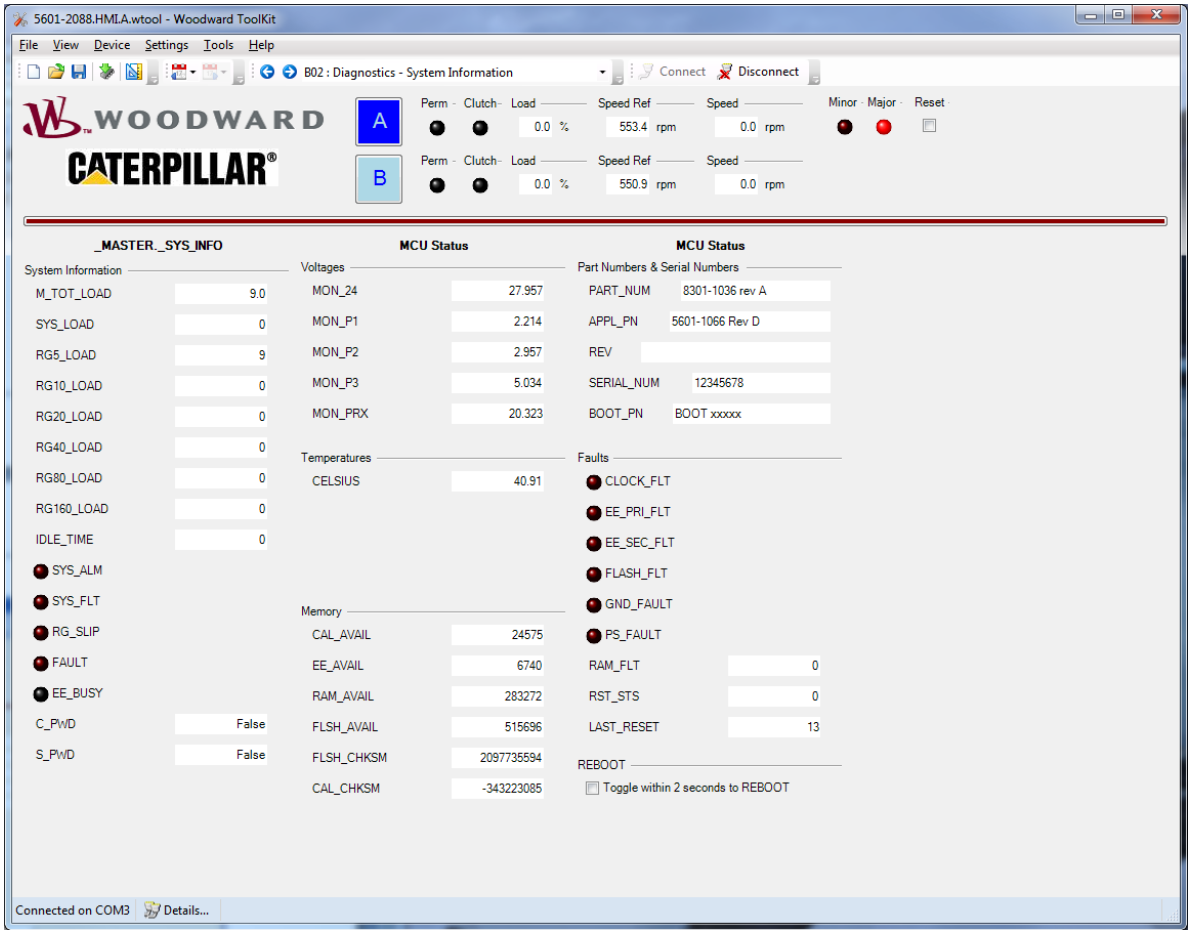
B01 : Diagnostics – Alarms



The Alarm page displays active and latched alarms with red LED's.

Minor Alarms will not necessarily interrupt running operation mode of the load-sharing control.

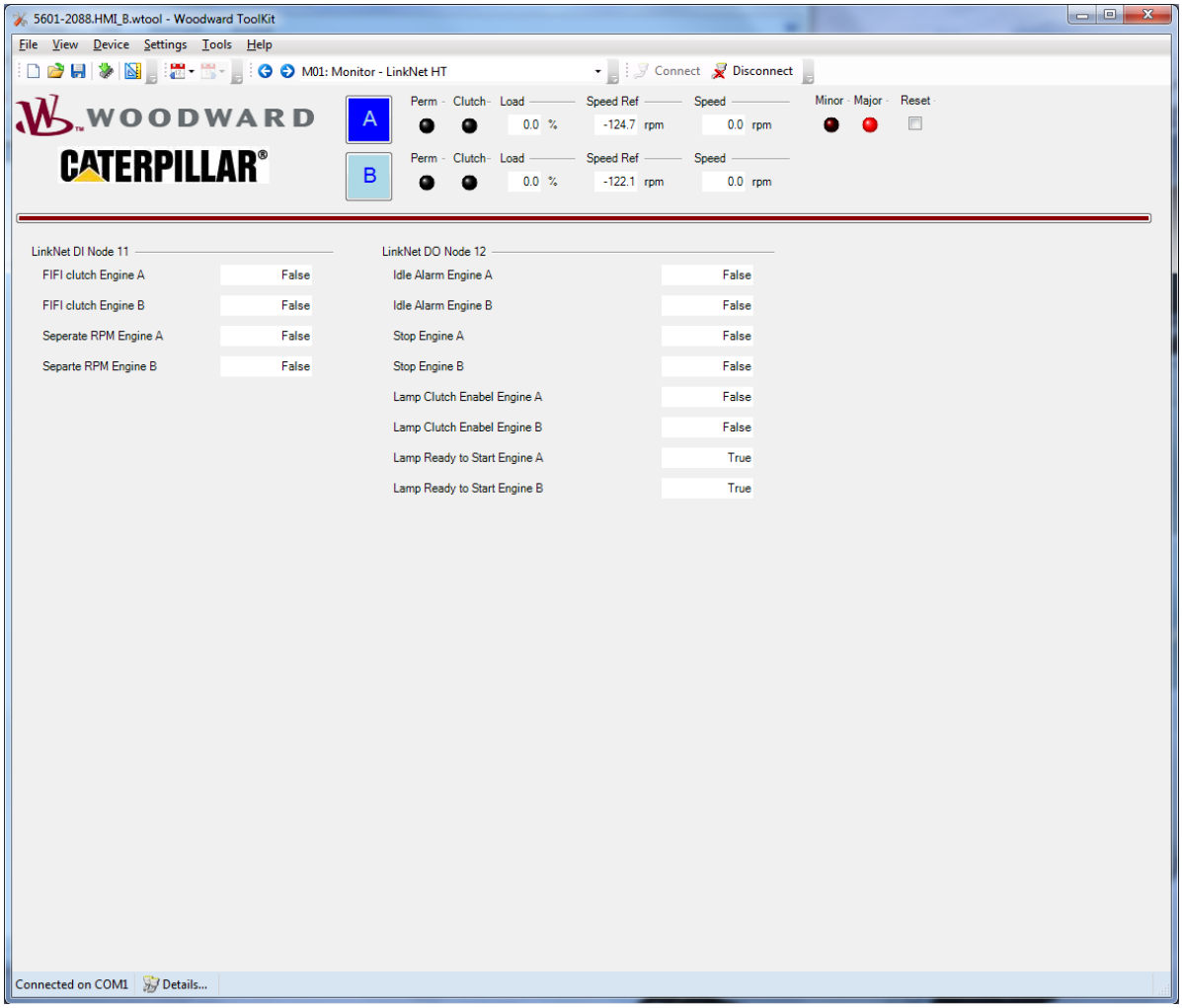
B02 : Diagnostics – System Information



The System Information page will typically be not needed for normal operation of the MCU.

