WOODWARD

Product Manual 91525
(Revision B, 3/2012)
Original Instructions

In-Pulse™ II
Standard Multi-Point Driver

8280-1121, 8280-1122, 8280-1221, 8280-1222

Woodward manual 26343 is 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.

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Manual 91525

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Contents

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.

List of Abbreviations

This is a list of abbreviations and terminology used in this manual:

ALM	Alarm - a warning signal
BI	Boolean Input (see also CI & DI)
BO	Boolean Output (see also CO & DO)
CI	Contact Input
CO	Contact Output
°CA	Crank Angle Degrees
°CS	Degrees Crank Shaft
CPD	Closure Point Detection
CPU	Central Processing Unit
DCS	Digital Control System
DI	Discrete Input
DO	Discrete Output
EFI	Electronic Fuel Injection
EMF	Electromotive Force
ERV	Electronic Rail Valve
HMI	Human Machine Interface
HSS	Depends on the context: • High speed shaft of the gearbox • High signal selector in software
IP2	In-Pulse II, Electronic Fuel Injection Control
kW	Kilowatts
LED	Light Emitting Diode
LSS	Depends on the context: • Low speed shaft of the gearbox • Low signal selector in software
MCU	Microcontroller
MMI	Man Machine Interface
MPU	Magnetic Pick-up sensor
mA	Milliamps
mV	Millivolts
NA	Not Applicable Not Available
NC	Normally Closed
NO	Normally Open
NU	Not Used
PC	Personal Computer
PCB	Printed Circuit Board
PID	Proportional Integration Derivative
PLC	Programmable Logic Controller
PSU	Power Supply Unit
PWM	Pulse Width Modulation
rpm	Revolutions per Minute (can also be expressed as “1/s”)
SD	Shutdown
TB	Terminal Block
TBD	To be defined
TDC	Top Dead Centre
UPCI	Universal PC Interface
Vac	Volts (alternating current)
Vdc	Volts (direct current)

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SOGAV

The following are trademarks of their respective companies:
Modbus (Schneider Automation Inc.)

Chapter 1.
General Information

Introduction

The Woodward part numbers related to the “In-Pulse II – Standard Multi Point Driver” are the following:

System:	**8280-1121**
• Hardware: 110 V In-Pulse II	8237-1178
• Application software (speed pattern 2):	5418-3079
System:	**8280-1122**
• Hardware: 110 V In-Pulse II	8237-1178
• Application software (speed pattern 3,3):	5418-4079
System:	**8280-1221**
• Hardware: 24 V In-Pulse II	8237-1180
• Application software (speed pattern 2):	5418-7079
System:	**8280-1222**
• Hardware: 24 V In-Pulse II	8237-1180
• Application software (speed pattern 3,3):	5418-7080

IMPORTANT

Connector kits need to be ordered separately.
Black J1&J2 Connectors: 8928-7039 (Delphi) or 8928-7112 (Cinch)
White J3&J4 Connectors: 8928-7040 (Delphi) or 8928-7113 (Cinch)

For more parts & service items please refer to manual 26343

The Woodward “In-Pulse II – Standard Multi Point Driver” has the following functionality:

- Multipoint injection based upon (variable) input duration & timing
- Cylinder Temperature balancing

Main Features:

- Fully configurable & adjustable from graphical user-interface ToolKit
- Configurable number of injector outputs from 1 to 18
- Extensive interfacing capabilities by hardwired signals, Modbus communications and J1939 CAN communications
- Offline test mode (click test) and Online test mode, which allows changing duration and timing per injector output
- Individual injector output Duration and Timing offsets from ToolKit user-interface, Modbus, and CAN
- Cylinder Temperature balancing can bias each injector output Duration, with adjustable bias rate and range
- Duration input can be hardwired (4–20 mA) through Modbus, through CAN, or from curve based on speed
- Timing input can be hardwired (4–20 mA) through Modbus, through CAN, from curve based on speed, or from curve based on Duration
- Closure Point Detection (CPD) allows automatic current profile optimizations and injector/valve wear diagnostics
- Optional ERV purging cycle when entering RUN mode
- Several Injector output current profiles; full manual, semi automatic and fully automatic
- Optional pre-injection for double injection events per cylinder
- Pull-in currents up to 20 A

Associated Publications

The following publications contain additional product or installation information on Woodward controls & products, and related components. These can be downloaded with the following link: www.woodward.com/publications.

26343 In-Pulse II Electronic Fuel Injection Control
25070 Electronic Control Installation Guide
26260 Governing Fundamentals and Power Management
82715 Guide for Handling & Protection: Electronic Controls, PCBs, Modules

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 related Sensor Inputs

Application software (speed pattern 2): 5418-3079, 5418-7079
In this 4-cycle engine version, the control needs 3 signals;

- Teeth on Crank — Wiring Pin Out: J1 - G3/F3/F2
- TDC on Crank pin — Wiring Pin Out: J1 - G1/F1/F2
- Phase on Cam pin — Wiring Pin Out: J1 - E2/D1/D2

The speed sensor inputs and TDC can be either passive (MPU) or active (PROXIMITY).
The Phase pin needs to be a proximity type, MPU type is not allowed.

Application software (speed pattern 3,3): 5418-4079
In this 4-cycle engine version, the control needs 2 or 4 signals;

- Teeth on Crank (set #1) — Wiring Pin Out: J1 - G3/F3/F2
- TDC on Cam pin (set #1) — Wiring Pin Out: J1 - E3/D1/D2
- Teeth on Crank (set #2) — Wiring Pin Out: J1 - G1/F1/F2
- TDC on Cam pin (set #2) — Wiring Pin Out: J1 - E2/D1/D2

Set #2 can optionally be connected and used for redundancy purposes.

The speed sensor inputs can be either passive (MPU) or active (PROXIMITY).
The TDC pin needs to be a proximity type, MPU type is not allowed.

Analog Inputs

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

- Duration Input (4-20 mA) — Wiring Pin Out: J1 - P2/N3/N2
- Timing Input (4-20 mA) — Wiring Pin Out: J1 - N1/M1/N2

Connect these signals if the control has been configuration for hardwired connection of these signals.

Analog Outputs

- 4-20 mA Analog Output #1 — Wiring Pin Out: J1 - H3/G2
- 4-20 mA Analog Output #2 — Wiring Pin Out: J1 - H1/H2
- 4-20 mA Analog Output #3 — Wiring Pin Out: J1 - B3/A3
- 4-20 mA Analog Output #4 — Wiring Pin Out: J1 - A1/A2

The following list of signals can be configured to be output on any of the 4 analog 4–20 mA outputs of this control:

- Speed
- Duration
- Timing
- Average Cylinder Temperature
- Average CPD
- EFI Voltage
- MCU Voltage
- Fixed Value of choice

For each parameter the range of the signal being output can be set from the ToolKit page.

Discrete Inputs

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

- RUN permissive — Wiring Pin Out: J1 – E1/D2
- Temperature Balancer permissive — Wiring Pin Out: J1 – D3/D2
- RESET command — Wiring Pin Out: J1 – C3/B2
- Pre-Injection enable — Wiring Pin Out: J1 – C2/B2

All contacts are defined as NO, close for action.

The RUN contact always needs to be connected and can be combined with RUN permissives from either CAN or Modbus.

The Temperature Balancer permissive contact always needs to be connected when using the Temperature Balancing, and can be combined with RUN permissives from either CAN or Modbus.

The RESET command contact needs be closed momentarily to reset any latched alarms in the control. From ToolKit it is also possible to issue a reset command.

The control can be configured to need an external Pre-Ignition enable contact to switch on the pre-ignition.

Discrete Outputs

- Discrete Output #1 — Wiring Pin Out: J1 - K3/J2/K2
- Discrete Output #2 — Wiring Pin Out: J1 - J3/J2/K2
- Discrete Output #3 — Wiring Pin Out: J1 - K1/J2/K2
- Discrete Output #4 — Wiring Pin Out: J1 - J1/J2/K2

The following list of signals can be configured to be output on any of the 4 discrete outputs of this control:

- Major Alarm
- Minor Alarm
- Mode Stopped
- Mode Click-Test
- Mode Running
- Mode On-Line Test
- EFI Run Permissive
- Speed > Minimum
- Injection Active
- Temperature Balancer Permissive
- Temperature Balancer Active
- ERV finished, ready for GAS

For each parameter the selection of the signal being output can be set from the ToolKit page.

Injection Output Drivers

CONNECTOR J3

Injector 1.1 (#1)	(+)	J3-A2
	(-)	J3-A1
(#1 & #7)	shield	J3-A3

Injector 5.1 (#5)	(+)	J3-C1
	(-)	J3-B1
(#5 & #13)	shield	J3-C2

Injector 1.2 (#7)	(+)	J3-B2
	(-)	J3-B3
(#1 & #7)	shield	J3-A3

Injector 5.2 (#11)	(+)	J3-D2
	(-)	J3-D1
(#11 & #17)	shield	J3-E1

Injector 1.3 (#13)	(+)	J3-C3
	(-)	J3-D3
(#5 & #13)	shield	J3-C2

Injector 5.3 (#17)	(+)	J3-E2
	(-)	J3-E3
(#11 & #17)	shield	J3-E1

Injector 3.1 (#3)	(+)	J3-G1
	(-)	J3-H1
(#3)	shield	J3-F1

Injector 3.2 (#9)	(+)	J3-G3
	(-)	J3-H3
(#9)	shield	J3-F3

Injector 3.3 (#15)	(+)	J3-G2
	(-)	J3-H2
(#15)	shield	J3-F2

CONNECTOR J4

Injector 2.1 (#2)	(+)	J4-Y2
	(-)	J4-Y1
(#2 & #8)	shield	J4-Y3

Injector 6.1 (#6)	(+)	J4-W1
	(-)	J4-X1
(#6 & #14)	shield	J4-W2

Injector 2.2 (#8)	(+)	J4-X2
	(-)	J4-X3
(#2 & #8)	shield	J4-Y3

Injector 6.2 (#12)	(+)	J4-T2
	(-)	J4-T1
(#12 & #18)	shield	J4-S1

Injector 2.3 (#14)	(+)	J4-W3
	(-)	J4-T3
(#6 & #14)	shield	J4-W2

Injector 6.3 (#18)	(+)	J4-S2
	(-)	J4-S3
(#12 & #18)	shield	J4-S1

Injector 4.1 (#4)	(+)	J4-P1
	(-)	J4-N1
(#4)	shield	J4-R1

Injector 4.2 (#10)	(+)	J4-P3
	(-)	J4-N3
(#10)	shield	J4-R3

Injector 4.3 (#16)	(+)	J4-P2
	(-)	J4-N2
(#16)	shield	J4-R2

Chapter 3.
Description of Operation

Introduction

This chapter provides an overview of the features, setup, and operation of this In-Pulse II – Standard Multi-Point Driver.

The control defines 4 operational modes:
- Stopped Mode
- Click-Test Mode
- Running Mode
- On-Line Test Mode

The test modes can be selected on their respective ToolKit pages.

Stopped Mode

In the Stopped mode, EFI injection will be disabled. This mode stays active as long as any of these conditions is true:
- There is an active shutdown
- Speed < minimum
- EFI Injection permissives are absent

In Stopped Mode, it is possible for the operator to select Click-Test Mode.

Click-Test Mode

In the Click-Test mode. EFI injection can be enabled. This mode stays active as long as all of these conditions are true:
- Speed < minimum
- Time in Click-Test mode is under 1 hour

The operator can leave the Click-Test Mode at any time and return to Stopped Mode. This mode allows energizing the individual injector outputs with full control over the individual timing and duration. It is typically used to verify wiring from EFI to the correct cylinder. After 1 hour in this mode, the control will automatically leave this mode and return to Stopped Mode.

Running Mode

In the Running mode, EFI injection will be enabled. This mode stays active as long as all of these conditions is true:
- There is no shutdown
- Speed stays > minimum
- EFI Injection permissives stay present

In Running Mode, it is possible for the operator to select On-Line Test Mode. The EFI will follow the configured Duration & Timing in the Running mode.

On-Line Test Mode

The On-Line Test mode can be selected when the EFI is in Running mode. EFI injection will stay enabled. This mode stays active as long as all of these conditions is true:

- There is no shutdown
- Speed stays > minimum
- EFI Injection permissives stay present
- Time in On-Line Test mode is under 10 minutes

The operator can leave the On-Line-Test Mode at any time and return to Running Mode.

Each EFI injector output (Timing and/or Duration) can be put in test individually. When put in On-Line test mode, the Timing and/or Duration will freeze, and not follow the main Duration and/or Timing. For safety purposes, this mode will automatically be left after 10 minutes and it will return to normal Running Mode.

WARNING

Only trained and qualified people shall enter the Online TEST mode!

WARNING

Only enter Online TEST mode in steady state operation!
Do not overfuel!

Be aware of knocking limits when advancing injection timing!

Cylinder Temperature Balancing

Cylinder Temperature Balancing can be enabled when the EFI is in Running mode. When all applicable permissives are True (contact input, CAN permissive, minimum load threshold), Cylinder Temperature Balancing becomes active. Individual cylinder injector duration will be biased (within the Bias Limit) such that all the cylinder temperatures tend to move toward each other. With Bias Rate the dynamic of this control can be optimized.

When temperature sensors fail, they will taken out of the average calculation. Optionally, Cylinder Temperature Balancing can be stopped when a set number of temperature sensors fail.

ERV Cycling

When EFI Running becomes active, it is possible to perform an "ERV Purge Cycle" sequence (if enabled). Duration & Timing will be switched over to pre-defined ERV Purge Cycle values for an adjustable amount of time. When the cycle ends, a discrete output “Ready for Gas” will become active, and the Duration & Timing will switch over to their normal inputs. When the EFI enters Stopped Mode, ERV Purge Cycling will be blocked for an adjustable amount of time.

Chapter 4.
ToolKit

ToolKit Introduction

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

Throughout, the Woodward user interface program ToolKit it used to configure and operate the In-Pulse II – Standard Multi-Point driver.

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. For the In-Pulse II – Standard Multi-Point driver, these files will be supplied with the control system.

When the .WTOOL file is opened, one can connect to the In-Pulse II control on its serial port #1 (RS-232) using a null-modem serial cable.

TX	←--→	RX
RX	←--→	TX
GND	←--→	GND

NOTICE

Prevent grounding issues when connecting a computer to an IP2, through its serial port and cable. Preferably use 1784-1099, which is an isolated serial USB port capable of RS-232, RS-485, and RS-422.

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

NOTICE

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 In-Pulse II control with the .SID file which comes with the .WTOOL user interface tool. If these do not match, there is a mismatch between the In-Pulse II 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 16 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 can allows changing almost all configuration parameters.

Level 16 is the highest access level. It allows changing any configuration parameter, including the model related parameters for the injector output current profile.

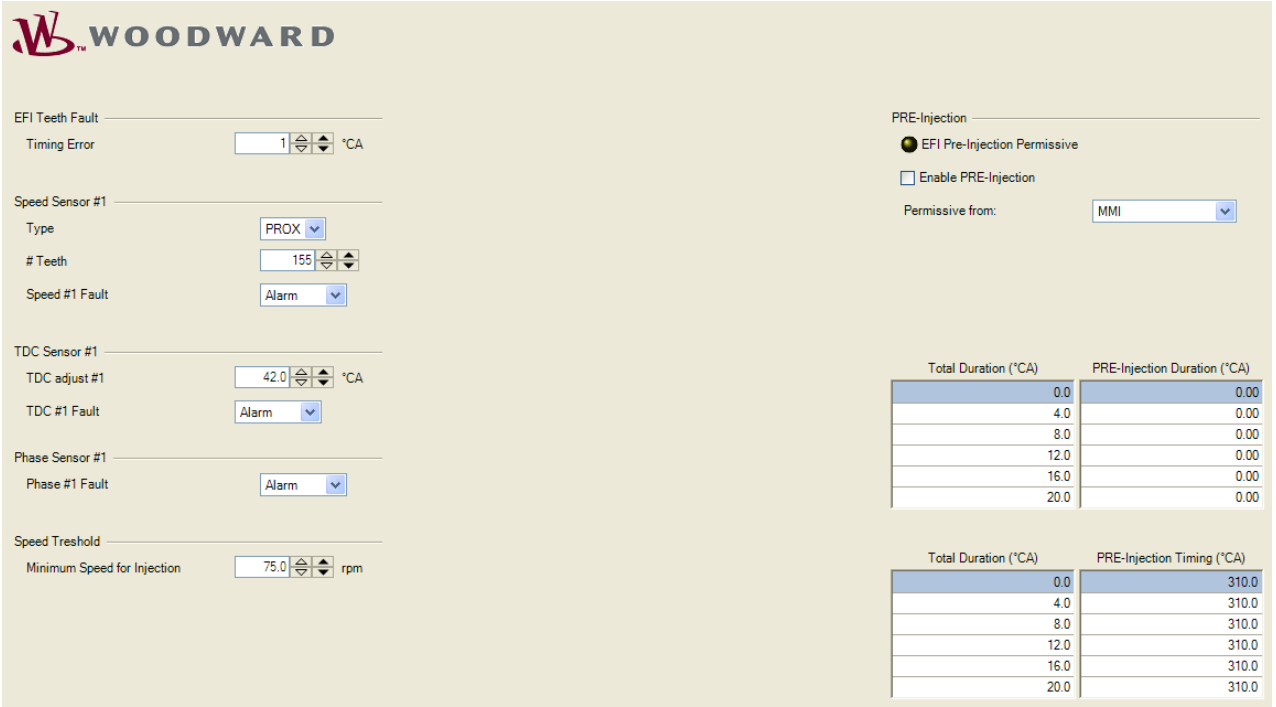
Configuration Pages

WARNING **When setting up the Configuration, the engine must be stopped and prevented from starting!**

The Configure Pages shall be visited to properly setup the In-Pulse II – Standard Multi-Point driver:

- C01 : Configure EFI & Speed
- C02 : Configure EFI – Outputs Selection
- C03 : Configure EFI – Current Profile
- C04 : Configure EFI – Inputs Selection
- C05 : Configure Outputs (DO and AO)
- C06 : Configure Temperature Balancing
- C07 : Configure Serial, CAN & Modbus
- C08 : Configure Alarm & Shutdown

CO1: Configure EFI & Speed



Setting up the speed sensing should be one of the first things to do.
Please refer to manual 26343 for details and limitations for the speed sensors.

IMPORTANT **Most of the speed related configuration settings require a reboot of the control for them to take effect.**

SAVE tunables prior to rebooting the control!