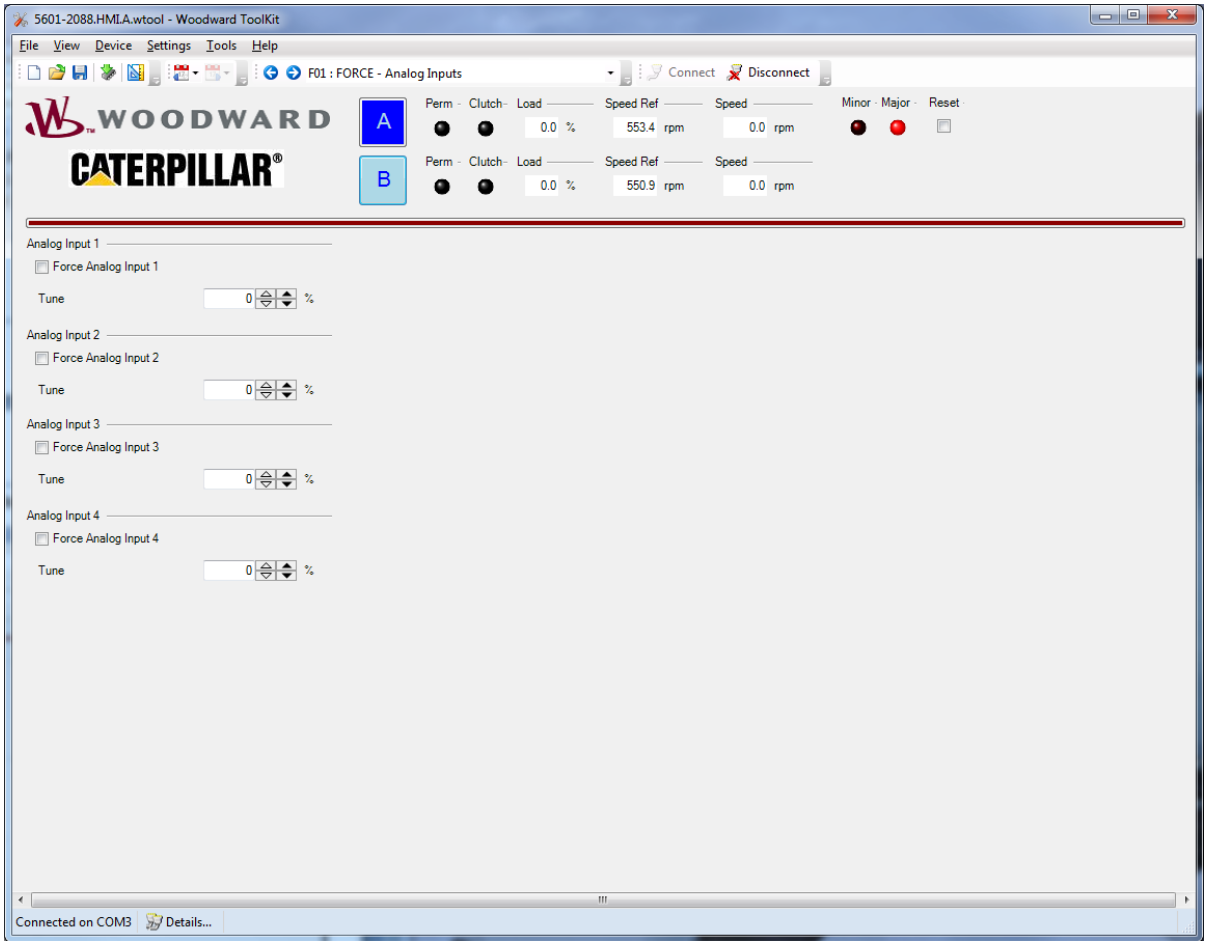
It contains low level detail data, that may be of use to Woodward.

M01 : MONITOR – LINKnet HT



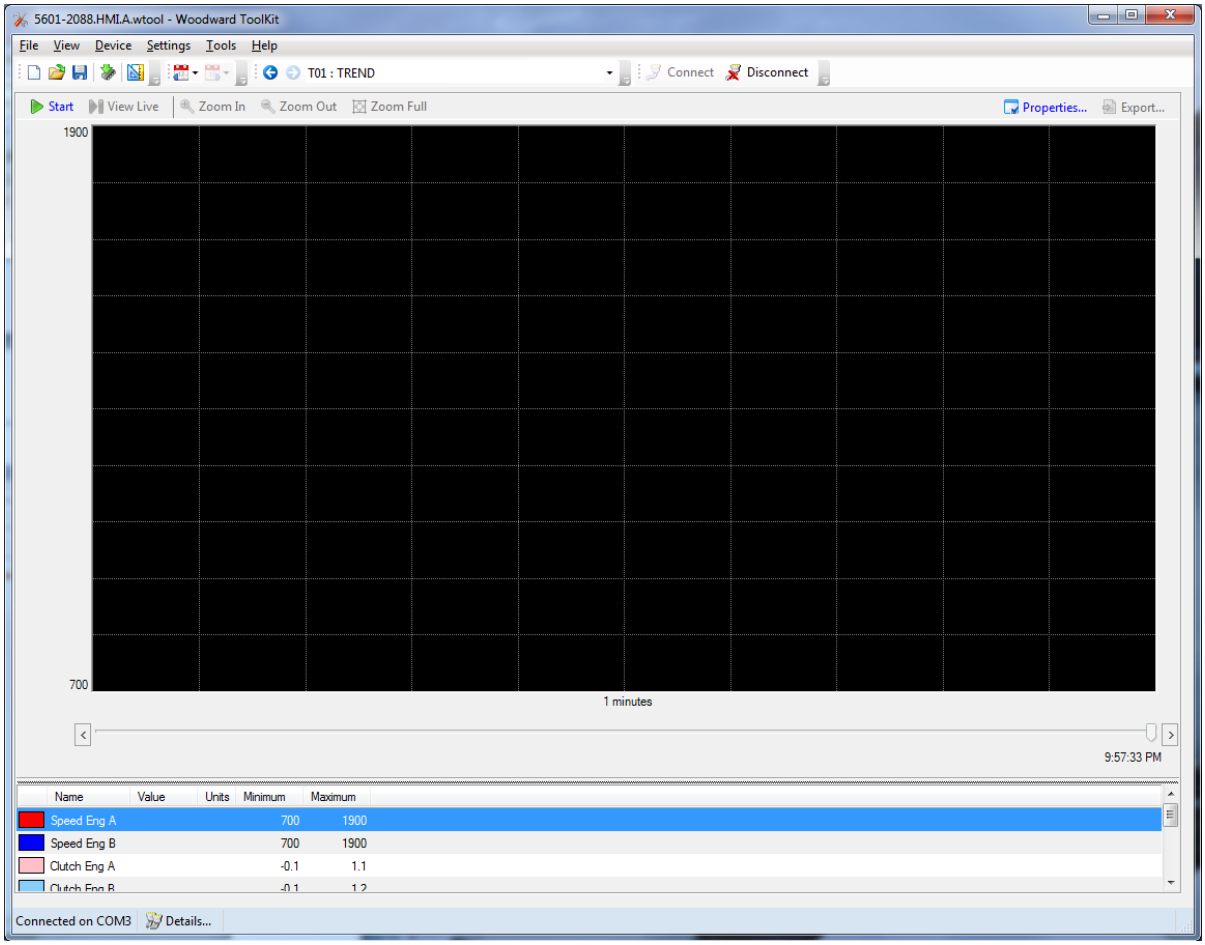
This is LINKnet HT Monitoring page showing details for discrete input and output status of both engines.
For LINKnet DI Node 11 “False” indicate open contact and “True” indicate closed contact.
For LINKnet DI Node 12; “False” indicate de-energized output and “True” indicate energized output.

F01 : FORCE – Analog Inputs



The FORCE – Analog Inputs page will allow the forcing of the analog input signals of the control, normally only used by Woodward engineer during commissioning.

T01 : TREND



The TREND page will allow trending option of the following signals:

- Speed Eng A
- Speed Eng B
- Spd Ref Eng A
- Spd Ref Eng B
- Load Eng A
- Load Eng B
- Load SP Eng A
- Load SP Eng B
- Clutch Eng A
- Clutch Eng B

Chapter 5.
Functional Block Diagram

This chapter contains Functional Block Diagram 9989-4123.

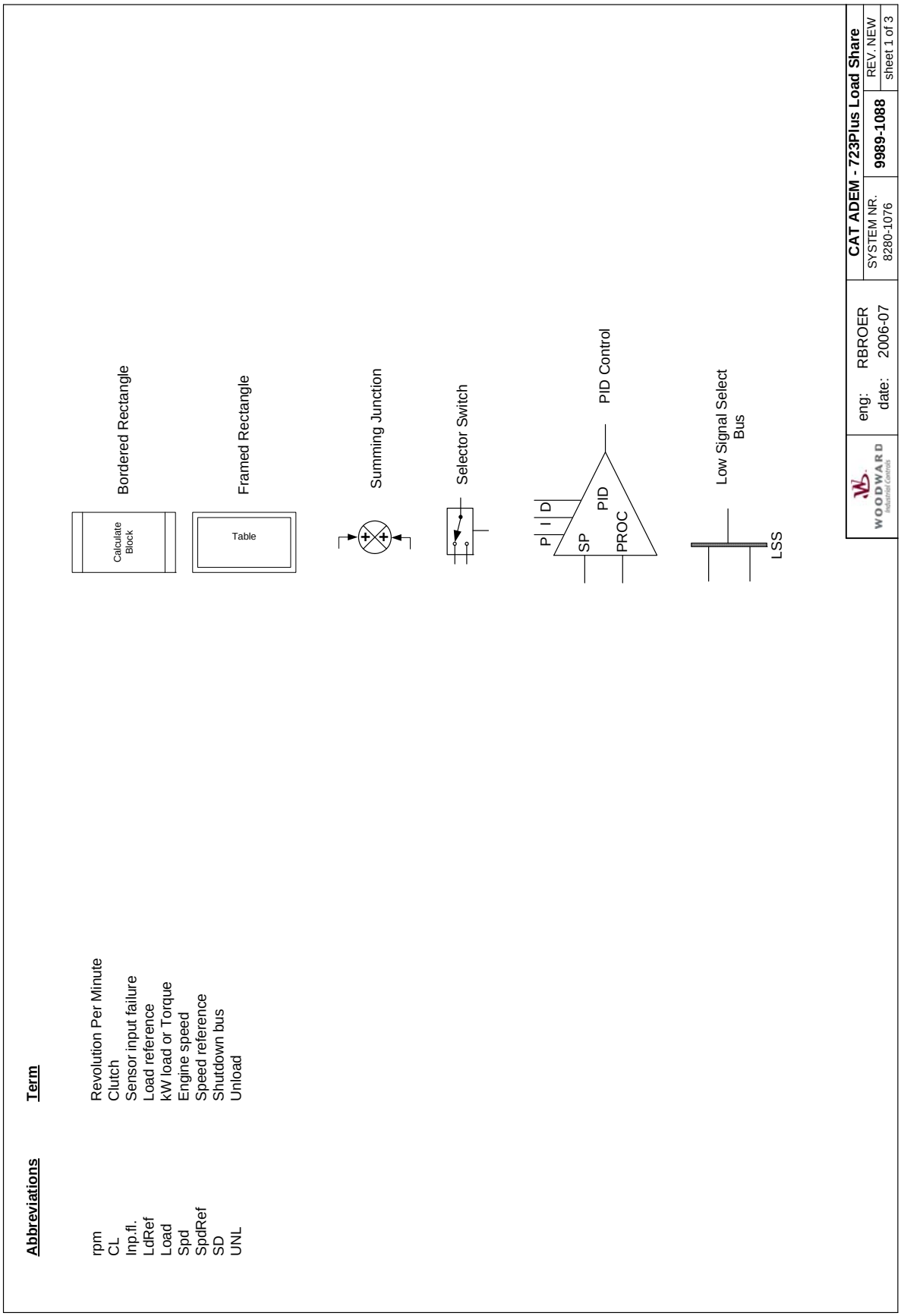


Figure 5-1a. Functional Block Diagram 9989-4123

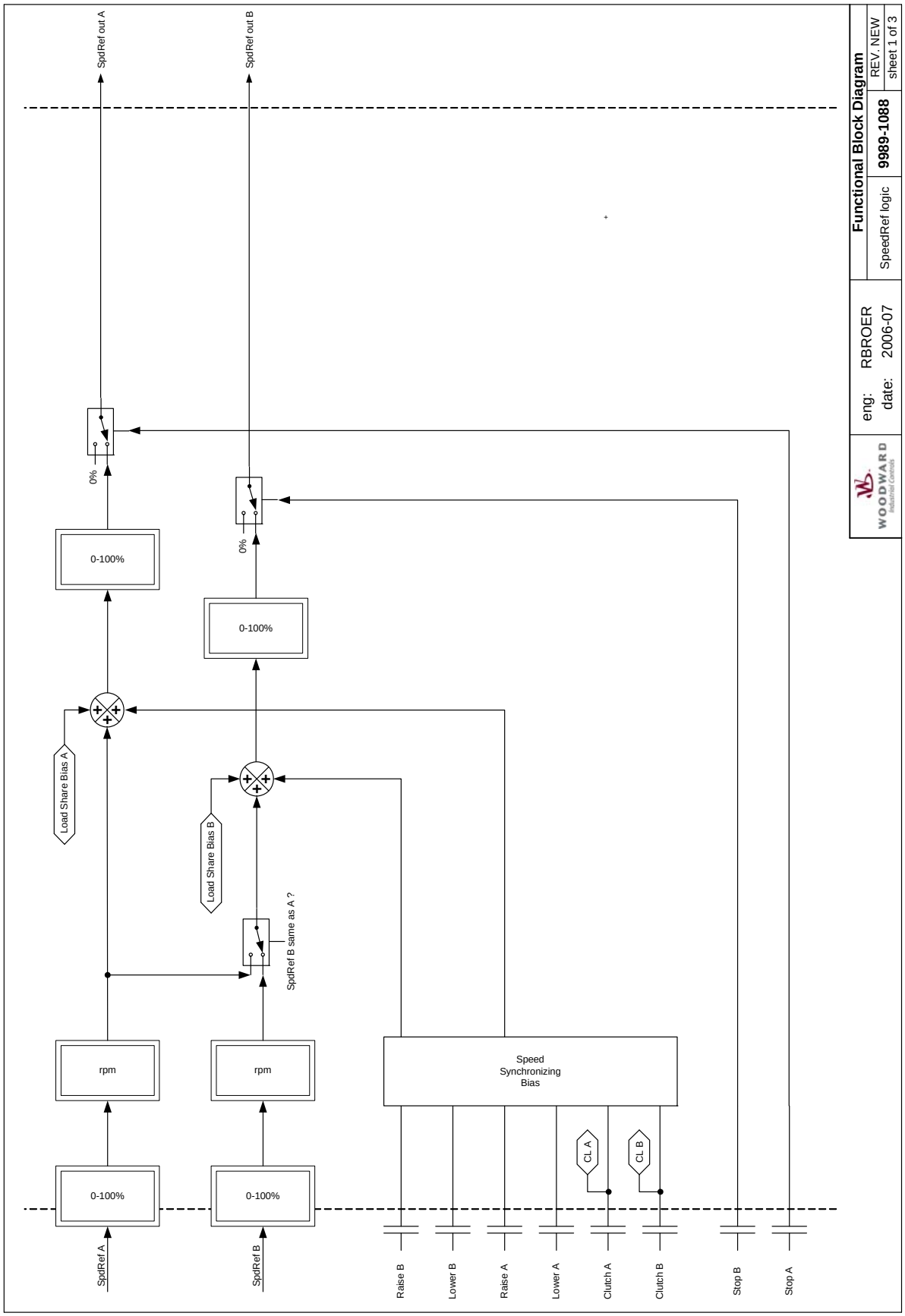


Figure 5-1b. Functional Block Diagram 9989-4123

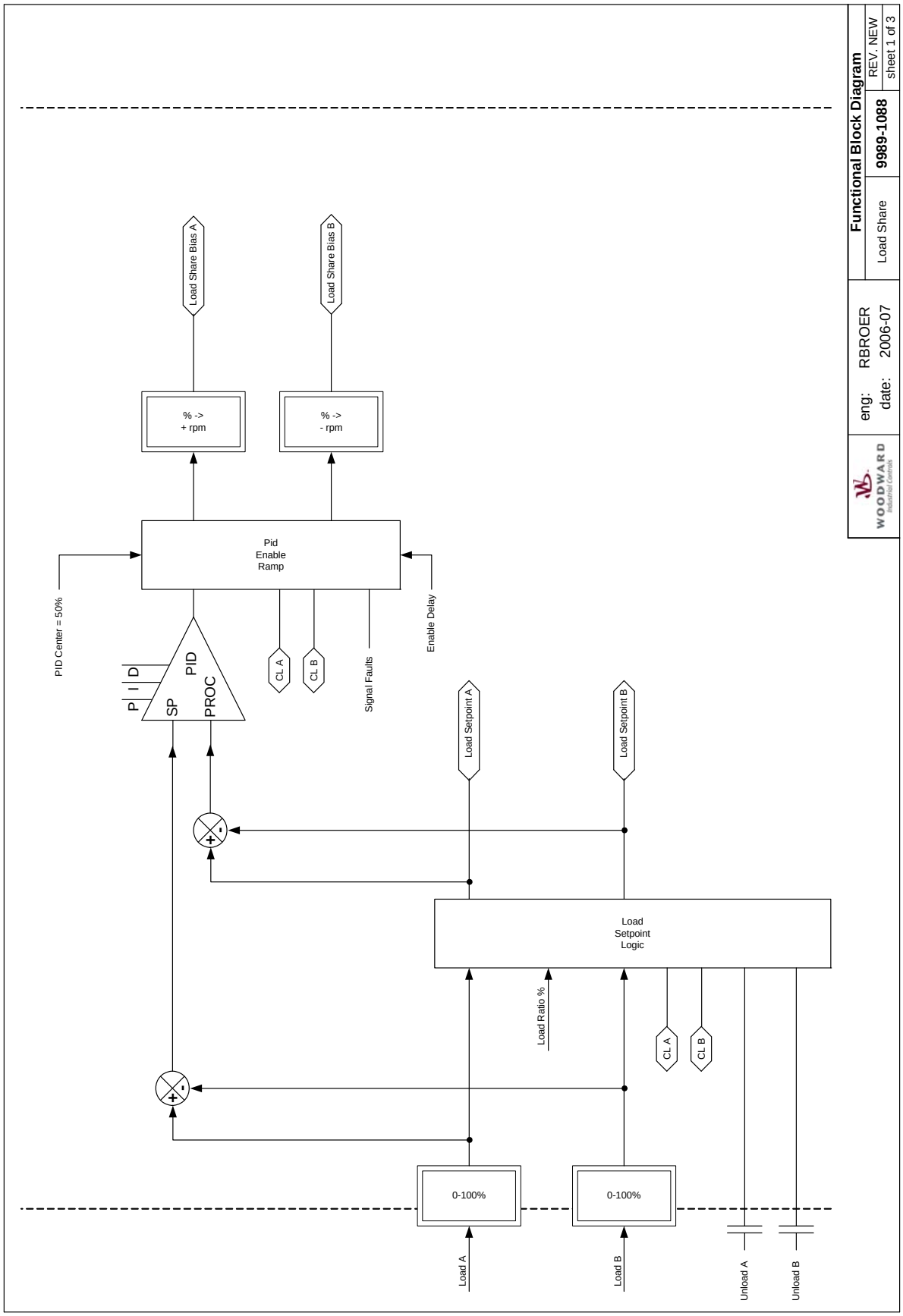


Figure 5-1c. Functional Block Diagram 9989-4123

Chapter 6.
Modbus Signals List

This chapter lists the Modbus List with 733 Load Sharing Control system parameters which are available for monitoring by external systems (SCADA, PLC etc.)