Timing Error This is the number of degrees of timing error that is allowed. This determines the number of extra or missing teeth that the control can count without causing TEETH_FLT to be set to true. The extra or missing teeth allowed = TIM_ERROR / degrees per tooth. This value is rounded down to the closest integer number. If the actual tooth count differs by more than this amount then the TEETH_FLT output will be set to true.

Type Select either PROX or MPU

 # Teeth Sets the number of teeth for the speed sensor(s)

Speed #1/2 Fault Set the required action for a speed sensor failure. This can be either an Alarm, Shutdown or switchover to group #2 (if applicable).

#TDC adjust #1/2 Sets the distance in crank angle degrees from the true TDC reference point to the TDC point measured by the sensor. The range is 0 to 720°.

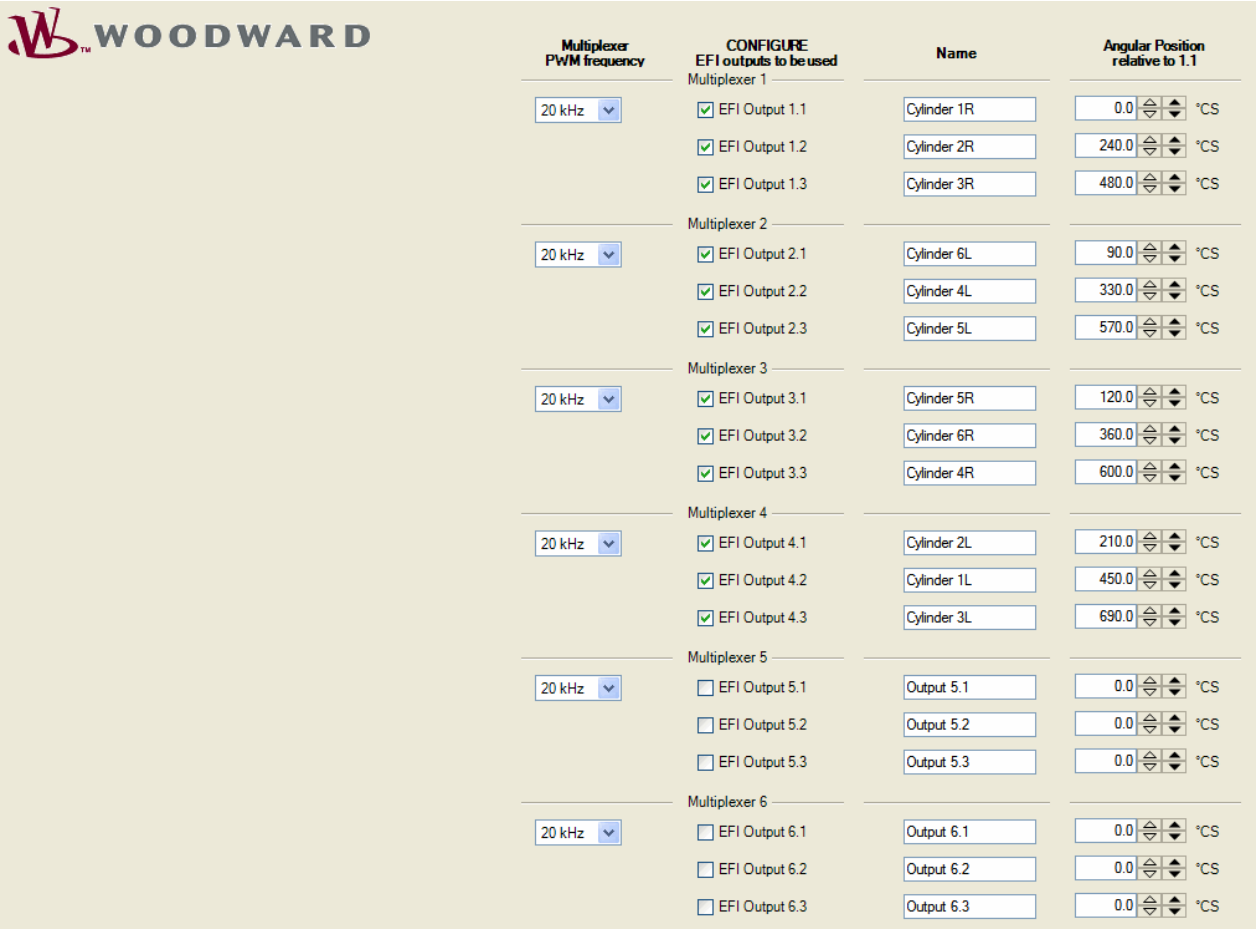
Example: If TDC is sensed before the true TDC by 10 degrees, then for a 2-stroke engine TDC_ADJST1 should be set to 350 degrees. If the same conditions were true for a 4-stroke engine then TDC_ADJST1 should be set to 710 degrees.

TDC #1/2 Fault Set the required action for a TDC sensor failure. This can be either an Alarm, Shutdown or switchover to group #2 (if applicable).

Minimum Speed Sets the minimum required speed that enables the injection control; this is typically set a bit below the maximum obtainable starter/cranking speed.

Pre- Injection When pre-injection is used, two tables will appear. These tables define the duration of the pre-injection in °CA, and the timing in °CA before normal injection.

CO2: Configure EFI Outputs Selection

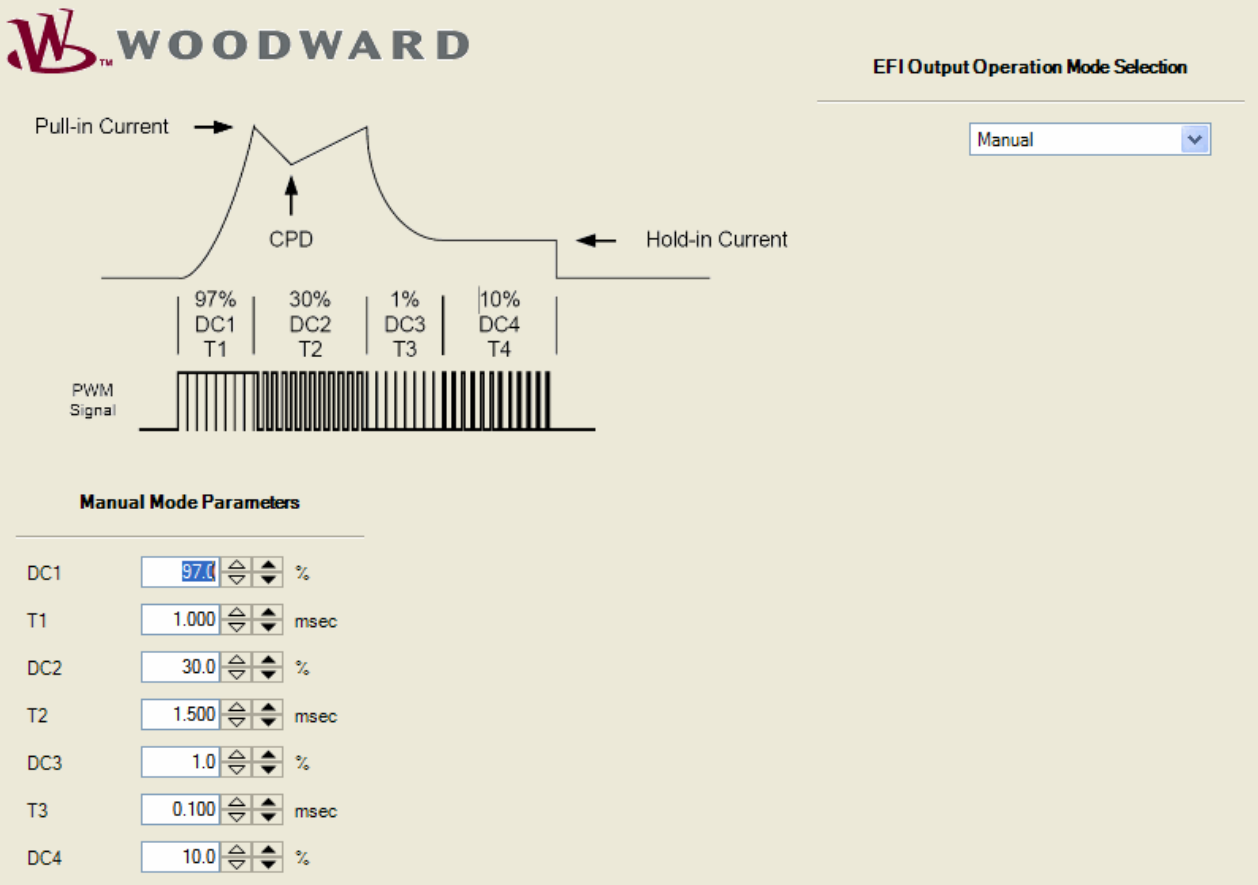


Up to 18 injector outputs can be used. They are distributed over 6 multiplexers of 3 injectors each. Per multiplexer group, only 1 injector can be active at any time. Using the firing order of the engine, the injectors output shall be distributed to cylinders such that there will be no overlap in activation time of injectors within the same multiplexer group.

Multiplexer PWM frequency Sets the PWM frequency of the injector outputs.
10 kHz - For valves with very large inductance. SOGAV 250 or larger.
20 kHz - For valves with moderate inductance. All SOGAV & Rail valves
30 kHz - For valves with low inductance. Some common rail injectors.
150 kHz - For valves with very low inductance. Applications such as 12 V truck diesel injectors require this setting.
If the frequency is too low, the signal to noise ratio of the closure event suffers.

Each of the 18 injector outputs can be enabled by placing a “tick”.
An injector/cylinder **Name** can be entered and saved for convenience.
The **Angular Position relative to 1.1** sets the crank angle degrees with respect to injector output 1.1. Output 1.1 shall remain at an offset of 0.0 relative to the real TDC.

CO3: Configure EFI Current Profile (Manual Mode)



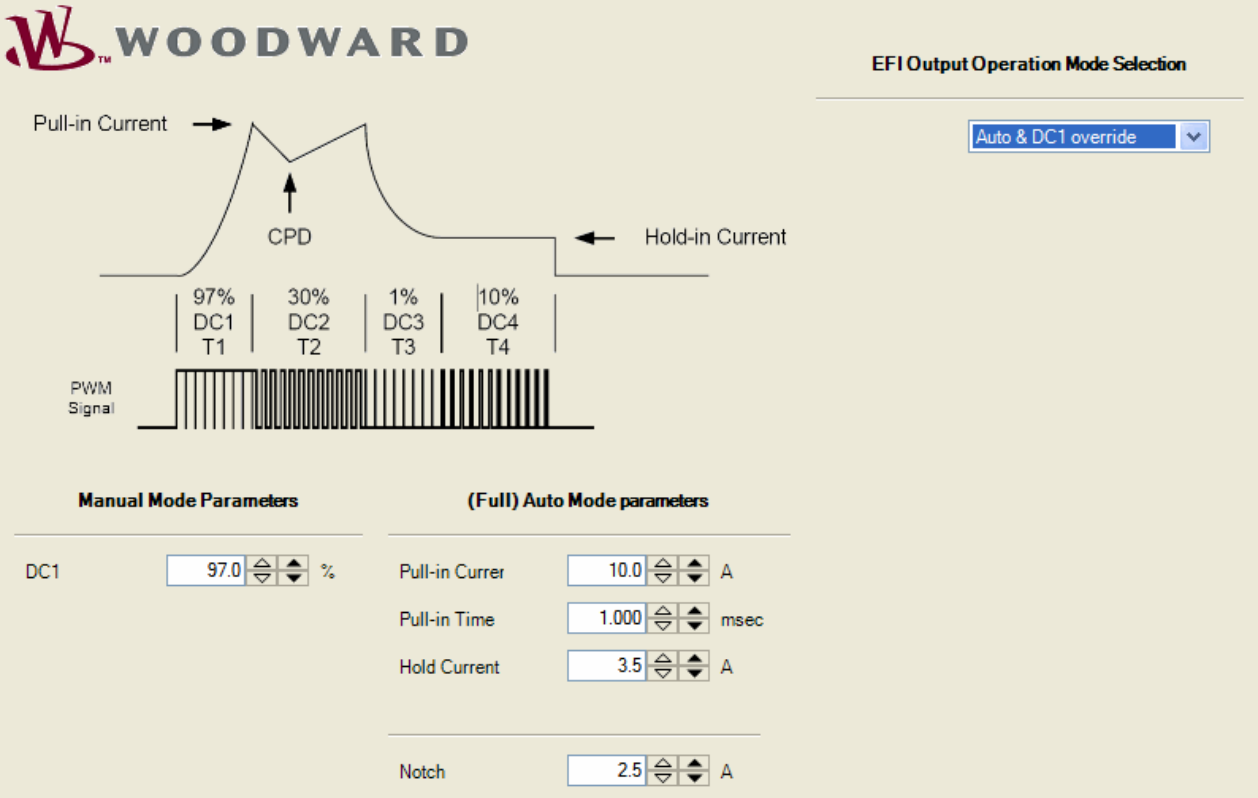
The required **EFI Output Operation Mode Selection** can be selected from the drop down list.

Manual mode The current profile is setup open loop, current is not monitored. There is no Closure Point Detection, no Open Coil diagnostics, no current compensation for (environmental) changes.
Typically this mode is used for common rail injectors when the injection duration is quite short (too short for proper automatic model operation).

DC1 PWM duty cycle for pull-in. Typically as high as possible for fast pull-in.
T1 Pull in time
DC2 PWM duty cycle for pull-in2.
T2 Pull-in2 time
DC3 PWM duty cycle for decay.
T3 Decay time
DC4 PWM duty cycle for hold current.

DC1 and **T1** are adjusted such that the pull-in current & times match the valve/injector manufacturer's datasheet.
DC2 and **T2** are adjusted such that the pull-in time is according specification and the final current does not exceed the pull-in current. Typically due to needle or valve movement, the current will drop due to changing impedance and back-EMF of the injector/valve.
DC3 and **T3** are adjusted such that the decay time to the hold current is short.
DC4 is adjusted for the correct hold current of the injector/valve.

CO3: Configure EFI Current Profile (Auto Mode)

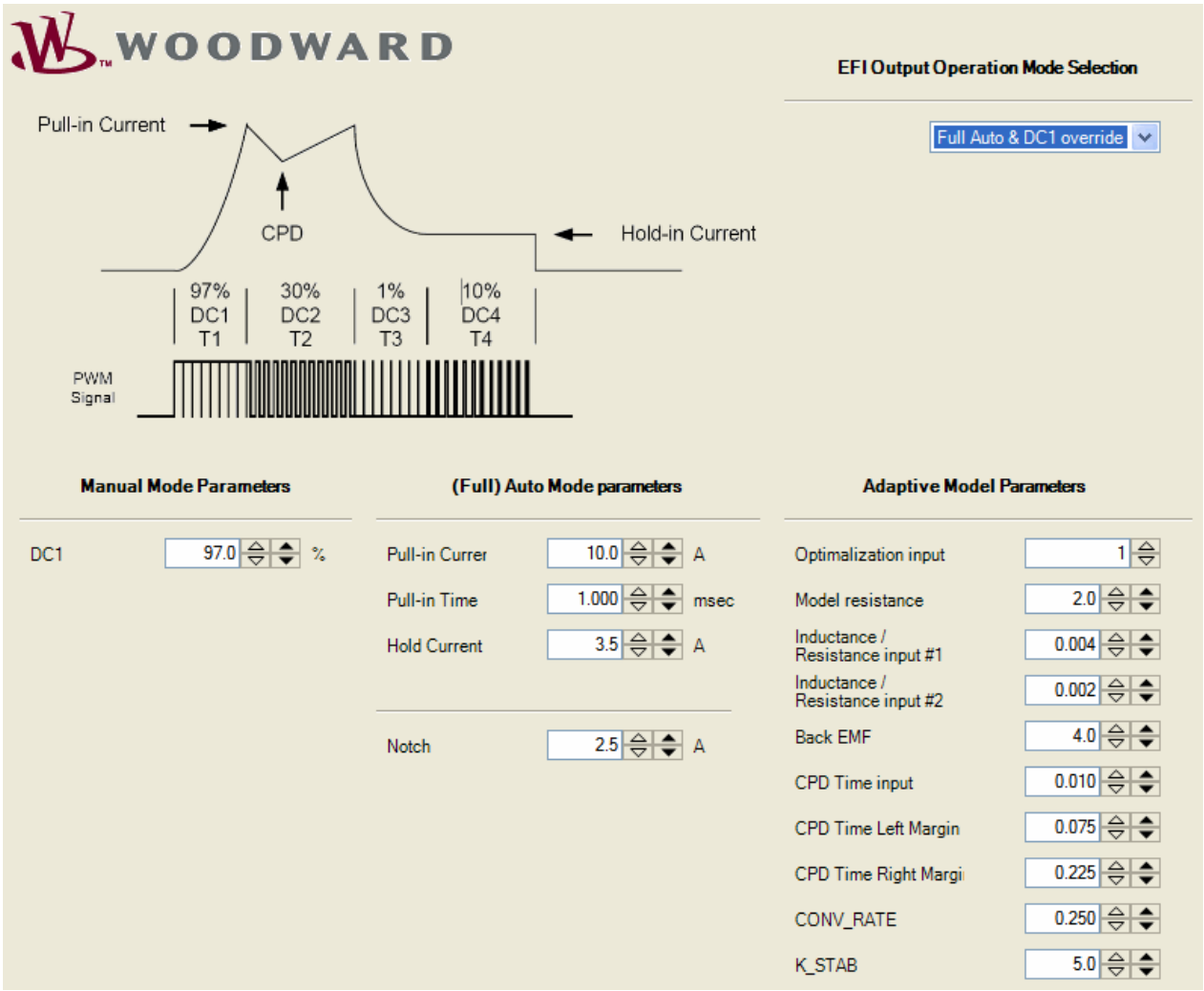


Auto mode The current profile is setup closed loop, current is actively controlled. There is Open Coil diagnostics and current compensation for (environmental) changes. There is no Closure Point Detection.

Pull-in Current This is normally the worst-case value specified by the valve manufacturer
Pull in Time Total Pull-in Time before decay to Hold current. This is normally the worst-case value specified by the valve manufacturer
Hold Current After the valve closes the current is reduced to this level to maintain closure
Notch Adaptive current control algorithm parameter used to control the size of the closure deflection.
Typically set at (Pull-in current – Hold current) / 2

When the DC Override option has been chosen in **auto** mode:
DC1 PWM duty cycle for pull-in. Some valves/injectors may need a maximum limitation on the pull in PWM duty cycle.

CO3: Configure EFI Current Profile (Full Auto Mode)



Full Auto mode Embedded algorithm automatically controls the current waveform and CPD.
Reports CPD for control and/or diagnostics
Reports open coil diagnostics
Reports valve parameters which may be useful for other prognostics
Compensate for variation in operating conditions such as fuel pressure, supply voltage, coil resistance, etc.
Compensate for unit to unit variation in injectors
Compensate for type to type variation (mix of injectors)
Compensate for aging and fouling effects
Tested with many valve types

Set **Pull-in Current, Pull in Time, Hold Current, Notch, DC1** as per **auto** mode

CONV_RATE Used to control the step size of changes applied by the model each time it runs. Input is a percent of the total change identified by the model. Keep small to avoid reacting to transient conditions (~0.25)
Temporarily make large during commissioning to make it faster (~0.5)

K_STAB Stability constant for CPD control. Main (fast) control loop is for TIME_x and DC_x changes due to current feedback monitoring. Secondary (slow) control loop is for CPD control (notch control) to keep it properly placed between the margins. Large numbers cause slower reactions to changing CPD (~10). Small numbers allow faster reactions to CPD (notch) movement (~3). May want small number during commissioning to speed the process.

Model Resistance Directly proportional to hold-in current. Used by model to estimate DC4 for first iteration.
DC4 = I x R / V. Where V = Coil Volts, I = desired hold current

Inductance/Resistance #1 Time constant for current rise during TIME_1 Used by model to estimate T1 for first iteration. Larger values of LR1_IN will result in the first estimate of T1 being longer

Inductance/Resistance #2 Time constant for current fall during TIME_3 Used by model to estimate T3 for first iteration
Larger values of LR2_IN will result in the first estimate of T3 being longer

Back EMF A measure of the energy needed to restore the pull-in current level after closure. Used by model to estimate DC2 for first iteration. Larger values of BEMF_IN will result in the first estimate of DC2 being higher

CPD Time An estimate of the time to valve closure. Used by model to locate the CPD anchor for the first iteration. The TIME_x and DC_x parameters are changed assuming a constant CPD. Set this value according to the expected CPD provided by the manufacturer.

CPD Time Left Margin Desired time from the peak of T1 until Notch Used again each time the model is run. Values that are too short will result in a loss of closure into T1. Smaller values cause T1 to increase.

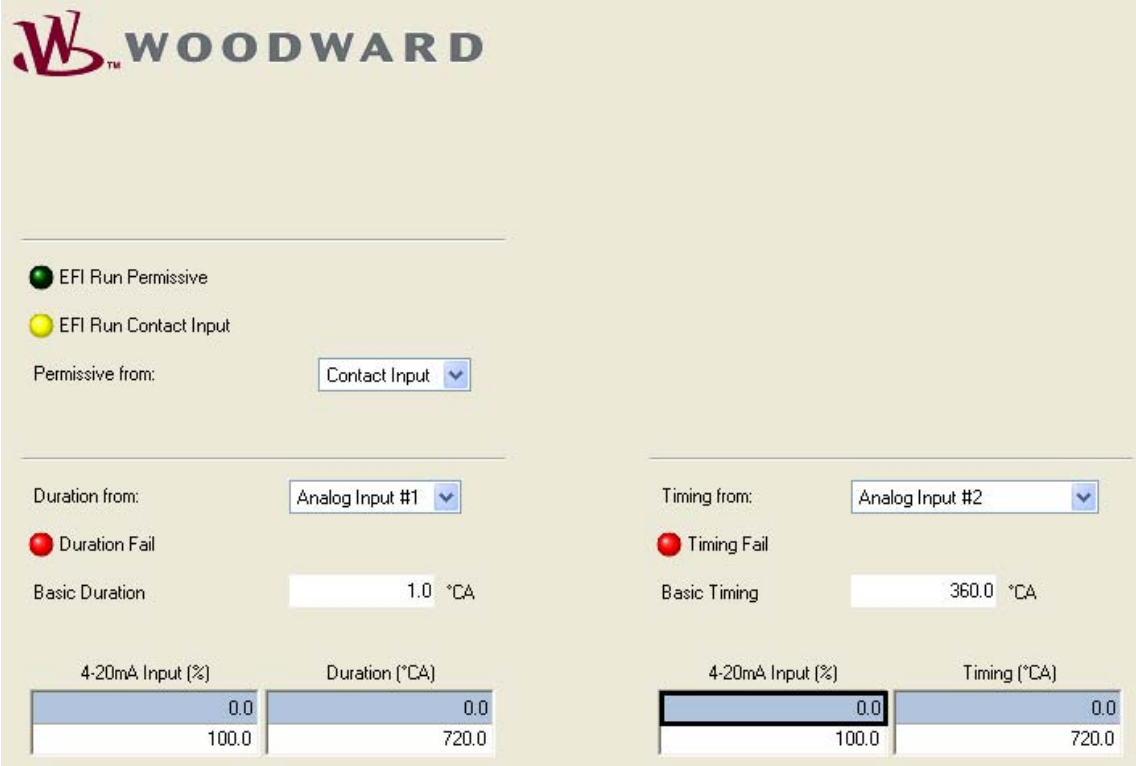
CPD Time Right Margin Desired time from Notch until the peak of T2 Used again each time the model is run. Values that are too short will result in a loss of closure into T3. Smaller values cause incorrect values for T2 and DC2

IMPORTANT

Please consult Woodward for proper setup of the model parameters when using Woodward valves in Full Auto mode.

Woodward can also assist when using 3rd party valves or injectors.

CO4: Configure EFI Inputs Selection



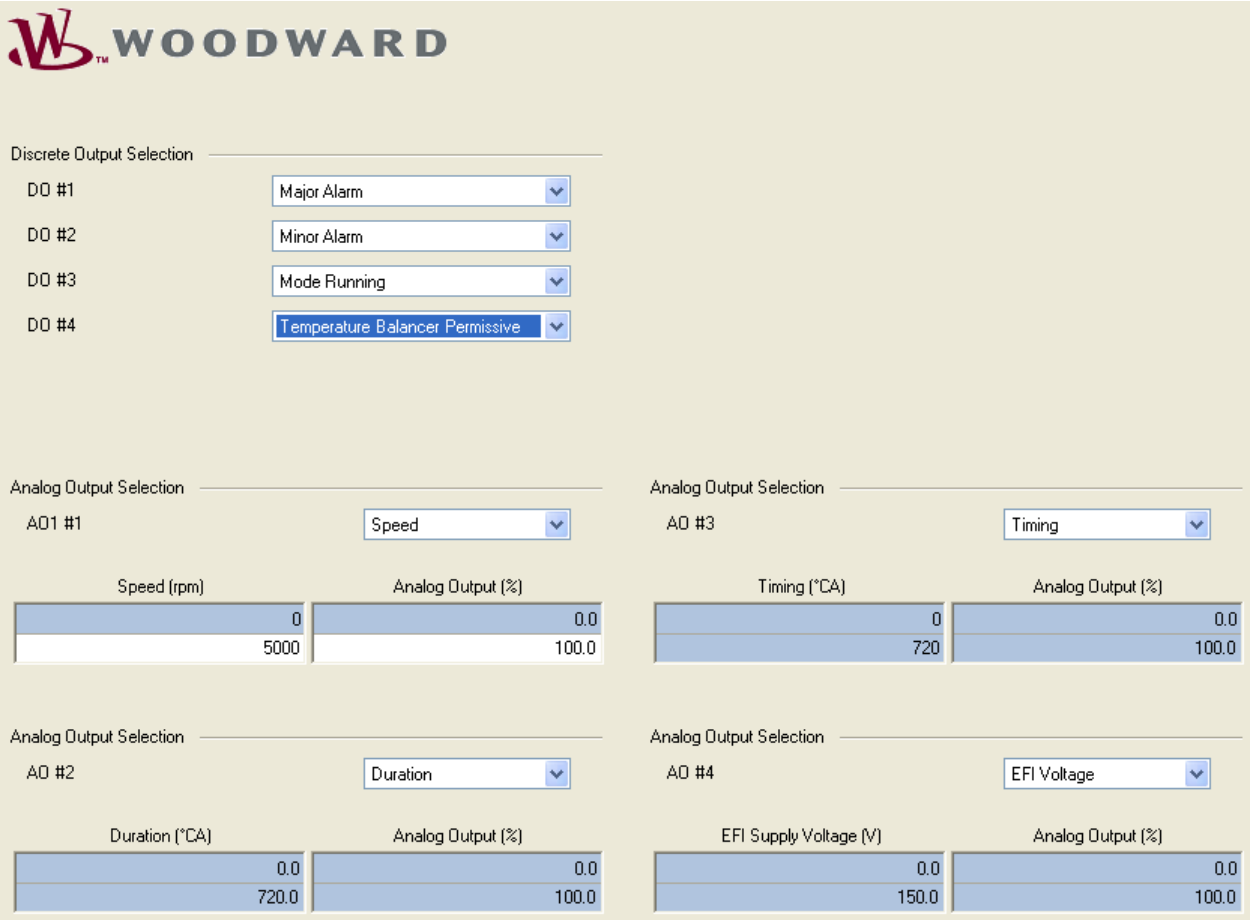
The required **EFI Permissive, Duration & Timing Inputs** can be selected from their respective drop down lists.

EFI Run Permissive The input contact #1 is always needed.
Another RUN permissive bit from either Modbus or CAN can be chosen. The green LED will light when all permissives are OK.

Duration Can originate from 4–20 mA input #1, or via CAN, or via Modbus or can be set to a fixed value from the ToolKit user interface.
The signal will fail if the current is <4 mA or >20 mA, the CAN communication fails, or the Modbus communication fails.
In case of 4–20 mA or Modbus, input signal scaling can be adjusted.
In case of Analog Input, the type of input signal can be set up in the Analog Input type dropdown list.

Timing Can originate from 4–20 mA input #2, or via CAN, or via Modbus or based upon a duration curve, speed curve, or can be set to a fixed value from the ToolKit user interface.
The signal will fail if the current is <4 mA or >20 mA, the CAN communication fails, or the Modbus communication fails.
In case of 4–20 mA or Modbus, input signal scaling can be adjusted.
In case of Analog Input the type of input signal can be setup in the Analog Input type drop down list.
In case of a duration based curve or speed based curve, 6 points are available.

CO5: Configure EFI Outputs (DO & AO)



The following list of signals can be configured to be output on any of the 4 discrete outputs of this control:

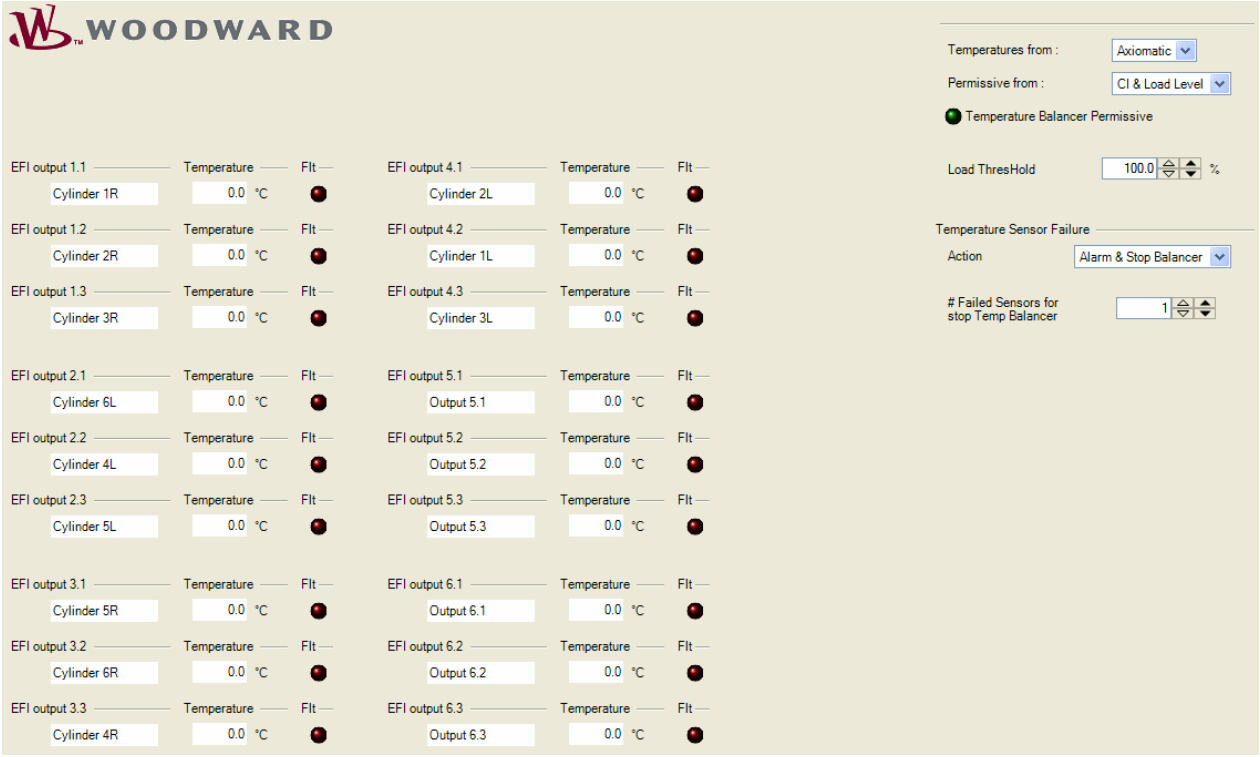
- Major Alarm
- Minor Alarm
- Mode Stopped
- Mode Click-Test
- Mode Running
- Mode On-Line Test
- EFI Run Permissive
- Speed > Minimum
- Injection Active
- Temperature Balancer Permissive
- Temperature Balancer Active
- ERV finished, ready for GAS

The following list of signals can be configured to be output on any of the 4 analog 4-20 mA outputs of this control:

- Speed
- Duration
- Timing
- Average Cylinder Temperature
- Average CPD
- EFI Voltage
- MCU Voltage
- Fixed Value of choice

Output signal scaling can be adjusted

CO6: Configure Temperature Balancing



Temperatures from: The cylinder temperatures can originate from the Axiomatic TC module, J1939 CAN, or Modbus. Select Not Used to disable Temperature Balancing.

Temperature Balancer Permissive The input contact #4 is always needed. Another Temperature Balancer permissive bit from either Modbus, CAN or an adjustable minimum Load/Duration threshold can be chosen. The green LED will light when all permissives are OK and the EFI is active.

Temperature Sensor Failure: This defines the action that will be taken when any of the cylinder temperature sensor signals fails.
Possible actions are: No Alarm, Alarm, Alarm & Stop Balancer & Shutdown.

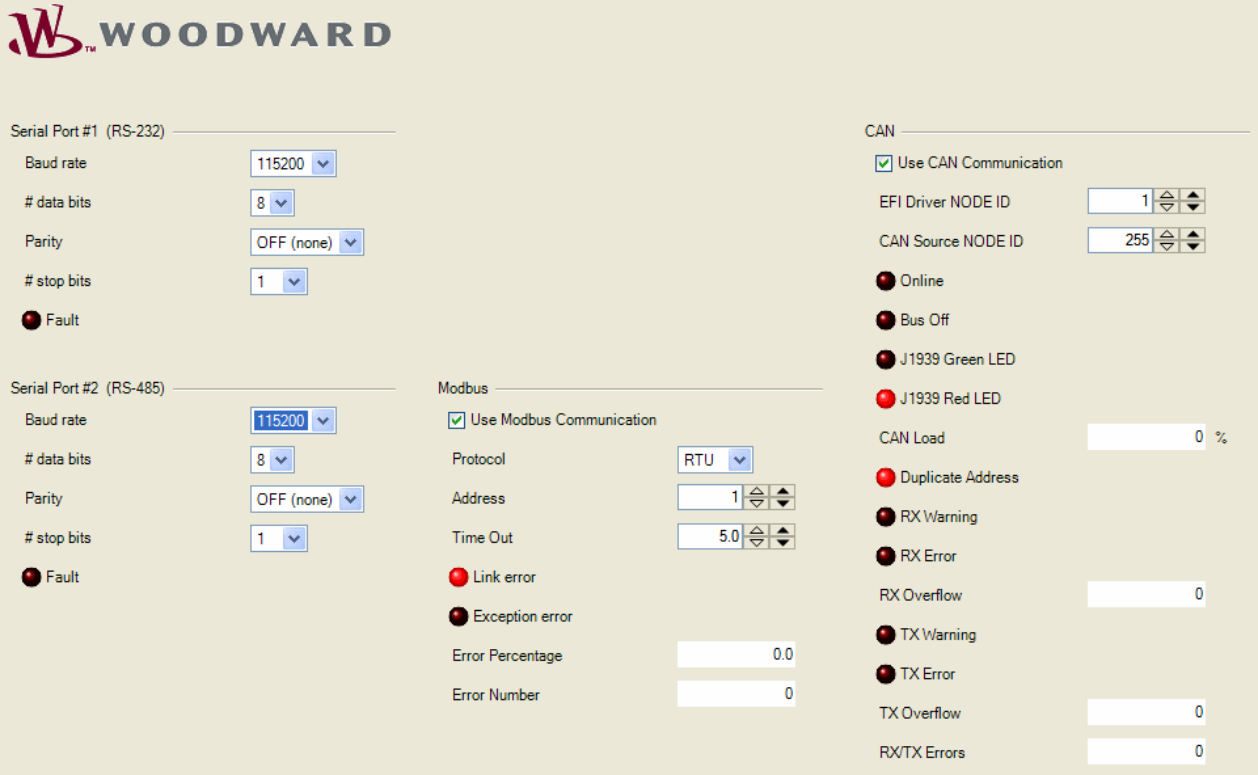
In case Alarm & Stop Balancer is chosen, the number of failed sensors can be set that will result in Stop Balancer.

Cylinders with a failed temperature sensor will not participate in Temperature Balancing anymore.

The page displays the actual cylinder temperatures and a Green or Red LED to indicate the signal (or communications) is OK or in fault.

⚠WARNING **Maintain the same assignment of temperature sensors to cylinders as injector outputs to cylinders for correct operation of Temperature Balancer.**

CO7: Configure Serial, CAN & Modbus



Serial Port #1 is always RS-232 and is used for ToolKit exclusively.
Serial Port #2 is always RS-485 and is used for Modbus communications.

The following properties can be configured:

Baud rate: The baud rate can be: 110, 300, 600, 1200, 1800, 2400, 4800, 9600, 19200, 38400, 57600 or 115200. At the highest baud rates, the serial cabling (capacitance, twisted, shielding & length) can be a limiting factor. When getting communication errors, one can resort to better cabling, shorter lengths and lower baud rates.