The 733 Modbus is always “slave”.

Boolean Writes

Address	Description
0:0001	Not Applicable

Boolean Reads

Address	Description
1:0001	Discrete Input ch#1
1:0002	Discrete Input ch#2
1:0003	Discrete Input ch#3
1:0004	Discrete Input ch#4
1:0005	Discrete Input ch#5
1:0006	Discrete Input ch#6
1:0007	Discrete Input ch#7
1:0008	Discrete Input ch#8
1:0009	Engine A Clutch
1:0010	Engine B Clutch
1:0011	Engine A Raise
1:0012	Engine A Lower
1:0013	Engine B Raise
1:0014	Engine B Lower
1:0015	Engine A Unload
1:0016	Engine B Unload
1:0017	Engine A Unload
1:0018	Engine B Unload
1:0019	Reset Input
1:0020	
1:0021	
1:0022	
1:0023	Relay Out #1
1:0024	Relay Out #2
1:0025	Relay Out #3
1:0026	Relay Out #4
1:0027	Minor Alarm active
1:0028	Major Alarm active
1:0029	Any IO in Test/Override
1:0030	Load Sharing is active
1:0031	Engine A softload active
1:0032	Engine B softload active
1:0033	Analog input ch#1 fault
1:0034	Analog input ch#2 fault

Address	Description
1:0035	Analog input ch#3 fault
1:0036	Analog input ch#4 fault
1:0037	AI in Test/Override Minor Alarm
1:0038	AO in Test/Override Minor Alarm
1:0039	DI in Test/Override Minor Alarm
1:0040	DO in Test/Override Minor Alarm
1:0041	Speed-Ref A Minor Alarm
1:0042	Speed-Ref B Minor Alarm
1:0043	Engine Load A Minor Alarm
1:0044	Engine Load A Minor Alarm
1:0045	Modbus fault Minor Alarm
1:0046	AI in Test/Override Major Alarm
1:0047	AO in Test/Override Major Alarm
1:0048	DI in Test/Override Major Alarm
1:0049	DO in Test/Override Major Alarm
1:0050	Speed-Ref A Major Alarm
1:0051	Speed-Ref B Major Alarm
1:0052	Engine Load A Major Alarm
1:0053	Engine Load A Major Alarm
1:0054	Modbus fault Major Alarm
1:0055	Speed-A equal to B

Analog Reads

Address	Description	Multiplier
3:0001	Analog input ch#1 [%]	100
3:0002	Analog input ch#2 [%]	100
3:0003	Analog input ch#3 [%]	100
3:0004	Analog input ch#4 [%]	100
3:0005	Analog output ch#1 [%]	100
3:0006	Analog output ch#2 [%]	100
3:0007	Analog output ch#3 [%]	100
3:0008	Analog output ch#4 [%]	100
3:0009	Speed-Reference A Input [rpm]	1
3:0010	Speed-Reference B Input [rpm]	1
3:0011	Engine Load A Input [%]	100
3:0012	Engine Load B Input [%]	100
3:0013	Total Engine Load [0~200%]	100
3:0014	Engine A Load Setpoint [%]	100
3:0015	Engine B Load Setpoint [%]	100
3:0016	Load Ratio A versus B [%]	100
3:0017	Load Share PID output [%}	100
3:0018	Load Share Bias output [rpm}	100
3:0019	Load Share Bias A output [rpm}	100
3:0020	Load Share Bias B output [rpm}	100
3:0021	Synchronizing Bias A output [rpm}	100
3:0022	Synchronizing Bias B output [rpm}	100
3:0023	Speed-Reference A output [rpm]	1
3:0024	Speed-Reference B output [rpm]	1
3:0025	Speed-Reference A final output [%]	100

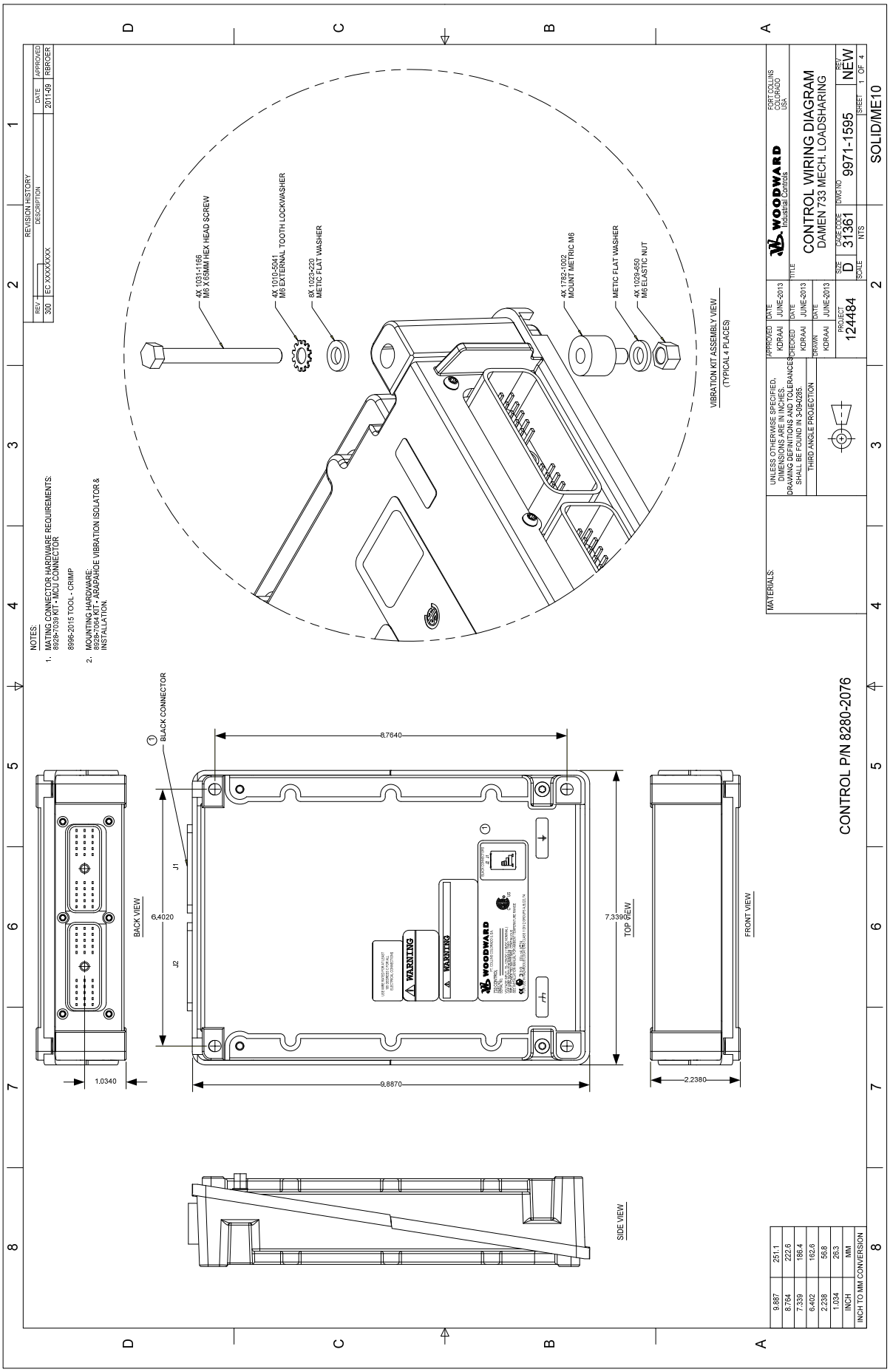
Address	Description	Multiplier
3:0026	Speed-Reference B final output [%]	100
3:0027	Engine Speed A [rpm]	1
3:0028	Engine Speed B [rpm]	1