 # data bits: Choose between 7 or 8

Parity: Choose between OFF (none), ODD or EVEN

 # stop bits: Choose between 1, 1.5 or 2

The fault LED will light up RED when communication is in not OK.

When **Use Modbus Communication** is selected, the following properties can be configured:

Protocol: Choose the Modbus ASCII or RTU protocol.

Address: Choose between 1 and 247. Defines the slave block address on the Modbus network

Time Out: Choose between 0.0 and 60.0. Defines the Modbus link dead time [s] allowed before a link error occurs

The **Link error** LED goes RED when the Modbus slave fails to answer a data request in specified number of time-out seconds.

The **Exception error** LED goes RED when an exception error such as "illegal Modbus command" is detected.

When Modbus communication is enabled and operating OK,
none of the LED's should be lit and **Error Percentage** should be 0 (or going towards 0), and **Error Number** shall be 0.

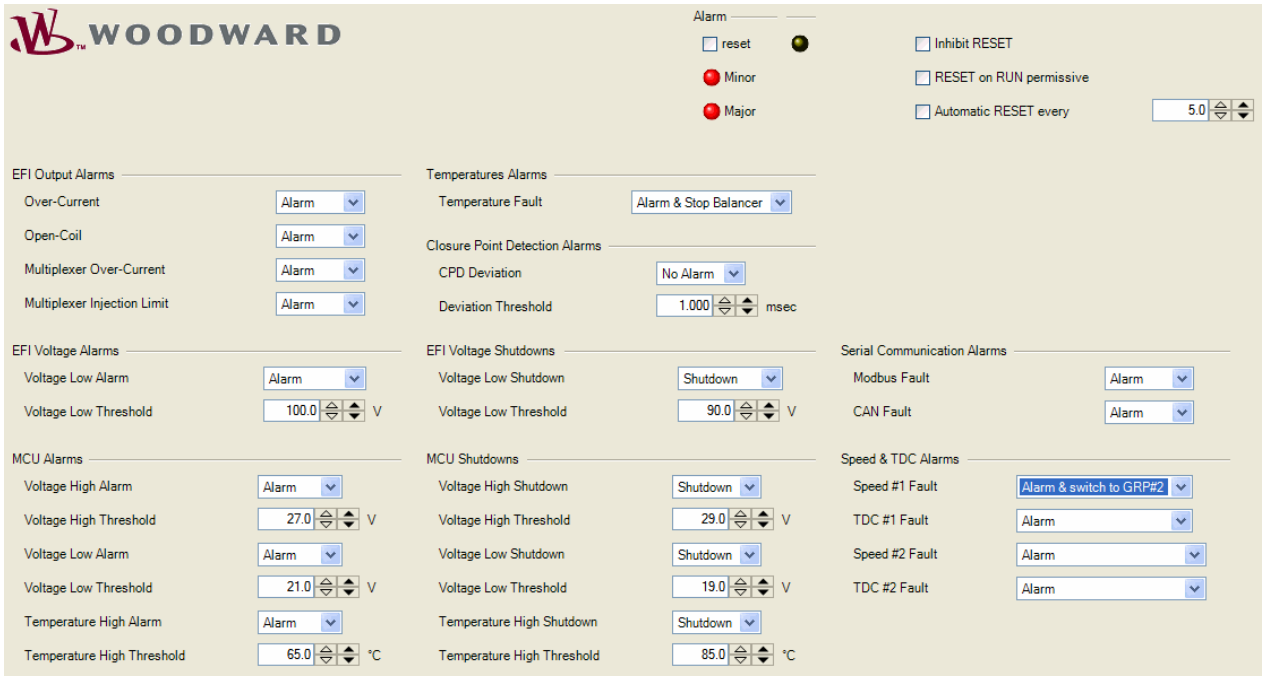
When Use CAN Communication is selected, the following properties can be configured:

EFI Driver NODE ID Choose between 0 and 253. Defines the node ID for this driver unit

CAN Source NODE ID Choose between 0 and 255. Defines the Producer's node ID number. If set to the default value of 255 the control will accept any node's message with the correct message ID. This is needed for the CAN messages this driver unit receives (for example receiving duration offsets by from an PLC system).

All J1939 CAN status LED's shall be either GREEN or not lit when communication is OK.

CO8: Configure Alarms & Shutdowns



For most failures, it is possible to choose between No action, Alarm, Alarm when running, Shutdown or Shutdown when running.

The individual alarms can be monitored on the Alarms page.
The individual shutdowns can be monitored on the Shutdown page.
Alarm & shutdowns are also logged; see the Event Manager page.

Alarms & shutdowns are latching, so a reset command is required to reset them.
The reset command can be initiated from this ToolKit page, by the RESET contact input, automatically every time the RUN permissives becomes TRUE or automatically by an internal cyclic RESET generator (cycle time is adjustable between 0 and 600 seconds).

EFI Voltage Low Thresholds Choose between 21 and 100 Vdc.
When the EFI supply voltage goes below these values, the respective Alarm or Shutdown action is activated.

MCU Voltage High Thresholds Choose between 18 and 34 Vdc.
When the MCU supply voltage goes above these values, the respective Alarm or Shutdown action is activated.

MCU Voltage Low Thresholds Choose between 18 and 34 Vdc.
When the MCU supply voltage goes below these values, the respective Alarm or Shutdown action is activated.

MCU Temperature High Thresholds Choose between 21 and 100 °C.
When the MCU temperature goes above these values, the respective Alarm or Shutdown action is activated.

CPD Deviation Threshold Choose between 0 and 1000 ms.
When an injectors individual CPD deviates from the average CPD time by more than the threshold value, the respective Alarm or Shutdown action is activated.

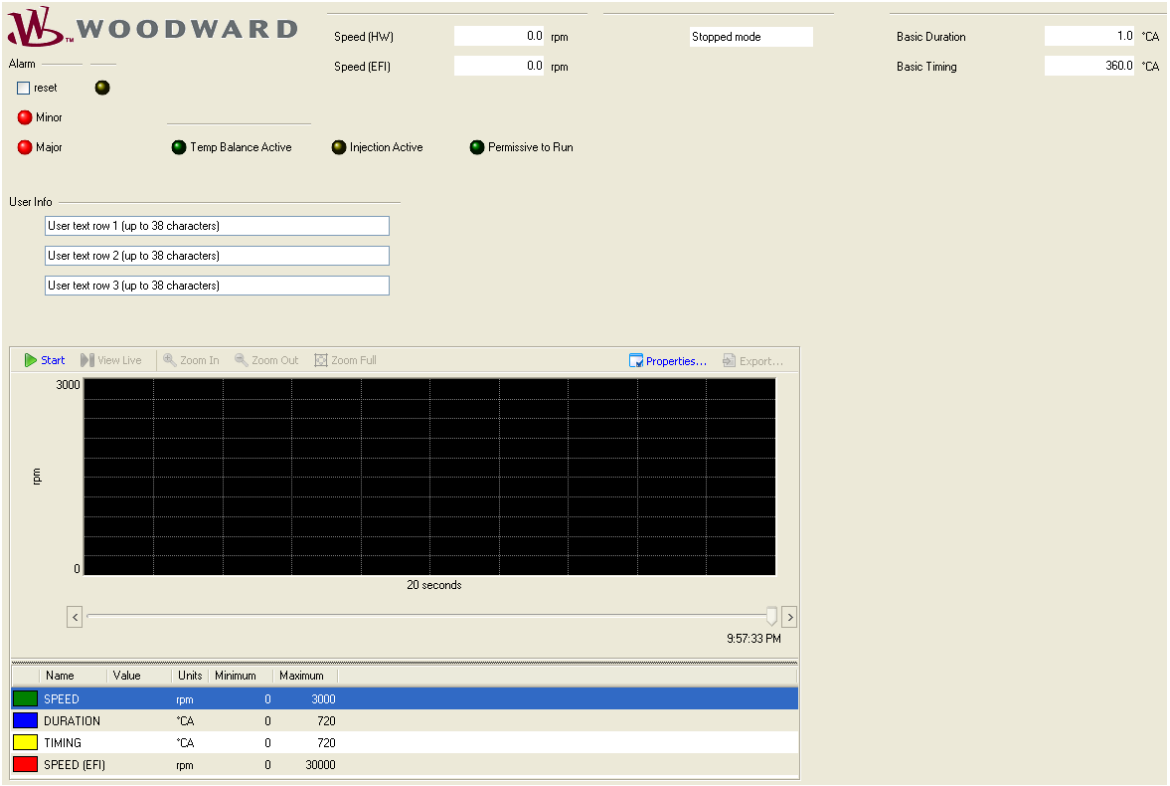
EFI Operation Pages

WARNING **Configuration must have been set up prior to operating the EFI.**

The following EFI operation pages are available:

- A01 : Main Page
- A02 : Monitor EFI outputs
- A03 : Temperature Balancing - Bias Control
- A04 : Closure Point Detection Deviation
- A05 : Timing & Duration - Manual bias
- A06 : Timing & Duration - Modbus bias
- A07 : Timing & Duration - CAN bias
- A08 : Test EFI outputs
- A09 : ERV Purge Cycling Sequence
- B01 : Alarms
- B02 : Shutdowns
- B03 : Event Manager
- B04 : System Information

A01: Main Page

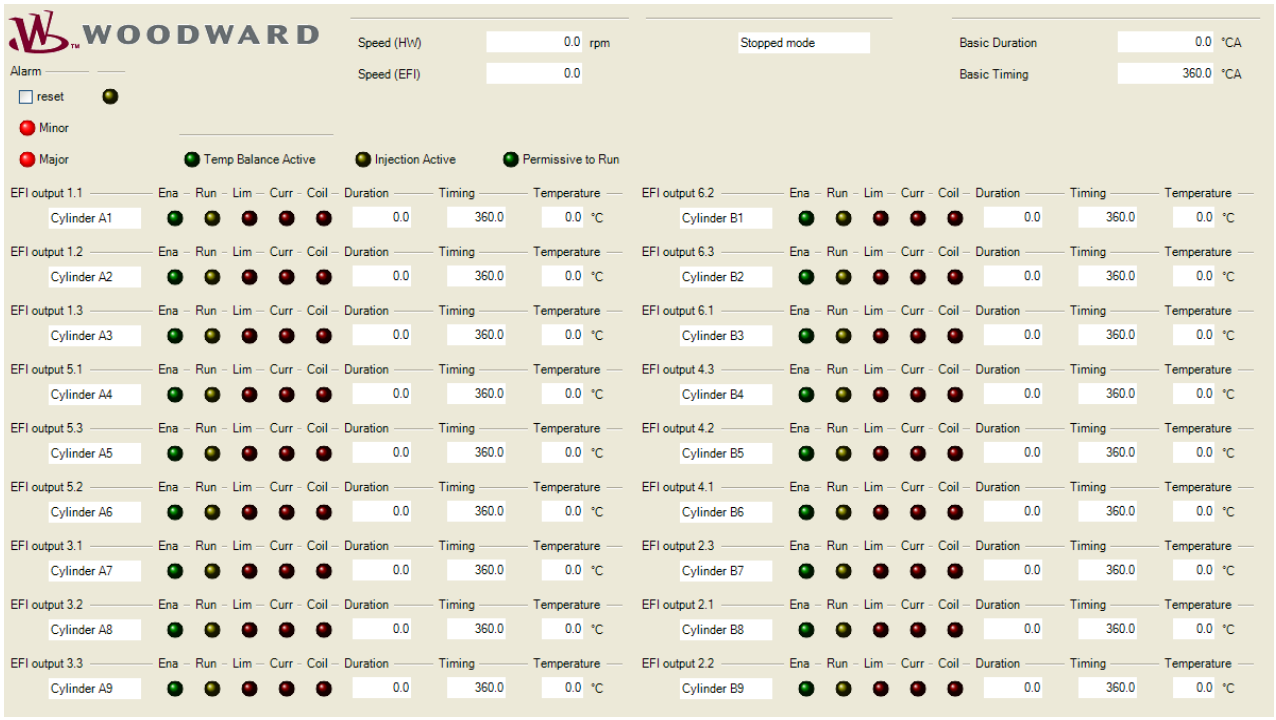


The Main Page shows an overview of the operation parameters & mode for the EFI driver unit.

The three rows of **User Info** can be filled out with a text of choice, each line can contain up to 38 characters. These text strings can be saved like any other parameter.

There is an embedded **Trend** on the page, but many parameters can be trended by using an ad hoc trend. Place the mouse cursor over a display parameter, right click and there will be a popup **add to trend**.

A02: Monitor EFI Outputs



The Monitor EFI outputs page shows an overview of the all the EFI outputs and their individual statuses and parameters.

For each injector output, the duration and timing (after biasing) are shown. The cylinder temperature is shown as well, if not used it will display 0.0 °C.

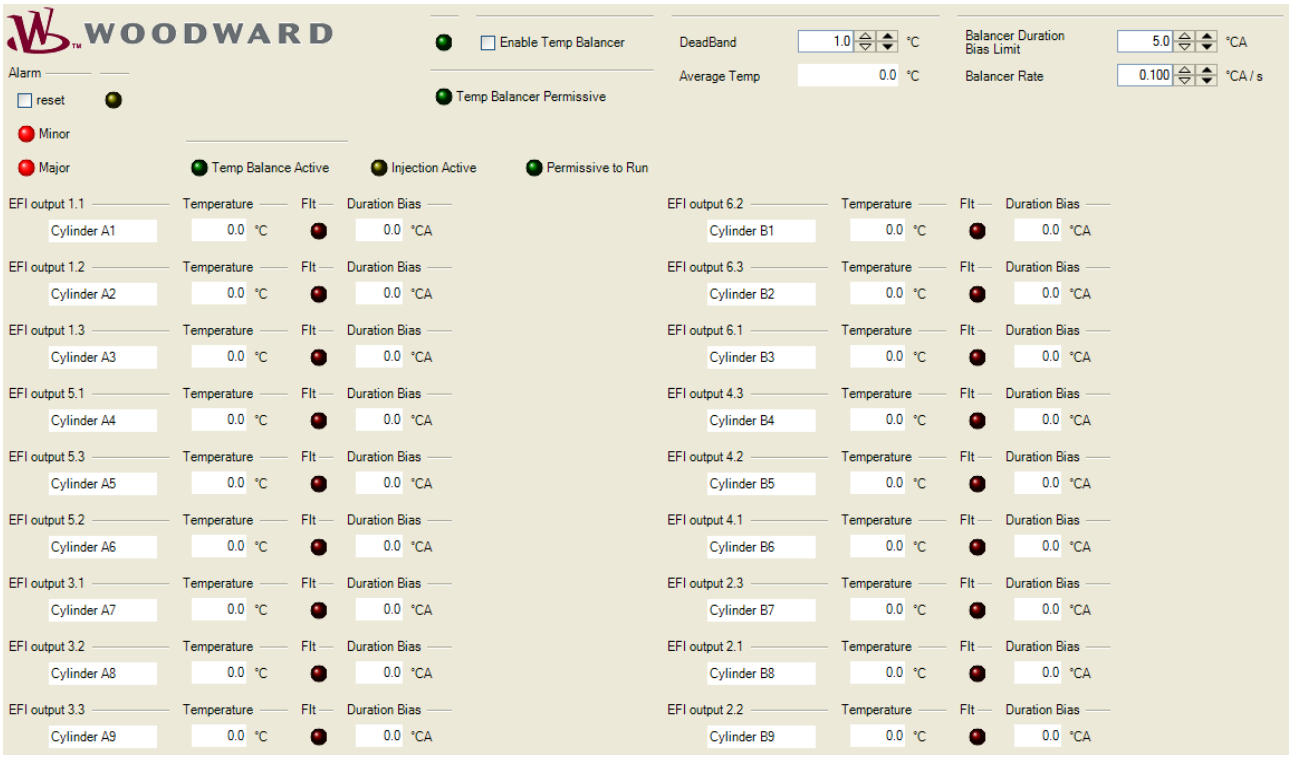
The **Ena** LED indicates the injector is enabled and the **Run** LED is a feedback that the hardware output is activated.

The **Lim** LED indicates that indicates a fuel injection limiting action has occurred. It may indicate that an overlap has occurred between pre-injection, main injection, and post-injection pulses. It may also indicate a fuel injection duration that is too long or that an injection timing violation has occurred.

The **Cur** LED field indicates that an overcurrent condition was sensed on the individual output channel or multiplexer. To reset this fault, the overcurrent condition must be removed, and a Reset command must be issued.

The **Coil** LED field indicates that an open coil was detected.

A03: Temperature Balancing – Bias Control



Max Duration Bias Limit Choose between 0 and 720 °CA.
Sets the maximum absolute bias that the Temperature Balancer can apply to individual injector outputs.

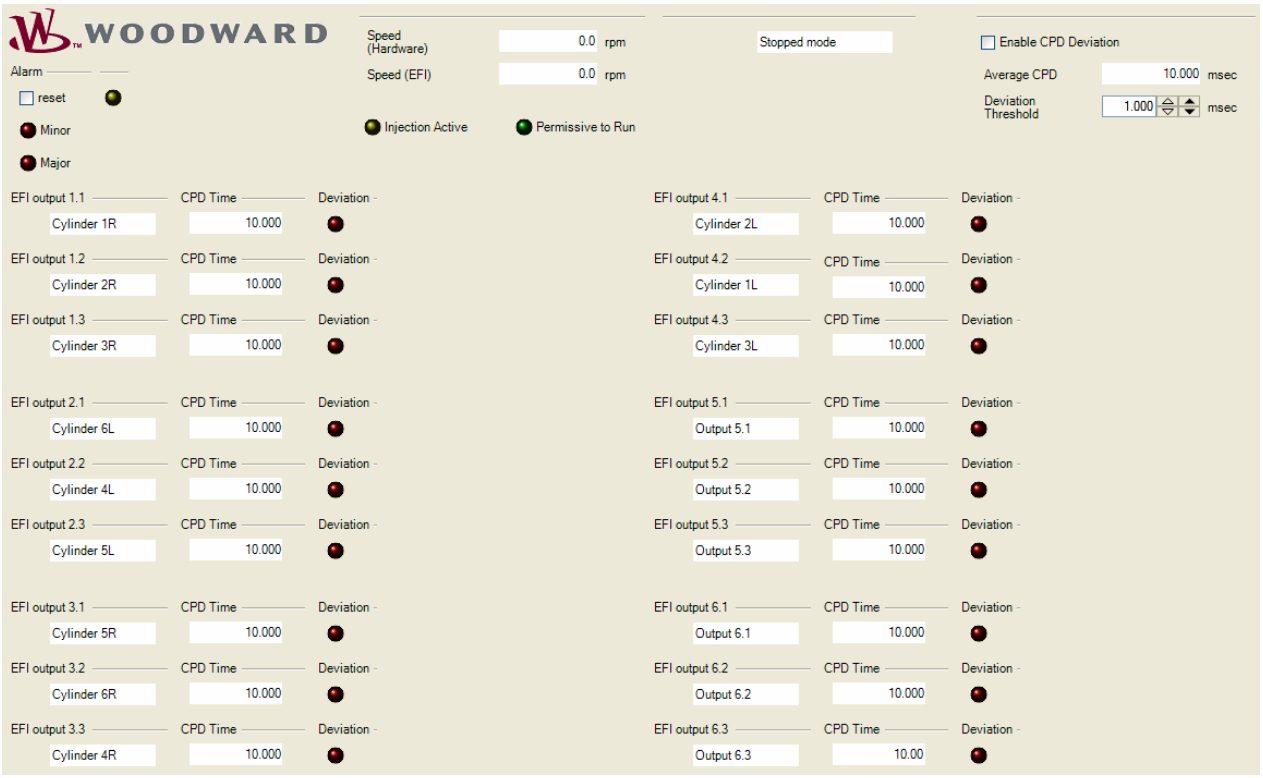
Balancer Rate Choose between 0 and 10 °CA/s.
Sets the bias change rate that the Temperature Balancer uses to change the bias for individual injector outputs.