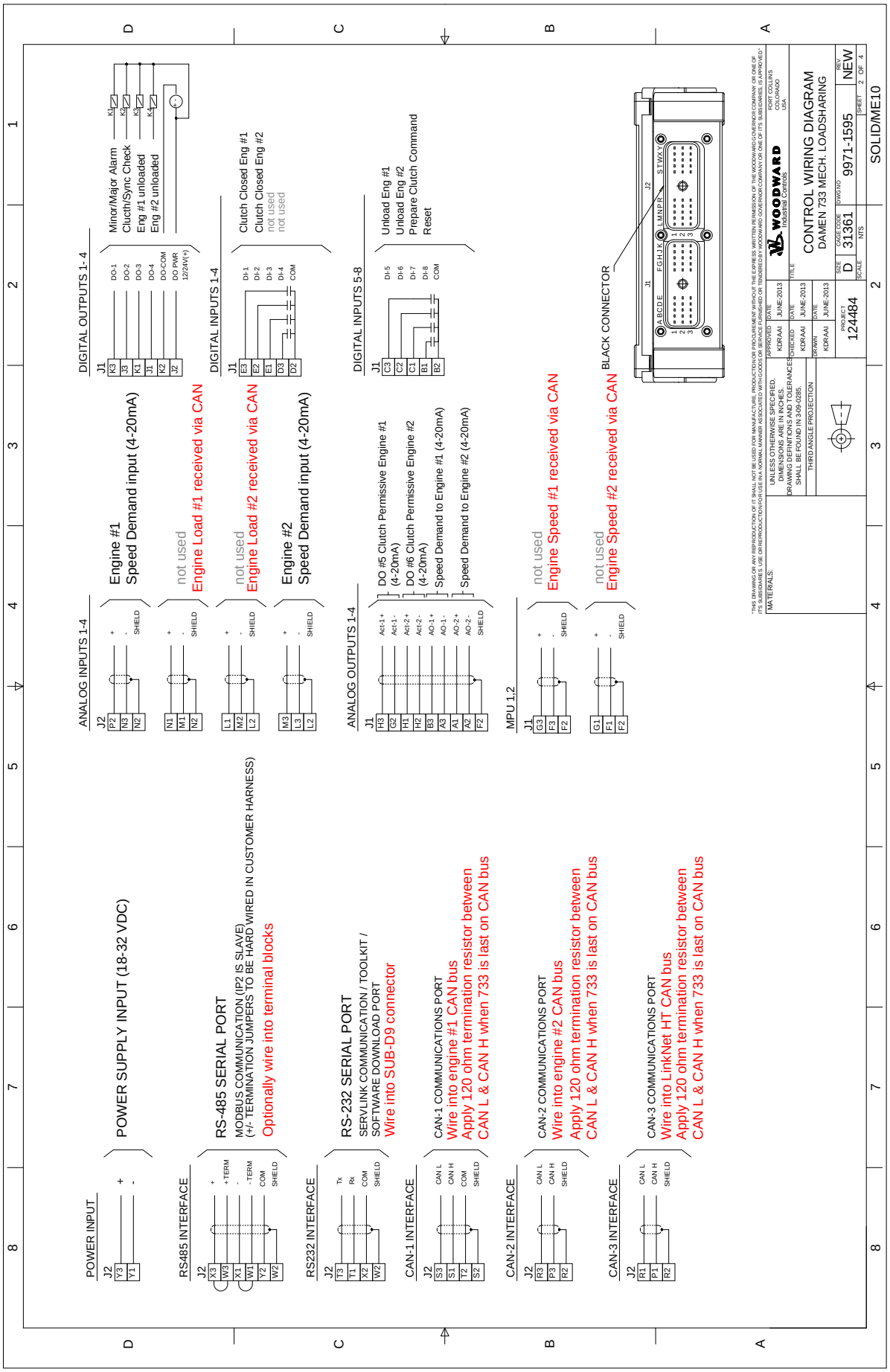
Analog Writes

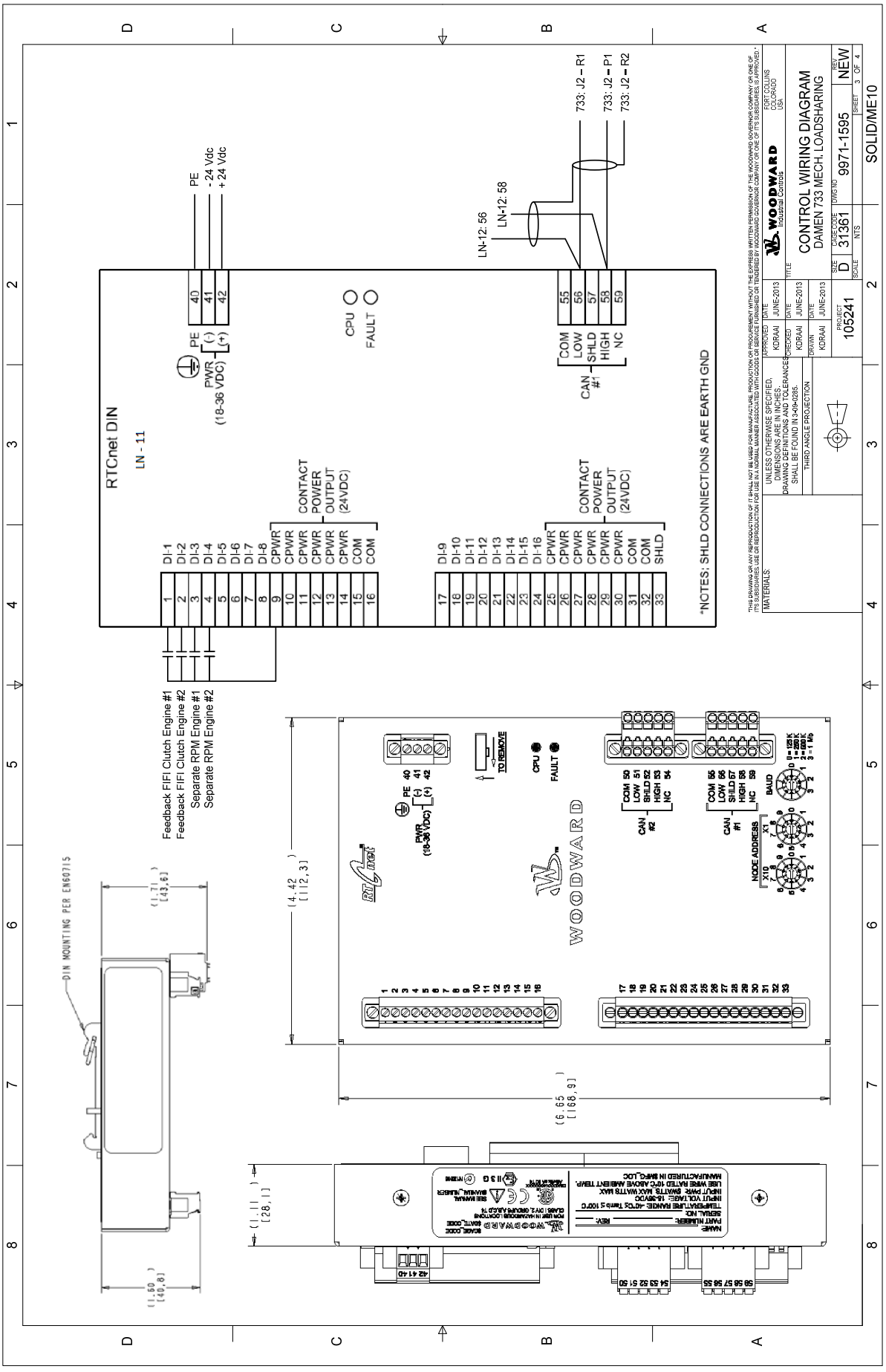
Address	Description	Multiplier
4:0001	Not Applicable	