Dead Band Choose between 0 and 100 °C.
Sets the minimum difference that a cylinder temperature needs with respect to the average temperature, before the Temperature Balancer will start to apply an individual injector output bias.

Tick **Enable Temp Balancer** to start this bias control.
Cylinder individual temperatures, sensor faults & biases will be shown.

IMPORTANT **When a cylinder temperature sensor has failed, it will not participate in the temperature average, and its temperature balancer bias will remain at 0%.**

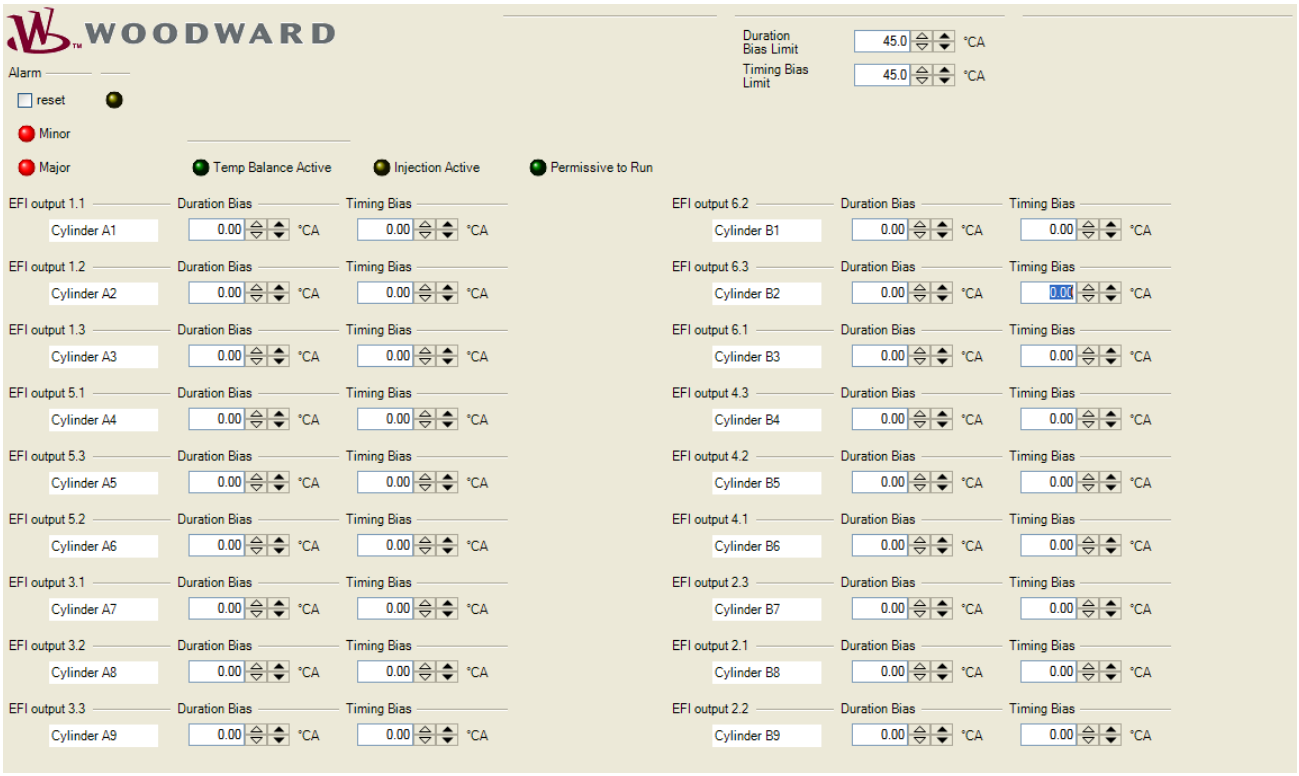
A04: Closure Point Detection Deviation



Deviation Threshold Choose between 0 and 1000 ms. Sets the maximum CPD deviation time between the average CPD time and an individual injector output.
When an output measure a CPD time that differs from the average by more than this threshold, an alarm/shutdown event can be generated for this output.

IMPORTANT **CPD deviation will only work with Full Automatic mode.**

A05: Timing & Duration—Manual Bias



Duration Bias Choose between -720 and 720 °CA.
Sets the individual injector output Duration bias.

Timing Bias Choose between -720 and 720 °CA.
Sets the individual injector output Timing bias.

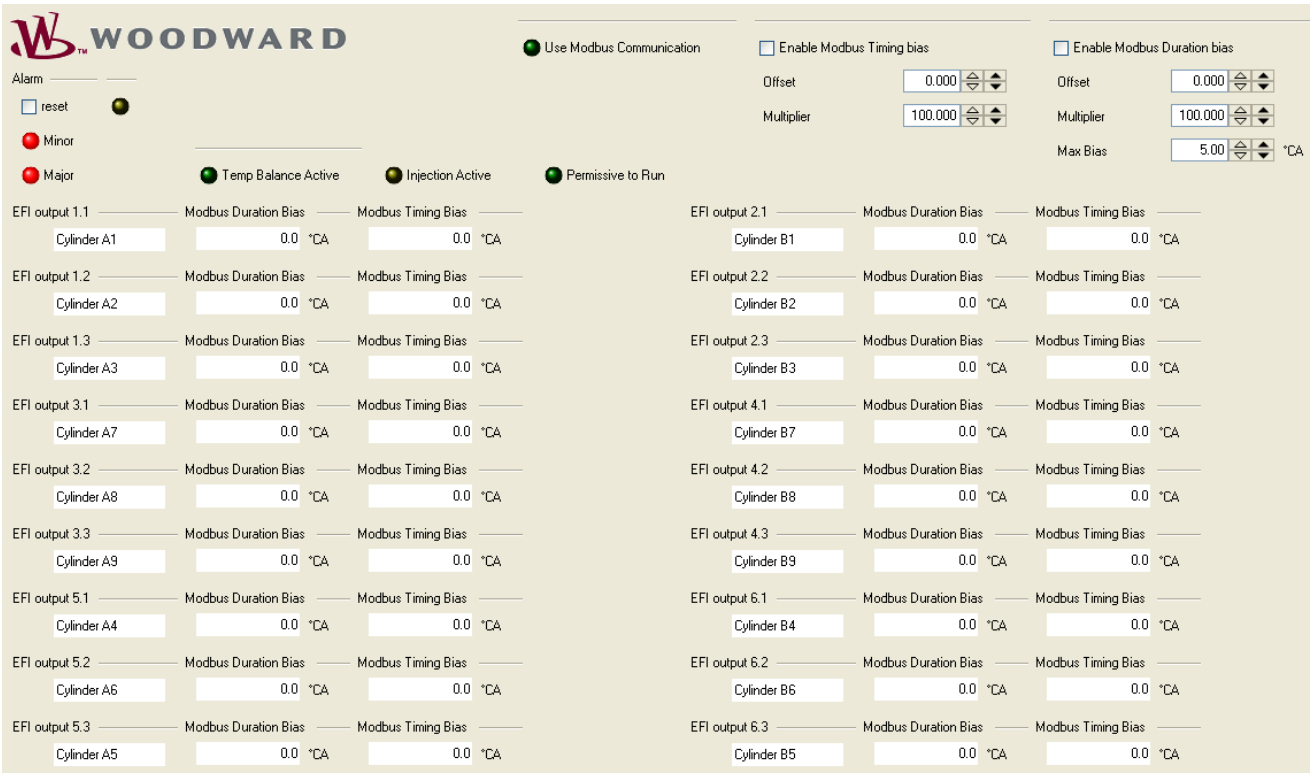
Duration Bias Limit Choose between -720 and 720 °CA. Sets the maximum absolute overall manual duration bias for an individual injector output.

IMPORTANT **The Duration Bias Limit is applied after summing all duration biases; Manual, CAN, Modbus, & Temp Balancing.**

Timing Bias Limit Choose between 0 and 720 °CA. Sets the maximum absolute overall manual timing bias for an individual injector output.
This limit is applied after summing all timing biases; Manual, CAN, & Modbus.

IMPORTANT **The Timing Bias Limit is applied after summing all duration biases; Manual, CAN, & Modbus.**

A06: Timing & Duration—Modbus Bias



To use the timing & duration biases from Modbus, each can be enabled/disabled.

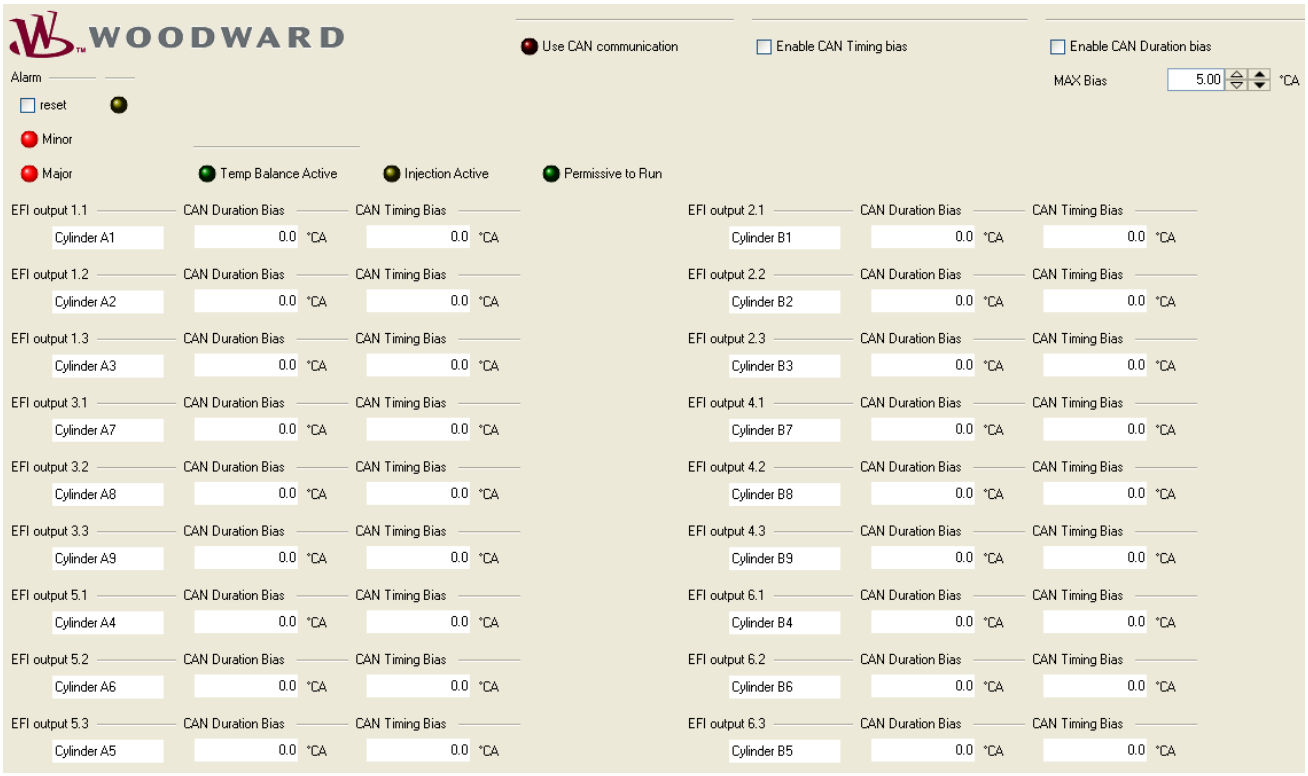
By default, Timing Biases need to be sent in °CA * 100;
This results in a possible range of- 32 to +32 °CA timing bias from Modbus.

By default, Duration Biases need to be sent in °CA * 100;
This results in a possible range of- 32 to +32 °CA duration bias from Modbus.

By default the max Modbus Bias is set to +/- 5 °CA. This can be changed in the box “MAX Bias”.

IMPORTANT **When Modbus communication fails, the biases stay at the last received values.**

A07: Timing & Duration – CAN Bias



To use the timing & duration biases from CAN, each can be enabled/disabled.

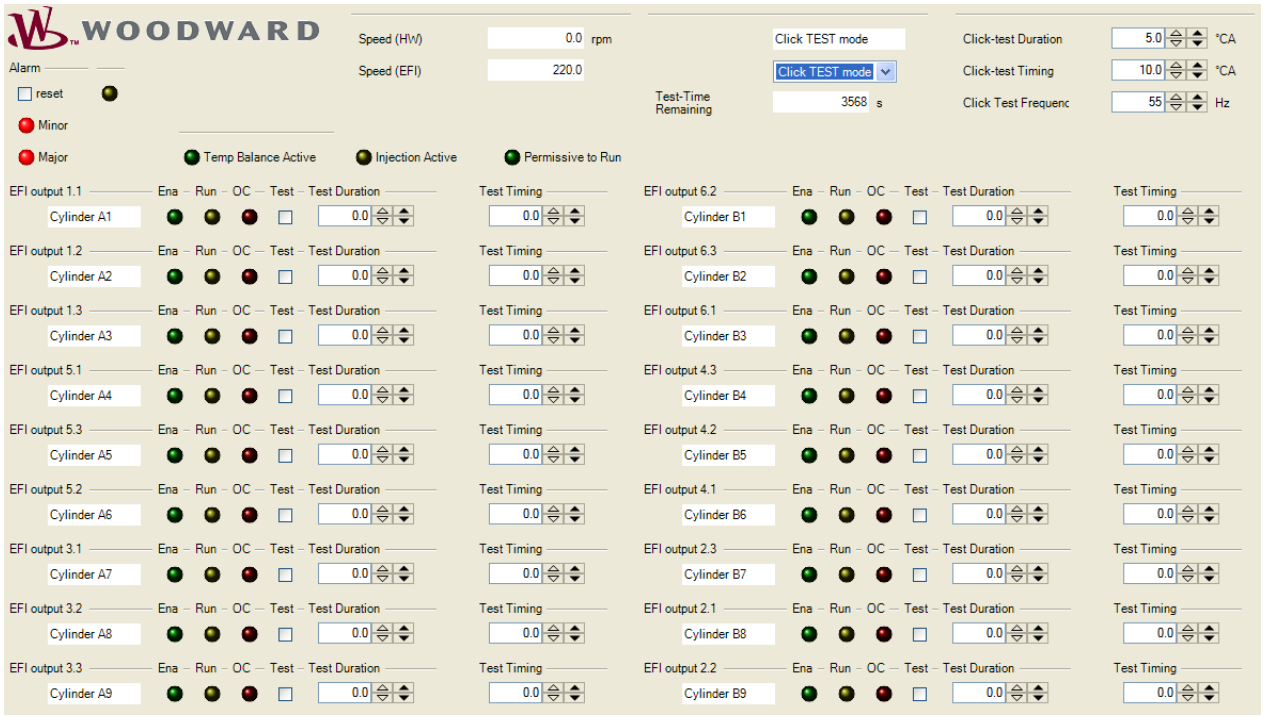
CAN Timing Biases range from -15.875 to +15.875 °CA

CAN Duration Biases range from -15.875 to +15.875 °CA

By default the max CAN Bias is set to +/- 5 °CA. This can be changed in the box “MAX Bias”.

IMPORTANT **When CAN communication fails, the biases go to 0.**

A08: Test EFI Outputs *(Click TEST Mode)*



When an engine is stopped, the **Click TEST mode** can be selected from the drop down selector.
The EFI driver hardware generates an internal test speed signal, which can be adjusted with **Click Test Frequency**, ranging from 32 Hz to 6 kHz.

Initially the common **Click-test Duration** (0~720 °CA) & **Timing** (0~720 °CA) will be copied to each individual EFI output, once it has been activated in Click Test mode. From then on, the individual duration & timing can be changed.

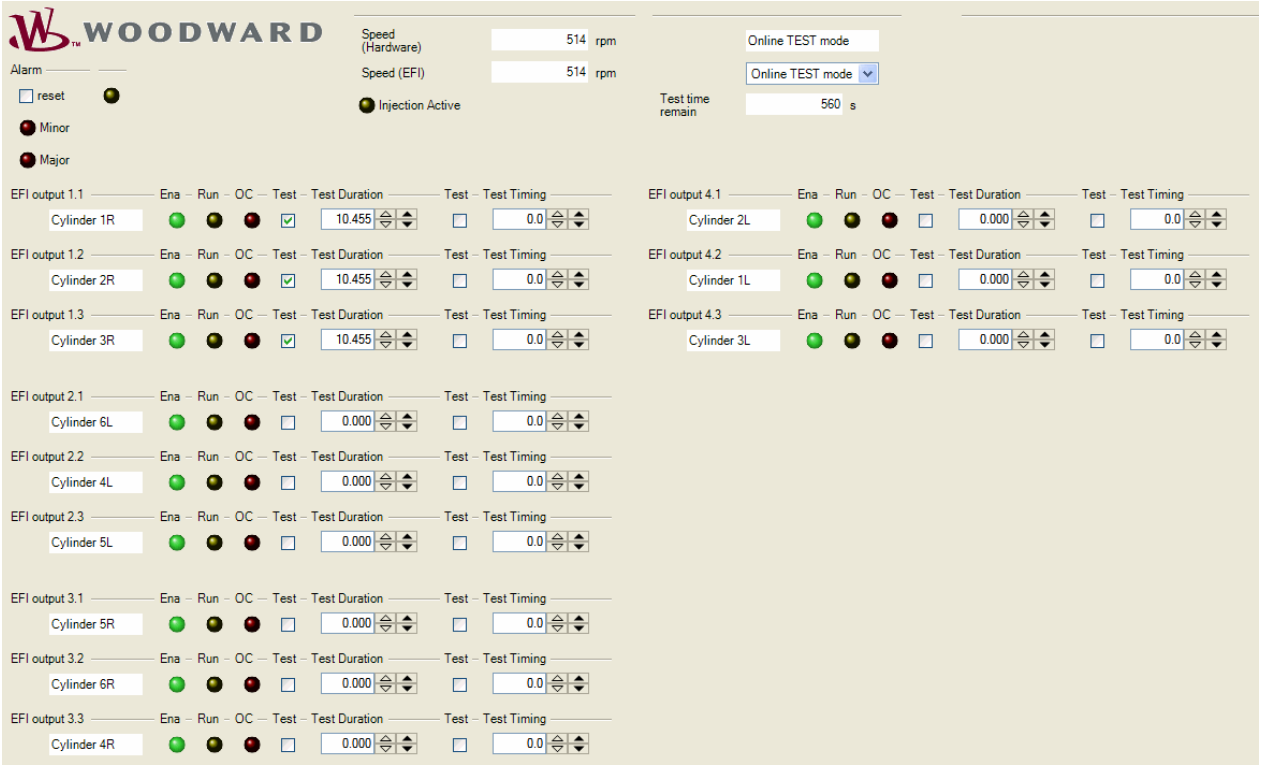
The **Ena** LED indicates the injector is enabled and the **Run** LED is a feedback that the hardware output is activated.

The **OC** LED field indicates that an open coil was detected.

Select **No TEST mode** to return to normal stopped mode.

IMPORTANT **Click TEST mode will be ended automatically after 1 hour.**

A08: Test EFI Outputs (*Online TEST Mode*)



When an engine is running, the **Online TEST mode** can be selected from the drop down selector.

WARNING

Only trained and qualified people shall enter the Online TEST mode!

WARNING

Only enter Online TEST mode in steady state operation!
Do not overfuel!

Be aware of knocking limits when advancing injection timing!

When the **Test** (Duration) is ticked for an EFI output, it will freeze the main duration at that point in time. From then on, it will not follow the main duration anymore, but one has full manual control over the **Test Duration** (0~720 °CA). Untick it, to go back to normal operation.

When the **Test** (Timing) is ticked for an EFI output, it will freeze the main timing at that point in time. From then on, it will not follow the main timing anymore, but one has full manual control over the **Test Duration** (0~100%). Untick it, to go back to normal operation.

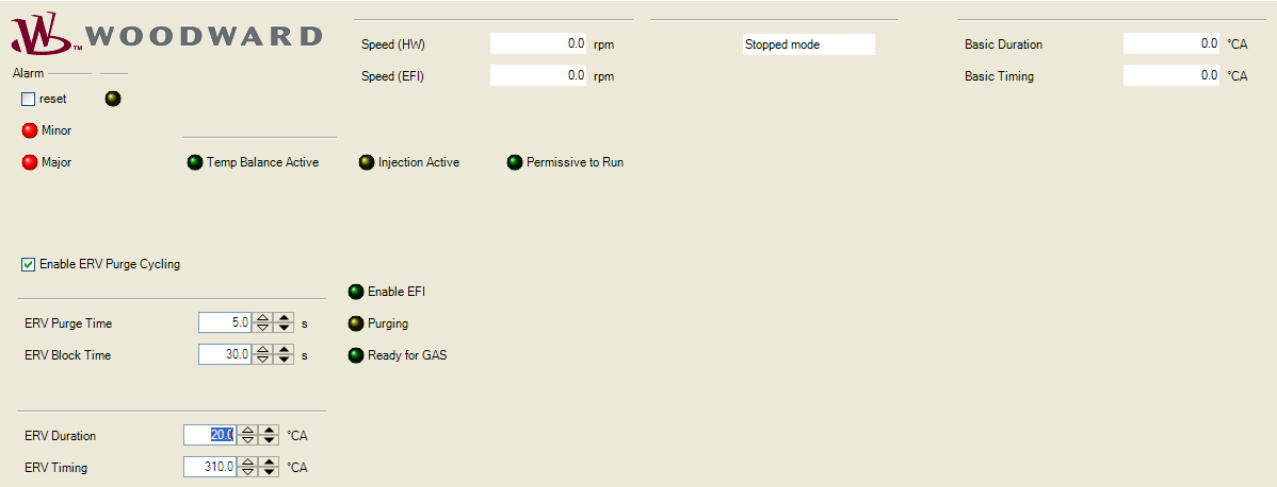
The **Ena** LED indicates the injector is enabled and the **Run** LED is a feedback that the hardware output is activated.
The **OC** LED field indicates that an open coil was detected.

Select **No TEST mode** to return to normal stopped mode.

IMPORTANT

Online TEST mode will be ended automatically after 10 minutes, or after a shutdown.

A09: ERV Purge Cycling Sequence



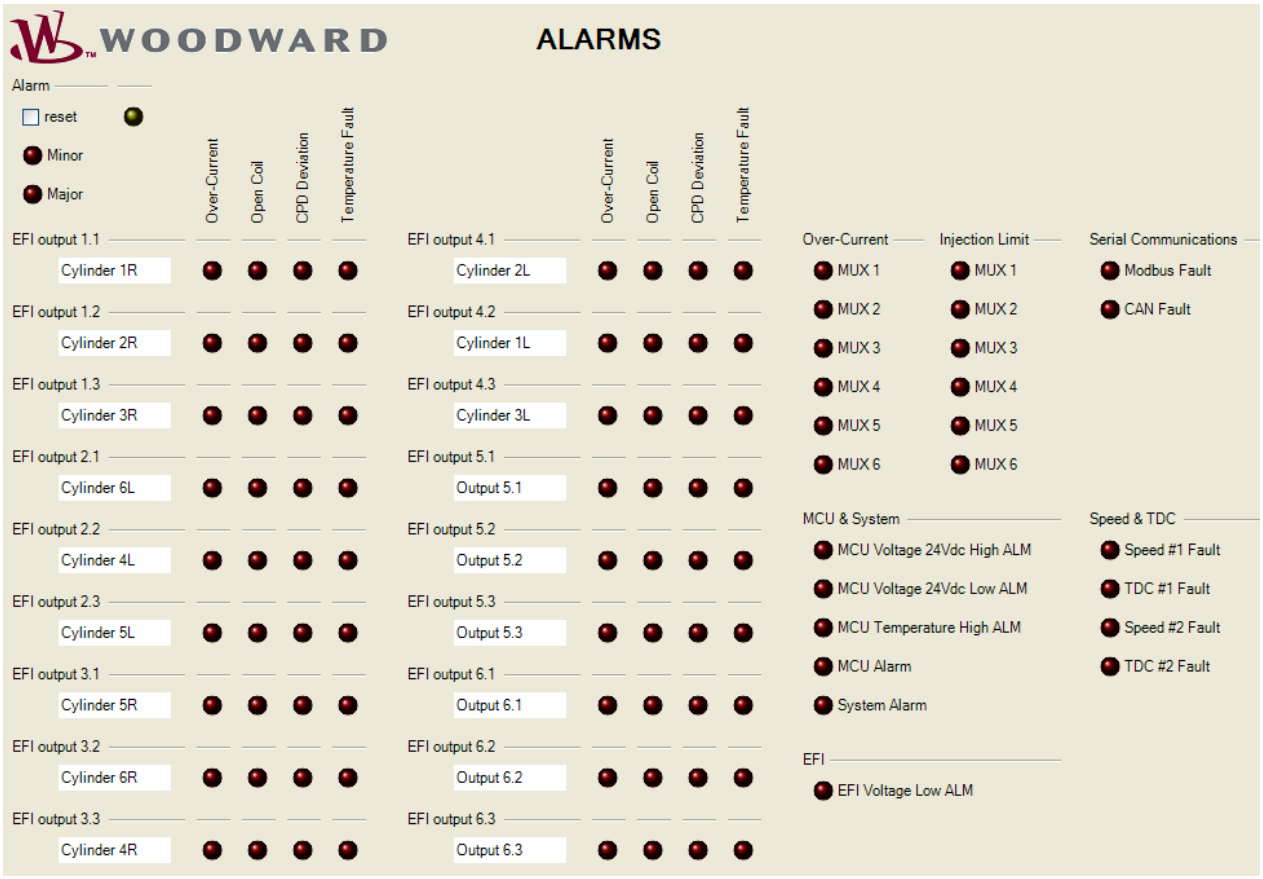
When the **ERV Purge Cycling** Sequence is enabled,
the **ERV Purge Time** can be tuned between 0 and 240 seconds,
the **ERV Block Time** can be tuned between 0 and 240 seconds,
the **ERV Duration** can be tuned between 0 and 720 °CA,
the **ERV Timing** can be tuned between 0 and 720 °CA,

When the **ERV Purge Cycling** Sequence is enabled, as soon as all injection permissives are TRUE, this purge sequence will start. Duration & Timing will switch-over to the **ERV Duration & Timing** value respectively, and the purge will continue until **ERV Purge Timer** has expired. Only then the **Ready for Gas** discrete output will become active, which should used as a permissive for allowing gas admission to the engine. Duration & Timing switch back to their “normal” values.

When the **ERV Purge Cycling** Sequence is disabled, as soon as all injection permissives are TRUE, **Ready for Gas** discrete output will become active, which should used as a permissive for allowing gas admission to the engine. Duration & Timing always stay at their “normal” values.

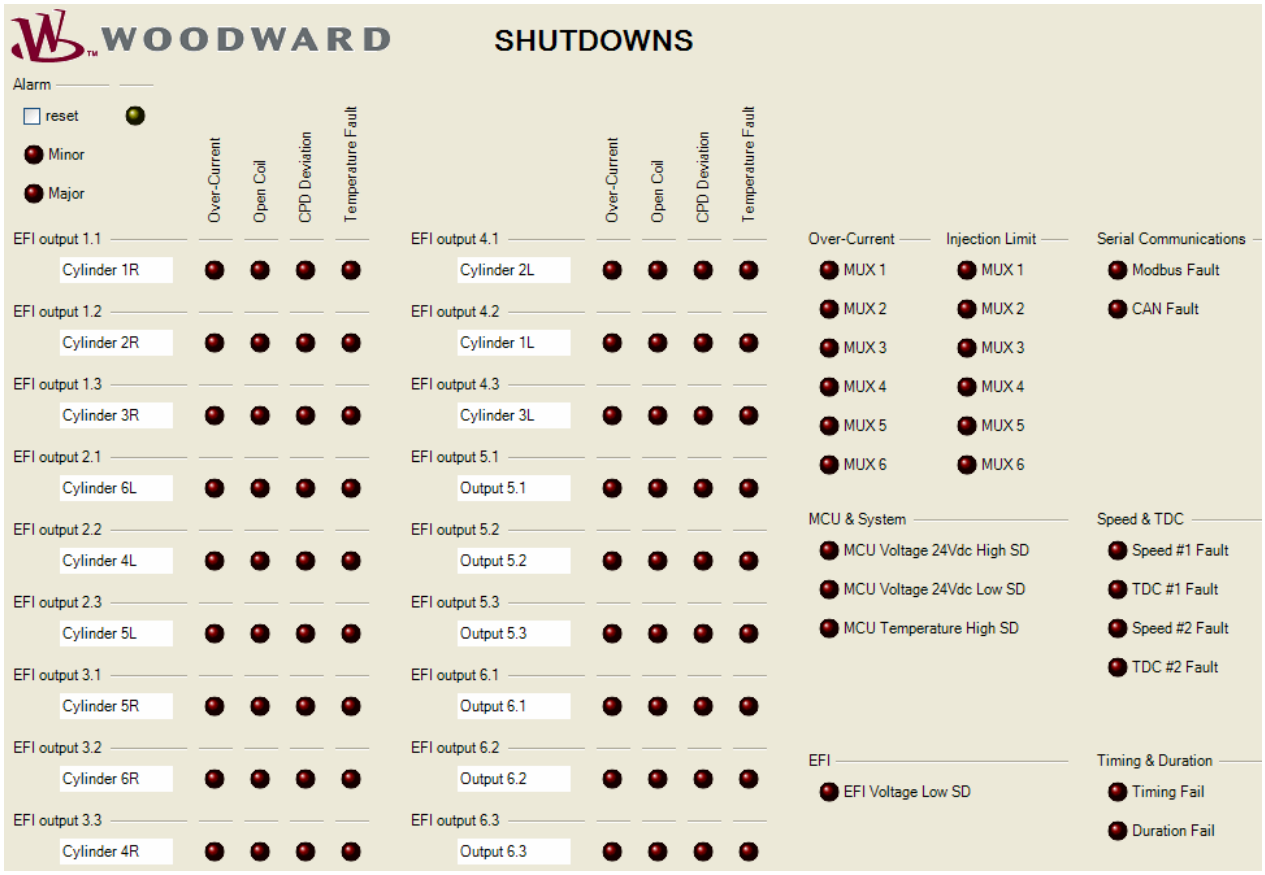
When injection is stopped, **ERV Block Time** will need to expire first, before another ERV Purge Cycle will be permitted.

B01: Alarms (*Minor Alarms*)



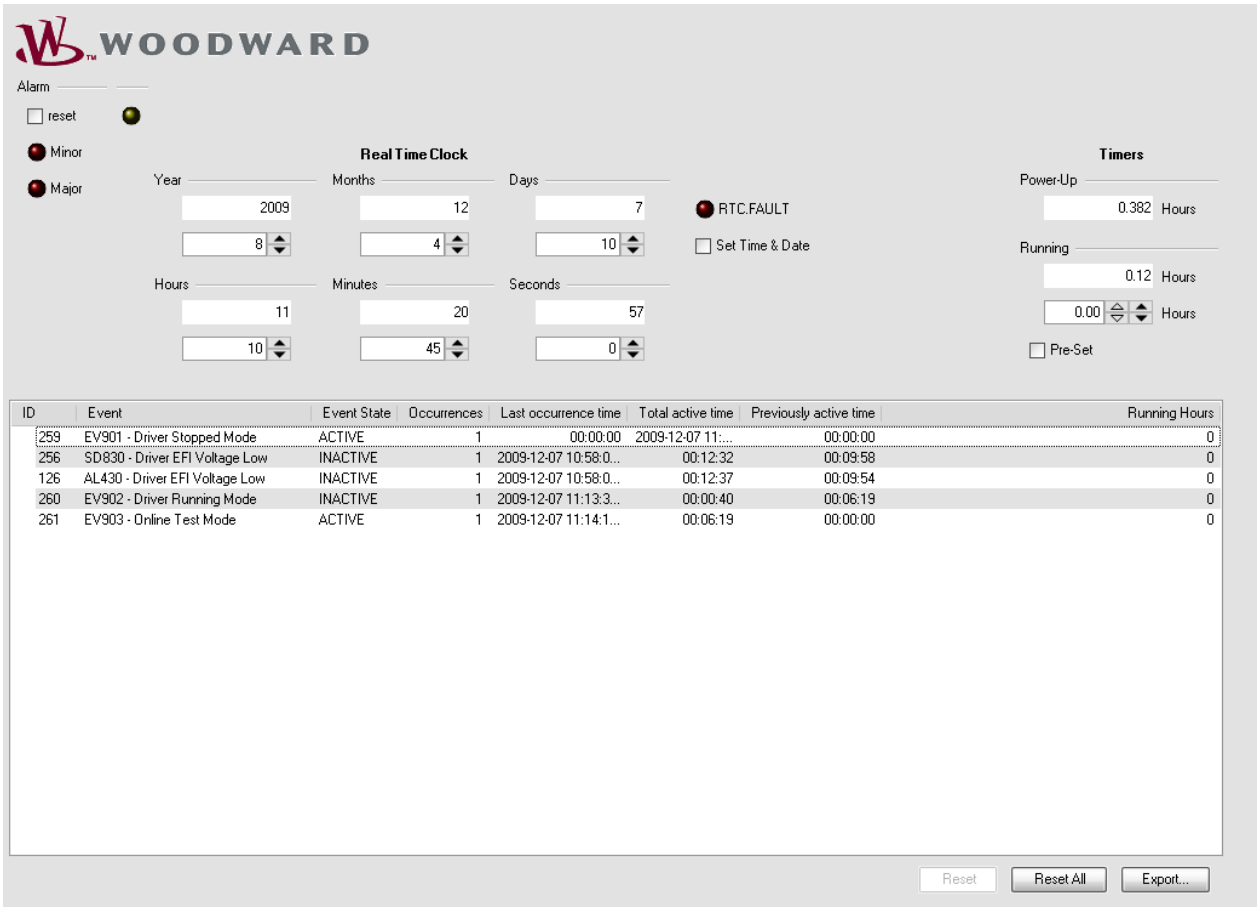
The Alarm page displays active and latched alarms with red LED's.
Alarms will not necessarily interrupt running operation mode of the EFI output.

B02: Shutdowns (*Major Alarms*)



The Shutdowns page displays active and latched shutdowns with red LED's. Shutdowns will always stop the running operation mode of the EFI output.