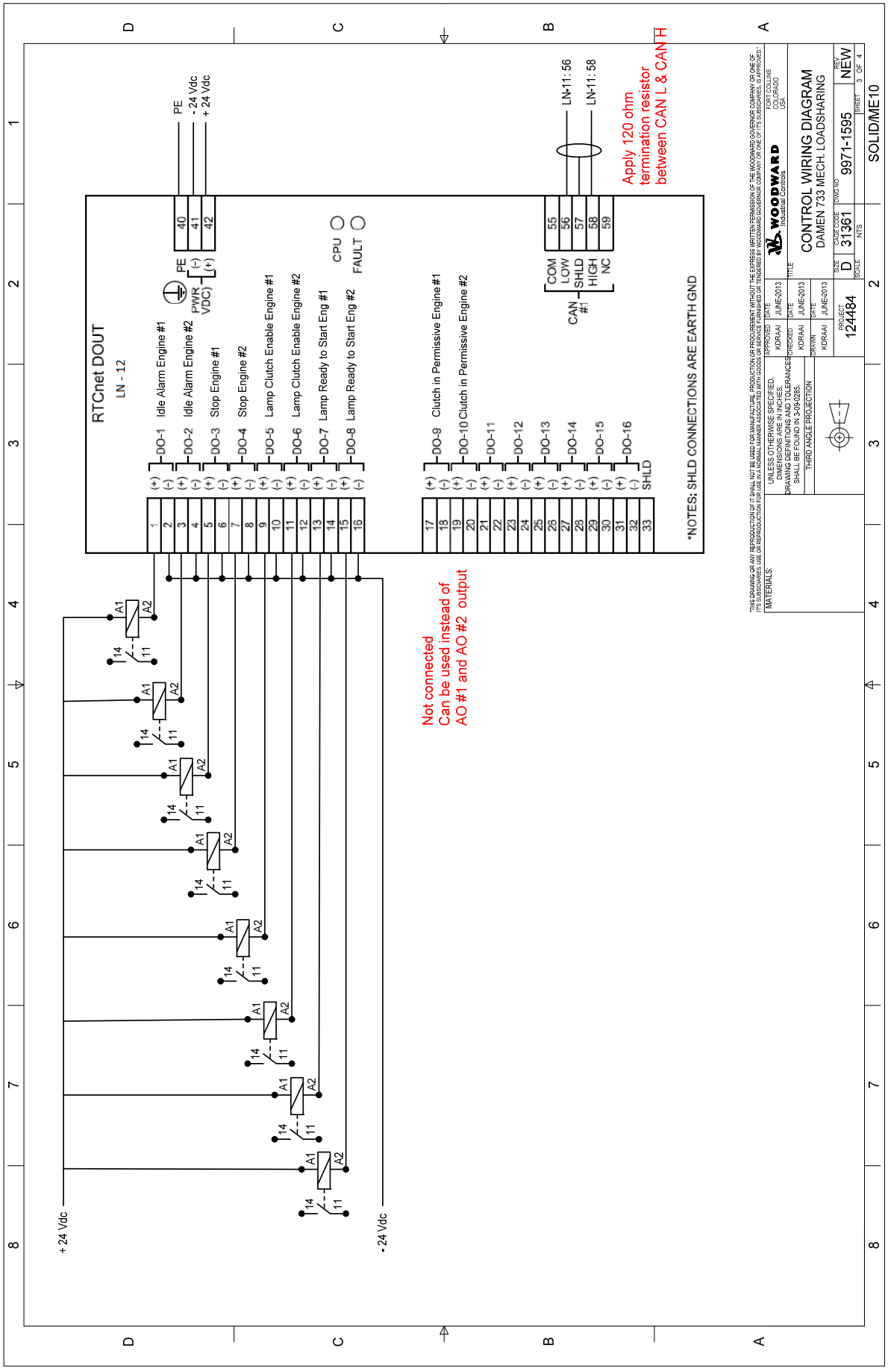
Chapter 7.
Wiring Diagram

This chapter contains the wiring diagram for the 733 system.