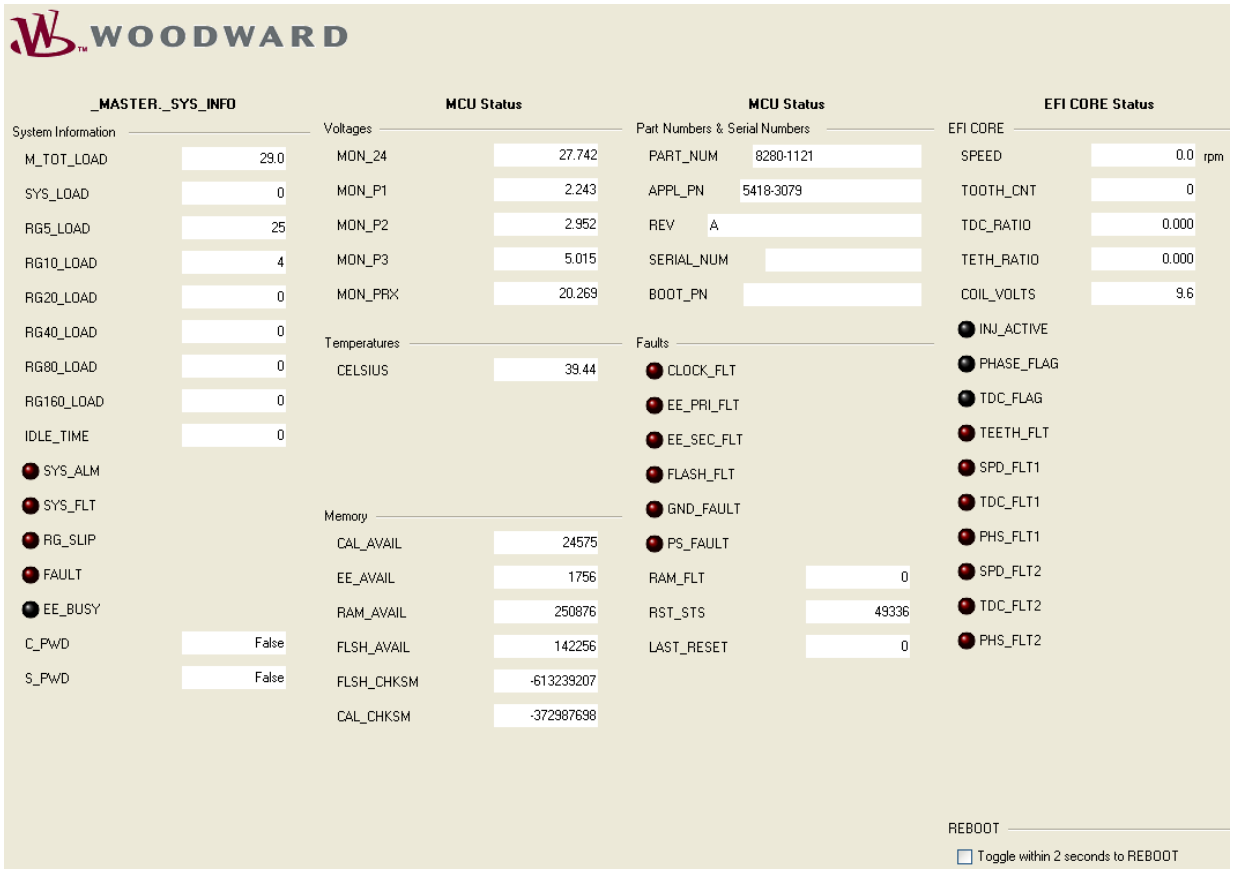
B03: Event Manager



The Event Manager page displays a log of all Alarms, Shutdowns and Events that have happened.
The Event Manager logs the number of occurrences and the hours certain event have been active or have been latched without being reset.
The Event Manager memory is non-volatile, so when the EFI driver is reboot, the memory will be cleared.

When **Reset All** is pressed, the Event Memory log will be cleared.

B04: System Information



The System Information page will typically be not needed for normal operation of the EFI driver. It contains low level detail data, that may be of use to Woodward.

Chapter 5. Commissioning

Introduction

Suggested tools for commissioning the IP2:

- Oscilloscope
- Current clamp
- Multimeter

We suggest commissioning the IP2 according the following procedures:

- Phase 1 commissioning
  Mounting, wiring and configuration of the IP2 and valves/injectors
- Phase 2 commissioning
  Offline Click-testing of valves/injectors
- Phase 3 commissioning
  Speed signals & EFI running mode
- Cylinder Temperature Balancing
  Cylinder temperature sensors & balancing

Phase 1 Commissioning Steps

1. Check the mounting, wiring and fuel conditions for the SOGAVs if applicable, the manufacturers injector and fuel pump etc.
2. Double check the mounting, wiring and fuel conditions.
3. Check the wiring to the IP2 hardware, according to the guidelines in the IP2 manual 26343.
4. Double check the wiring.
5. Apply supply voltage to the IP2; this can be either high voltage or low voltage.
6. If possible, initially apply current limiting to limit any damage in case of short circuits in the wiring.
7. Connect a null-modem serial cable between PC and the IP2.
8. Start-up the In-Pulse II standard Multi-Point driver ToolKit tool.
9. It should be possible to make a connection once the IP2 has booted up (only takes a few seconds after applying power).
10. Configure the IP2 using the ToolKit tool configuration pages.
11. Double check the configuration & save to the IP2 and as a file on the PC.
12. Verify the input and output signals are OK; that is, analog and digital inputs and outputs.
13. If possible, turn the engine to create and verify the necessary speed, TDC and Phase signals.

Phase 2 Commissioning Steps

1. The **phase 1 commissioning** shall have been finished.
2. Apply EFI supply high voltage to the IP2 if this has not been done yet.
3. Keep the engine in a shutdown state (no permissives) and enter Click-Test mode.

4. Choose an injector output to calibrate & test.
   Typically output #1.1 for cylinder #1.
5. The injector or valve will shortly be opened in a cyclic way.
   Typically this results in audible “clicking”.
6. When no clicks are heard, one can increase the test duration.
7. Verify the current profile with a current clamp and oscilloscope.
   Make sure the pull-in currents and holding currents are according the valve/injector manufacture datasheets.
8. If current profile seems incorrect, one might need to (temporarily) switch to full manual mode to set the PWM output times & frequencies manually to “create” the correct current profile.
9. Repeat the click-test for each output to verify correct valve/injector wiring and operation.
10. When finished, save tunables to the IP2 and as a file on the PC.

Phase 3 Commissioning Steps

1. The **phase 2 commissioning** shall have been finished.
2. Keep the engine in a shutdown state (no permissives) and turn the engine. Verify all speed signals are input correctly and there are no faults.
3. Double check the real engine TDC with the speed sensing TDC & Offset as configured in the IP2.
4. Allow the engine to run by setting all permissives to True. Start the engine and observe the IP2 enters Running Mode. Observe the engine keeps running and follows the Duration and Timing inputs/settings.
5. Enter On-Line Test Mode and verify all injector outputs can be taken into test mode and can be individually be changed for Duration & Timing.

Cylinder Temperature Balancing

1. The **phase 3 commissioning** shall have been finished.
2. Verify all cylinder temperature signals are input OK.
3. Verify correct temperature sensor connection to cylinder. Enter On-Line Test Mode. For each cylinder, take the duration into manual mode and make a little change. Observe the correct temperature will follow the manual change. Repeat for all cylinders.
4. Enable cylinder temperature balancing by setting all permissives to True. Observe correct behavior; that is, all temperature tend to move to each other. Optimize the cylinder temperature balancing by adjusting the Bias Limit, Balancer Rate and Deadband parameters.

Chapter 6.
Modbus Signals List

Introduction

This chapter lists the Modbus List with the In-Pulse II – Standard Multi Point Driver system parameters which are available for monitoring & control by external systems like SCADA, PLC etc.

The In-Pulse II Modbus is always “slave”.

Boolean Writes

Address	Input	Description
0:0001		Duration Signal OK
0:0002		Timing Signal OK
0:0003		Reset command
0:0004		Run permissive
0:0005		Pre-Injection 1 command
0:0006		(Spare)
0:0007		(Spare)
0:0008		(Spare)
0:0009		(Spare)
0:0010		Temp Balance Permissive
0:0011		Temperature OK 1.1
0:0012		Temperature OK 1.2
0:0013		Temperature OK 1.3
0:0014		Temperature OK 2.1
0:0015		Temperature OK 2.2
0:0016		Temperature OK 2.3
0:0017		Temperature OK 3.1
0:0018		Temperature OK 3.2
0:0019		Temperature OK 3.3
0:0020		Temperature OK 4.1
0:0021		Temperature OK 4.2
0:0022		Temperature OK 4.3
0:0023		Temperature OK 5.1
0:0024		Temperature OK 5.2
0:0025		Temperature OK 5.3
0:0026		Temperature OK 6.1
0:0027		Temperature OK 6.2
0:0028		Temperature OK 6.3
0:0029		Temperature OK 7.1 (Spare)
0:0030		Temperature OK 7.2 (Spare)
0:0031		Temperature OK 7.3 (Spare)
0:0032		Temperature OK 8.1 (Spare)
0:0033		Temperature OK 8.2 (Spare)
0:0034		Temperature OK 8.3 (Spare)

Boolean Reads

Address	Description
1:0001	Major Alarm
1:0002	Minor Alarm
1:0003	Stopped Mode
1:0004	Click Test Mode
1:0005	Running Mode
1:0006	Online Test Mode
1:0007	EFI permissive
1:0008	Speed Permissive
1:0009	Injection Active
1:0010	Temp Balancing Permissive
1:0011	Temp Balancing Active
1:0012	ERV finished, Ready for GAS
1:0013	ERV Purge is active
1:0014	
1:0015	
1:0016	
1:0017	
1:0018	
1:0019	
1:0020	
1:0021	Output 1.1 is used
1:0022	Output 1.2 is used
1:0023	Output 1.3 is used
1:0024	Output 2.1 is used
1:0025	Output 2.2 is used
1:0026	Output 2.3 is used
1:0027	Output 3.1 is used
1:0028	Output 3.2 is used
1:0029	Output 3.3 is used
1:0030	Output 4.1 is used
1:0031	Output 4.2 is used
1:0032	Output 4.3 is used
1:0033	Output 5.1 is used
1:0034	Output 5.2 is used
1:0035	Output 5.3 is used
1:0036	Output 6.1 is used
1:0037	Output 6.2 is used
1:0038	Output 6.3 is used
1:0039	Output 7.1 is used (Spare)
1:0040	Output 7.2 is used (Spare)
1:0041	Output 7.3 is used (Spare)
1:0042	Output 8.1 is used (Spare)
1:0043	Output 8.2 is used (Spare)
1:0044	Output 8.3 is used (Spare)
1:0045	
1:0046	
1:0047	
1:0048	
1:0049	
1:0050	AL001 - Output 1.1 Over-Current
1:0051	AL002 - Output 1.2 Over-Current

Address	Description
1:0052	AL003 - Output 1.3 Over-Current
1:0053	AL004 - Output 2.1 Over-Current
1:0054	AL005 - Output 2.2 Over-Current
1:0055	AL006 - Output 2.3 Over-Current
1:0056	AL007 - Output 3.1 Over-Current
1:0057	AL008 - Output 3.2 Over-Current
1:0058	AL009 - Output 3.3 Over-Current
1:0059	AL010 - Output 4.1 Over-Current
1:0060	AL011 - Output 4.2 Over-Current
1:0061	AL012 - Output 4.3 Over-Current
1:0062	AL013 - Output 5.1 Over-Current
1:0063	AL014 - Output 5.2 Over-Current
1:0064	AL015 - Output 5.3 Over-Current
1:0065	AL016 - Output 6.1 Over-Current
1:0066	AL017 - Output 6.2 Over-Current
1:0067	AL018 - Output 6.3 Over-Current
1:0068	AL019 - Output 7.1 Over-Current (Spare)
1:0069	AL020 - Output 7.2 Over-Current (Spare)
1:0070	AL021 - Output 7.3 Over-Current (Spare)
1:0071	AL022 - Output 8.1 Over-Current (Spare)
1:0072	AL023 - Output 8.2 Over-Current (Spare)
1:0073	AL024 - Output 8.3 Over-Current (Spare)
1:0074	AL101 - Output 1.1 Open-Coil
1:0075	AL102 - Output 1.2 Open-Coil
1:0076	AL103 - Output 1.3 Open-Coil
1:0077	AL104 - Output 2.1 Open-Coil
1:0078	AL105 - Output 2.2 Open-Coil
1:0079	AL106 - Output 2.3 Open-Coil
1:0080	AL107 - Output 3.1 Open-Coil
1:0081	AL108 - Output 3.2 Open-Coil
1:0082	AL109 - Output 3.3 Open-Coil
1:0083	AL110 - Output 4.1 Open-Coil
1:0084	AL111 - Output 4.2 Open-Coil
1:0085	AL112 - Output 4.3 Open-Coil
1:0086	AL113 - Output 5.1 Open-Coil
1:0087	AL114 - Output 5.2 Open-Coil
1:0088	AL115 - Output 5.3 Open-Coil
1:0089	AL116 - Output 6.1 Open-Coil
1:0090	AL117 - Output 6.2 Open-Coil
1:0091	AL118 - Output 6.3 Open-Coil
1:0092	AL119 - Output 7.1 Open-Coil (Spare)
1:0093	AL120 - Output 7.2 Open-Coil (Spare)
1:0094	AL121 - Output 7.3 Open-Coil (Spare)
1:0095	AL122 - Output 8.1 Open-Coil (Spare)
1:0096	AL123 - Output 8.2 Open-Coil (Spare)
1:0097	AL124 - Output 8.3 Open-Coil (Spare)
1:0098	AL201 - Output 1.1 CPD Deviation
1:0099	AL202 - Output 1.2 CPD Deviation
1:0100	AL203 - Output 1.3 CPD Deviation
1:0101	AL204 - Output 2.1 CPD Deviation
1:0102	AL205 - Output 2.2 CPD Deviation
1:0103	AL206 - Output 2.3 CPD Deviation
1:0104	AL207 - Output 3.1 CPD Deviation

Address	Description
1:0105	AL208 - Output 3.2 CPD Deviation
1:0106	AL209 - Output 3.3 CPD Deviation
1:0107	AL210 - Output 4.1 CPD Deviation
1:0108	AL211 - Output 4.2 CPD Deviation
1:0109	AL212 - Output 4.3 CPD Deviation
1:0110	AL213 - Output 5.1 CPD Deviation
1:0111	AL214 - Output 5.2 CPD Deviation
1:0112	AL215 - Output 5.3 CPD Deviation
1:0113	AL216 - Output 6.1 CPD Deviation
1:0114	AL217 - Output 6.2 CPD Deviation
1:0115	AL218 - Output 6.3 CPD Deviation
1:0116	AL219 - Output 7.1 CPD Deviation (Spare)
1:0117	AL220 - Output 7.2 CPD Deviation (Spare)
1:0118	AL221 - Output 7.3 CPD Deviation (Spare)
1:0119	AL222 - Output 8.1 CPD Deviation (Spare)
1:0120	AL223 - Output 8.2 CPD Deviation (Spare)
1:0121	AL224 - Output 8.3 CPD Deviation (Spare)
1:0122	AL301 - Temperature 1.1
1:0123	AL302 - Temperature 1.2
1:0124	AL303 - Temperature 1.3
1:0125	AL304 - Temperature 2.1
1:0126	AL305 - Temperature 2.2
1:0127	AL306 - Temperature 2.3
1:0128	AL307 - Temperature 3.1
1:0129	AL308 - Temperature 3.2
1:0130	AL309 - Temperature 3.3
1:0131	AL310 - Temperature 4.1
1:0132	AL311 - Temperature 4.2
1:0133	AL312 - Temperature 4.3
1:0134	AL313 - Temperature 5.1
1:0135	AL314 - Temperature 5.2
1:0136	AL315 - Temperature 5.3
1:0137	AL316 - Temperature 6.1
1:0138	AL317 - Temperature 6.2
1:0139	AL318 - Temperature 6.3
1:0140	AL319 - Temperature 7.1 (Spare)
1:0141	AL320 - Temperature 7.2 (Spare)
1:0142	AL321 - Temperature 7.3 (Spare)
1:0143	AL322 - Temperature 8.1 (Spare)
1:0144	AL323 - Temperature 8.2 (Spare)
1:0145	AL324 - Temperature 8.3 (Spare)
1:0146	AL401 - Timing Input Fault
1:0147	AL402 - Duration Input Fault
1:0148	AL403 - Speed #1 Fault
1:0149	AL404 - Speed #2 Fault
1:0150	AL405 - TDC #1 Fault
1:0151	AL406 - TDC #2 Fault
1:0152	AL407 - PHS #1 Fault (Spare)
1:0153	
1:0154	
1:0155	
1:0156	AL411 - Multiplexer #1 Over-Current
1:0157	AL412 - Multiplexer #2 Over-Current

Address	Description
1:0158	AL413 - Multiplexer #3 Over-Current
1:0159	AL414 - Multiplexer #4 Over-Current
1:0160	AL415 - Multiplexer #5 Over-Current
1:0161	AL416 - Multiplexer #6 Over-Current
1:0162	AL417 - Multiplexer #7 Over-Current (Spare)
1:0163	AL418 - Multiplexer #8 Over-Current (Spare)
1:0164	AL421 - Multiplexer #1 Injection Limit
1:0165	AL422 - Multiplexer #2 Injection Limit
1:0166	AL423 - Multiplexer #3 Injection Limit
1:0167	AL424 - Multiplexer #4 Injection Limit
1:0168	AL425 - Multiplexer #5 Injection Limit
1:0169	AL426 - Multiplexer #6 Injection Limit
1:0170	AL427 - Multiplexer #7 Injection Limit
1:0171	AL428 - Multiplexer #8 Injection Limit
1:0172	AL431 - Driver Supply Voltage Low
1:0173	AL432 - Driver Supply Voltage High
1:0174	AL433 - Driver Temperature High
1:0175	AL434 - Driver EFI Voltage Low
1:0176	AL435 - Driver MCU Alarm
1:0177	AL436 - Driver System Alarm
1:0178	AL437 - Driver Modbus Fault
1:0179	AL438 - Driver CAN Fault
1:0180	
1:0181	
1:0182	
1:0183	
1:0184	
1:0185	
1:0186	
1:0187	
1:0188	
1:0189	
1:0190	
1:0191	
1:0192	
1:0193	
1:0194	
1:0195	
1:0196	
1:0197	
1:0198	
1:0199	
1:0200	SD501 - Output 1.1 Over-Current
1:0201	SD502 - Output 1.2 Over-Current
1:0202	SD503 - Output 1.3 Over-Current
1:0203	SD504 - Output 2.1 Over-Current
1:0204	SD505 - Output 2.2 Over-Current
1:0205	SD506 - Output 2.3 Over-Current
1:0206	SD507 - Output 3.1 Over-Current
1:0207	SD508 - Output 3.2 Over-Current
1:0208	SD509 - Output 3.3 Over-Current
1:0209	SD510 - Output 4.1 Over-Current
1:0210	SD511 - Output 4.2 Over-Current