REVISION HISTORY
REV
DESCRIPTION
DATE
APPROVED
300
EC: XXXXXXXX
2011-08
RBRGER
NOTES:
1. MATING CONNECTOR HARDWARE REQUIREMENTS:
8928-7039 KIT - MCU CONNECTOR
8996-2015 TOOL - CRIMP
2. MOUNTING HARDWARE:
8928-7064 KIT - ARAPAHOE VIBRATION ISOLATOR &
INSTALLATION.
4X 1031-1166
M6 X 65MM HEX HEAD SCREW
4X 1010-5041
M6 EXTERNAL TOOTH LOCKWASHER
8X 1023-220
METIC FLAT WASHER
4X 1782-1002
MOUNT METRIC M6
METIC FLAT WASHER
4X 1029-650
M6 ELASTIC NUT
VIBRATION KIT ASSEMBLY VIEW
(TYPICAL 4 PLACES)
BLACK CONNECTOR
8.7640
6.4020
J1
J2
1.0340
9.8870
7.3390
2.2380
BACK VIEW
TOP VIEW
FRONT VIEW
SIDE VIEW
WARNING
WOODWARD
CONTROL P/N 8280-2076
MATERIALS:
UNLESS OTHERWISE SPECIFIED,
DIMENSIONS ARE IN INCHES.
DRAWING DEFINITIONS AND TOLERANCES
SHALL BE FOUND IN 3-094286.
THIRD ANGLE PROJECTION
APPROVED KDRAAI JUNE-2013
CHECKED KDRAAI JUNE-2013
DRAWN KDRAAI JUNE-2013
PROJECT 124484
SIZE D
CAGE CODE 31361
DWG NO 9971-1595
REV NEW
SCALE NTS
SHEET 1 OF 4
WOODWARD
Industrial Controls
FORT COLLINS
COLORADO
USA
TITLE
CONTROL WIRING DIAGRAM
DAMEN 733 MECH. LOADSHARING
SOLID/ME10
INCH TO MM CONVERSION
INCH MM
9.887 251.1
8.764 222.6
7.339 186.4
6.402 162.6
2.238 56.8
1.034 26.3


POWER INPUT
POWER SUPPLY INPUT (18-32 VDC)
RS485 INTERFACE
RS-485 SERIAL PORT
MODBUS COMMUNICATION (IP2 IS SLAVE)
(+/- TERMINATION JUMPERS TO BE HARD WIRED IN CUSTOMER HARNESS)
Optionally wire into terminal blocks
RS232 INTERFACE
RS-232 SERIAL PORT
SERVLINK COMMUNICATION / TOOLKIT / SOFTWARE DOWNLOAD PORT
Wire into SUB-D9 connector
CAN-1 INTERFACE
CAN-1 COMMUNICATIONS PORT
Wire into engine #1 CAN bus
Apply 120 ohm termination resistor between CAN L & CAN H when 733 is last on CAN bus
CAN-2 INTERFACE
CAN-2 COMMUNICATIONS PORT
Wire into engine #2 CAN bus
Apply 120 ohm termination resistor between CAN L & CAN H when 733 is last on CAN bus
CAN-3 INTERFACE
CAN-3 COMMUNICATIONS PORT
Wire into LinkNet HT CAN bus
Apply 120 ohm termination resistor between CAN L & CAN H when 733 is last on CAN bus
ANALOG INPUTS 1-4
Engine #1
Speed Demand input (4-20mA)
not used
Engine Load #1 received via CAN
not used
Engine Load #2 received via CAN
Engine #2
Speed Demand input (4-20mA)
DIGITAL OUTPUTS 1- 4
Minor/Major Alarm
Cluch/Sync Check
Eng #1 unloaded
Eng #2 unloaded
DIGITAL INPUTS 1-4
Clutch Closed Eng #1
Clutch Closed Eng #2
not used
not used
ANALOG OUTPUTS 1-4
DO #5 Clutch Permissive Engine #1 (4-20mA)
DO #6 Clutch Permissive Engine #2 (4-20mA)
Speed Demand to Engine #1 (4-20mA)
Speed Demand to Engine #2 (4-20mA)
DIGITAL INPUTS 5-8
Unload Eng #1
Unload Eng #2
Prepare Clutch Command
Reset
MPU 1,2
not used
Engine Speed #1 received via CAN
not used
Engine Speed #2 received via CAN
BLACK CONNECTOR
WOODWARD
Industrial Controls
FORT COLLINS
COLORADO
USA
CONTROL WIRING DIAGRAM
DAMEN 733 MECH. LOADSHARING
9971-1595
NEW
SOLID/ME10


RTCnet DIN
LN - 11
PE
- 24 Vdc
+ 24 Vdc
PWR (18-36 VDC)
CPU
FAULT
CAN #1
COM
LOW
SHLD
HIGH
NC
LN-12: 56
LN-12: 58
733: J2 – R1
733: J2 – P1
733: J2 – R2
CONTACT POWER OUTPUT (24VDC)
*NOTES: SHLD CONNECTIONS ARE EARTH GND
Feedback FIFI Clutch Engine #1
Feedback FIFI Clutch Engine #2
Separate RPM Engine #1
Separate RPM Engine #2
DIN MOUNTING PER EN60715
WOODWARD
CONTROL WIRING DIAGRAM
DAMEN 733 MECH. LOADSHARING
9971-1595
SOLID/ME10


RTCnet DOUT
LN - 12
DO-1 Idle Alarm Engine #1
DO-2 Idle Alarm Engine #2
DO-3 Stop Engine #1
DO-4 Stop Engine #2
DO-5 Lamp Clutch Enable Engine #1
DO-6 Lamp Clutch Enable Engine #2
DO-7 Lamp Ready to Start Eng #1
DO-8 Lamp Ready to Start Eng #2
DO-9 Clutch in Permissive Engine #1
DO-10 Clutch in Permissive Engine #2
DO-11
DO-12
DO-13
DO-14
DO-15
DO-16
SHLD
CPU
FAULT
PE
- 24 Vdc
+ 24 Vdc
PWR (VDC)
CAN #1
COM
LOW
SHLD
HIGH
NC
LN-11: 56
LN-11: 58
Apply 120 ohm termination resistor between CAN L & CAN H
Not connected
Can be used instead of
AO #1 and AO #2 output
*NOTES: SHLD CONNECTIONS ARE EARTH GND
+ 24 Vdc
- 24 Vdc
CONTROL WIRING DIAGRAM
DAMEN 733 MECH. LOADSHARING
WOODWARD
Industrial Controls
FORT COLLINS
COLORADO
USA
9971-1595
NEW
SOLIDME10

Chapter 8.
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

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany:	
Kempen	--- +49 (0) 21 52 14 51
Stuttgart	- +49 (711) 78954-510
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
Poland	+48 12 295 13 00
United States	-----+1 (970) 482-5811

Products Used In Engine Systems

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

Products Used In Industrial Turbomachinery Systems

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

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 26608B.

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Email and Website—www.woodward.com

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