Address	Description
1:0211	SD512 - Output 4.3 Over-Current
1:0212	SD513 - Output 5.1 Over-Current
1:0213	SD514 - Output 5.2 Over-Current
1:0214	SD515 - Output 5.3 Over-Current
1:0215	SD516 - Output 6.1 Over-Current
1:0216	SD517 - Output 6.2 Over-Current
1:0217	SD518 - Output 6.3 Over-Current
1:0218	SD519 - Output 7.1 Over-Current (Spare)
1:0219	SD520 - Output 7.2 Over-Current (Spare)
1:0220	SD521 - Output 7.3 Over-Current (Spare)
1:0221	SD522 - Output 8.1 Over-Current (Spare)
1:0222	SD523 - Output 8.2 Over-Current (Spare)
1:0223	SD524 - Output 8.3 Over-Current (Spare)
1:0224	SD601 - Output 1.1 Open-Coil
1:0225	SD602 - Output 1.2 Open-Coil
1:0226	SD603 - Output 1.3 Open-Coil
1:0227	SD604 - Output 2.1 Open-Coil
1:0228	SD605 - Output 2.2 Open-Coil
1:0229	SD606 - Output 2.3 Open-Coil
1:0230	SD607 - Output 3.1 Open-Coil
1:0231	SD608 - Output 3.2 Open-Coil
1:0232	SD609 - Output 3.3 Open-Coil
1:0233	SD610 - Output 4.1 Open-Coil
1:0234	SD611 - Output 4.2 Open-Coil
1:0235	SD612 - Output 4.3 Open-Coil
1:0236	SD613 - Output 5.1 Open-Coil
1:0237	SD614 - Output 5.2 Open-Coil
1:0238	SD615 - Output 5.3 Open-Coil
1:0239	SD616 - Output 6.1 Open-Coil
1:0240	SD617 - Output 6.2 Open-Coil
1:0241	SD618 - Output 6.3 Open-Coil
1:0242	SD619 - Output 7.1 Open-Coil (Spare)
1:0243	SD620 - Output 7.2 Open-Coil (Spare)
1:0244	SD621 - Output 7.3 Open-Coil (Spare)
1:0245	SD622 - Output 8.1 Open-Coil (Spare)
1:0246	SD623 - Output 8.2 Open-Coil (Spare)
1:0247	SD624 - Output 8.3 Open-Coil (Spare)
1:0248	SD701 - Output 1.1 CPD Deviation
1:0249	SD702 - Output 1.2 CPD Deviation
1:0250	SD703 - Output 1.3 CPD Deviation
1:0251	SD704 - Output 2.1 CPD Deviation
1:0252	SD705 - Output 2.2 CPD Deviation
1:0253	SD706 - Output 2.3 CPD Deviation
1:0254	SD707 - Output 3.1 CPD Deviation
1:0255	SD708 - Output 3.2 CPD Deviation
1:0256	SD709 - Output 3.3 CPD Deviation
1:0257	SD710 - Output 4.1 CPD Deviation
1:0258	SD711 - Output 4.2 CPD Deviation
1:0259	SD712 - Output 4.3 CPD Deviation
1:0260	SD713 - Output 5.1 CPD Deviation
1:0261	SD714 - Output 5.2 CPD Deviation
1:0262	SD715 - Output 5.3 CPD Deviation
1:0263	SD716 - Output 6.1 CPD Deviation

Address	Description
1:0264	SD717 - Output 6.2 CPD Deviation
1:0265	SD718 - Output 6.3 CPD Deviation
1:0266	SD719 - Output 7.1 CPD Deviation (Spare)
1:0267	SD720 - Output 7.2 CPD Deviation (Spare)
1:0268	SD721 - Output 7.3 CPD Deviation (Spare)
1:0269	SD722 - Output 8.1 CPD Deviation (Spare)
1:0270	SD723 - Output 8.2 CPD Deviation (Spare)
1:0271	SD724 - Output 8.3 CPD Deviation (Spare)
1:0272	SD751 - Temperature 1.1
1:0273	SD752 - Temperature 1.2
1:0274	SD753 - Temperature 1.3
1:0275	SD754 - Temperature 2.1
1:0276	SD755 - Temperature 2.2
1:0277	SD756 - Temperature 2.3
1:0278	SD757 - Temperature 3.1
1:0279	SD758 - Temperature 3.2
1:0280	SD759 - Temperature 3.3
1:0281	SD760 - Temperature 4.1
1:0282	SD761 - Temperature 4.2
1:0283	SD762 - Temperature 4.3
1:0284	SD763 - Temperature 5.1
1:0285	SD764 - Temperature 5.2
1:0286	SD765 - Temperature 5.3
1:0287	SD766 - Temperature 6.1
1:0288	SD767 - Temperature 6.2
1:0289	SD768 - Temperature 6.3
1:0290	SD769 - Temperature 7.1 (Spare)
1:0291	SD770 - Temperature 7.2 (Spare)
1:0292	SD771 - Temperature 7.3 (Spare)
1:0293	SD772 - Temperature 8.1 (Spare)
1:0294	SD773 - Temperature 8.2 (Spare)
1:0295	SD774 - Temperature 8.3 (Spare)
1:0296	SD801 - Timing Input Fault
1:0297	SD802 - Duration Input Fault
1:0298	SD803 - Speed #1 Fault
1:0299	SD804 - Speed #2 Fault
1:0300	SD805 - TDC #1 Fault
1:0301	SD806 - TDC #2 Fault
1:0302	SD807 - PHS #1 Fault (Spare)
1:0303	
1:0304	
1:0305	
1:0306	SD811 - Multiplexer #1 Over-Current
1:0307	SD812 - Multiplexer #2 Over-Current
1:0308	SD813 - Multiplexer #3 Over-Current
1:0309	SD814 - Multiplexer #4 Over-Current
1:0310	SD815 - Multiplexer #5 Over-Current
1:0311	SD816 - Multiplexer #6 Over-Current
1:0312	SD817 - Multiplexer #7 Over-Current (Spare)
1:0313	SD818 - Multiplexer #8 Over-Current (Spare)
1:0314	SD821 - Multiplexer #1 Injection Limit
1:0315	SD822 - Multiplexer #2 Injection Limit
1:0316	SD823 - Multiplexer #3 Injection Limit

Address	Description
1:0317	SD824 - Multiplexer #4 Injection Limit
1:0318	SD825 - Multiplexer #5 Injection Limit
1:0319	SD826 - Multiplexer #6 Injection Limit
1:0320	SD827 - Multiplexer #7 Injection Limit
1:0321	SD828 - Multiplexer #8 Injection Limit
1:0322	SD831 - Driver Supply Voltage Low
1:0323	SD832 - Driver Supply Voltage High
1:0324	SD833 - Driver Temperature High
1:0325	SD834 - Driver EFI Voltage Low
1:0326	SD837 - Driver Modbus Fault
1:0327	SD838 - Driver CAN Fault
1:0328	EV901 - Driver Stopped Mode
1:0329	EV902 - Driver Running Mode
1:0330	EV903 - Online Test Mode
1:0331	EV904 - Driver Click-Test Mode
1:0332	EV905 - Temperature Balancer Active

Analog Reads

Address	Description	Units	Multiplier
3:0001	Main Duration	°CA	10
3:0002	Main Timing	°CA	10
3:0003	Speed (from hardware)	rpm	10
3:0004	Speed (from EFI_CORE)	rpm	10
3:0005	Average Temperature	°C	10
3:0006	Average CPD time	ms	1000
3:0007			
3:0008			
3:0009			
3:0010			
3:0011	Timing Output 1.1	°CA	10
3:0012	Timing Output 1.2	°CA	10
3:0013	Timing Output 1.3	°CA	10
3:0014	Timing Output 2.1	°CA	10
3:0015	Timing Output 2.2	°CA	10
3:0016	Timing Output 2.3	°CA	10
3:0017	Timing Output 3.1	°CA	10
3:0018	Timing Output 3.2	°CA	10
3:0019	Timing Output 3.3	°CA	10
3:0020	Timing Output 4.1	°CA	10
3:0021	Timing Output 4.2	°CA	10
3:0022	Timing Output 4.3	°CA	10
3:0023	Timing Output 5.1	°CA	10
3:0024	Timing Output 5.2	°CA	10
3:0025	Timing Output 5.3	°CA	10
3:0026	Timing Output 6.1	°CA	10
3:0027	Timing Output 6.2	°CA	10
3:0028	Timing Output 6.3	°CA	10
3:0029	Timing Output 7.1 (Spare)	°CA	10
3:0030	Timing Output 7.2 (Spare)	°CA	10
3:0031	Timing Output 7.3 (Spare)	°CA	10
3:0032	Timing Output 8.1 (Spare)	°CA	10

Address	Description	Units	Multiplier
3:0033	Timing Output 8.2 (Spare)	°CA	10
3:0034	Timing Output 8.3 (Spare)	°CA	10
3:0035	Duration Output 1.1	°CA	10
3:0036	Duration Output 1.2	°CA	10
3:0037	Duration Output 1.3	°CA	10
3:0038	Duration Output 2.1	°CA	10
3:0039	Duration Output 2.2	°CA	10
3:0040	Duration Output 2.3	°CA	10
3:0041	Duration Output 3.1	°CA	10
3:0042	Duration Output 3.2	°CA	10
3:0043	Duration Output 3.3	°CA	10
3:0044	Duration Output 4.1	°CA	10
3:0045	Duration Output 4.2	°CA	10
3:0046	Duration Output 4.3	°CA	10
3:0047	Duration Output 5.1	°CA	10
3:0048	Duration Output 5.2	°CA	10
3:0049	Duration Output 5.3	°CA	10
3:0050	Duration Output 6.1	°CA	10
3:0051	Duration Output 6.2	°CA	10
3:0052	Duration Output 6.3	°CA	10
3:0053	Duration Output 7.1 (Spare)	°CA	10
3:0054	Duration Output 7.2 (Spare)	°CA	10
3:0055	Duration Output 7.3 (Spare)	°CA	10
3:0056	Duration Output 8.1 (Spare)	°CA	10
3:0057	Duration Output 8.2 (Spare)	°CA	10
3:0058	Duration Output 8.3 (Spare)	°CA	10
3:0059	Temperature 1.1	°C	10
3:0060	Temperature 1.2	°C	10
3:0061	Temperature 1.3	°C	10
3:0062	Temperature 2.1	°C	10
3:0063	Temperature 2.2	°C	10
3:0064	Temperature 2.3	°C	10
3:0065	Temperature 3.1	°C	10
3:0066	Temperature 3.2	°C	10
3:0067	Temperature 3.3	°C	10
3:0068	Temperature 4.1	°C	10
3:0069	Temperature 4.2	°C	10
3:0070	Temperature 4.3	°C	10
3:0071	Temperature 5.1	°C	10
3:0072	Temperature 5.2	°C	10
3:0073	Temperature 5.3	°C	10
3:0074	Temperature 6.1	°C	10
3:0075	Temperature 6.2	°C	10
3:0076	Temperature 6.3	°C	10
3:0077	Temperature 7.1 (Spare)	°C	10
3:0078	Temperature 7.2 (Spare)	°C	10
3:0079	Temperature 7.3 (Spare)	°C	10
3:0080	Temperature 8.1 (Spare)	°C	10
3:0081	Temperature 8.2 (Spare)	°C	10
3:0082	Temperature 8.3 (Spare)	°C	10

Analog Writes

Address	Description	Units	Multiplier
4:0001	Main Duration	°CA	10
4:0002	Main Timing	°CA	10
4:0003			
4:0004			
4:0005			
4:0006			
4:0007			
4:0008			
4:0009			
4:0010			
4:0011	Timing Bias Output 1.1	°CA	100
4:0012	Timing Bias Output 1.2	°CA	100
4:0013	Timing Bias Output 1.3	°CA	100
4:0014	Timing Bias Output 2.1	°CA	100
4:0015	Timing Bias Output 2.2	°CA	100
4:0016	Timing Bias Output 2.3	°CA	100
4:0017	Timing Bias Output 3.1	°CA	100
4:0018	Timing Bias Output 3.2	°CA	100
4:0019	Timing Bias Output 3.3	°CA	100
4:0020	Timing Bias Output 4.1	°CA	100
4:0021	Timing Bias Output 4.2	°CA	100
4:0022	Timing Bias Output 4.3	°CA	100
4:0023	Timing Bias Output 5.1	°CA	100
4:0024	Timing Bias Output 5.2	°CA	100
4:0025	Timing Bias Output 5.3	°CA	100
4:0026	Timing Bias Output 6.1	°CA	100
4:0027	Timing Bias Output 6.2	°CA	100
4:0028	Timing Bias Output 6.3	°CA	100
4:0029	Timing Bias Output 7.1 (Spare)	°CA	100
4:0030	Timing Bias Output 7.2 (Spare)	°CA	100
4:0031	Timing Bias Output 7.3 (Spare)	°CA	100
4:0032	Timing Bias Output 8.1 (Spare)	°CA	100
4:0033	Timing Bias Output 8.2 (Spare)	°CA	100
4:0034	Timing Bias Output 8.3 (Spare)	°CA	100
4:0035	Duration Bias 1.1	°CA	100
4:0036	Duration Bias 1.2	°CA	100
4:0037	Duration Bias 1.3	°CA	100
4:0038	Duration Bias 2.1	°CA	100
4:0039	Duration Bias 2.2	°CA	100
4:0040	Duration Bias 2.3	°CA	100
4:0041	Duration Bias 3.1	°CA	100
4:0042	Duration Bias 3.2	°CA	100
4:0043	Duration Bias 3.3	°CA	100
4:0044	Duration Bias 4.1	°CA	100
4:0045	Duration Bias 4.2	°CA	100
4:0046	Duration Bias 4.3	°CA	100
4:0047	Duration Bias 5.1	°CA	100
4:0048	Duration Bias 5.2	°CA	100
4:0049	Duration Bias 5.3	°CA	100
4:0050	Duration Bias 6.1	°CA	100
4:0051	Duration Bias 6.2	°CA	100

Address	Description	Units	Multiplier
4:0052	Duration Bias 6.3	°CA	100
4:0053	Duration Bias 7.1 (Spare)	°CA	100
4:0054	Duration Bias 7.2 (Spare)	°CA	100
4:0055	Duration Bias 7.3 (Spare)	°CA	100
4:0056	Duration Bias 8.1 (Spare)	°CA	100
4:0057	Duration Bias 8.2 (Spare)	°CA	100
4:0058	Duration Bias 8.3 (Spare)	°CA	100
4:0059	Temperature 1.1	°C	1
4:0060	Temperature 1.2	°C	1
4:0061	Temperature 1.3	°C	1
4:0062	Temperature 2.1	°C	1
4:0063	Temperature 2.2	°C	1
4:0064	Temperature 2.3	°C	1
4:0065	Temperature 3.1	°C	1
4:0066	Temperature 3.2	°C	1
4:0067	Temperature 3.3	°C	1
4:0068	Temperature 4.1	°C	1
4:0069	Temperature 4.2	°C	1
4:0070	Temperature 4.3	°C	1
4:0071	Temperature 5.1	°C	1
4:0072	Temperature 5.2	°C	1
4:0073	Temperature 5.3	°C	1
4:0074	Temperature 6.1	°C	1
4:0075	Temperature 6.2	°C	1
4:0076	Temperature 6.3	°C	1
4:0077	Temperature 7.1 (Spare)	°C	1
4:0078	Temperature 7.2 (Spare)	°C	1
4:0079	Temperature 7.3 (Spare)	°C	1
4:0080	Temperature 8.1 (Spare)	°C	1
4:0081	Temperature 8.2 (Spare)	°C	1
4:0082	Temperature 8.3 (Spare)	°C	1

Chapter 7.
J1939 CAN Signals List

Introduction

This chapter lists the J1939 CAN PGN/SPN's supported by the In-Pulse II – Standard Multi Point Driver system.

The control uses CAN WRITE messages to broadcast parameters, so they are available for monitoring & control by external systems like SCADA, PLC etc.

The control uses CAN READ messages to receive parameters sent from external systems like SCADA, PLC etc.

CAN READ messages (J1939 standard)

PGN 65187	SPN 1137	Engine Exhaust Gas Port 1 Temperature
	SPN 1138	Engine Exhaust Gas Port 2 Temperature
	SPN 1139	Engine Exhaust Gas Port 3 Temperature
	SPN 1140	Engine Exhaust Gas Port 4 Temperature
PGN 65186	SPN 1141	Engine Exhaust Gas Port 5 Temperature
	SPN 1142	Engine Exhaust Gas Port 6 Temperature
	SPN 1143	Engine Exhaust Gas Port 7 Temperature
	SPN 1144	Engine Exhaust Gas Port 8 Temperature
PGN 65185	SPN 1145	Engine Exhaust Gas Port 9 Temperature
	SPN 1146	Engine Exhaust Gas Port 10 Temperature
	SPN 1147	Engine Exhaust Gas Port 11 Temperature
	SPN 1148	Engine Exhaust Gas Port 12 Temperature
PGN 65184	SPN 1149	Engine Exhaust Gas Port 13 Temperature
	SPN 1150	Engine Exhaust Gas Port 14 Temperature
	SPN 1151	Engine Exhaust Gas Port 15 Temperature
	SPN 1152	Engine Exhaust Gas Port 16 Temperature
PGN 65183	SPN 1153	Engine Exhaust Gas Port 17 Temperature
	SPN 1154	Engine Exhaust Gas Port 18 Temperature
	SPN 1155	Engine Exhaust Gas Port 19 Temperature
	SPN 1156	Engine Exhaust Gas Port 20 Temperature

CAN READ messages (J1939 Woodward propriety)

PGN 65449 BYTE 1&2 Duration Input [°CA]
Range=0-720, Resolution=1/64 per bit, Offset=0

BYTE 3&4 Timing Input [°CA]
Range=0-720, Resolution=1/64 per bit, Offset=0

BYTE 5.1 RUN permissive input
BYTE 5.2 Temp Balancing permissive input
BYTE 5.3 RESET command input
BYTE 5.4 Pre-Injection enable input

Transmission Rate <= 50ms for all data in this PGN

PGN 65452
BYTE 1 Duration Offset #1 input [°CA]
BYTE 2 Duration Offset #2 input [°CA]
BYTE 3 Duration Offset #3 input [°CA]
BYTE 4 Duration Offset #4 input [°CA]
BYTE 5 Duration Offset #5 input [°CA]
BYTE 6 Duration Offset #6 input [°CA]
BYTE 7 Duration Offset #7 input [°CA]
BYTE 8 Duration Offset #8 input [°CA]

Range=-15.785~15.785, Resolution=1/8 per bit, Offset=-16
Transmission Rate <= 1s for all data in this PGN

PGN 65451
BYTE 1 Duration Offset #9 input [°CA]
BYTE 2 Duration Offset #10 input [°CA]
BYTE 3 Duration Offset #11 input [°CA]
BYTE 4 Duration Offset #12 input [°CA]
BYTE 5 Duration Offset #13 input [°CA]
BYTE 6 Duration Offset #14 input [°CA]
BYTE 7 Duration Offset #15 input [°CA]
BYTE 8 Duration Offset #16 input [°CA]

Range=-15.785~15.785, Resolution=1/8 per bit, Offset=-16
Transmission Rate <=1s for all data in this PGN

PGN 65450
BYTE 1 Duration Offset #17 input [°CA]
BYTE 2 Duration Offset #18 input [°CA]
BYTE 3 Duration Offset #19 input [°CA]
BYTE 4 Duration Offset #20 input [°CA]
BYTE 5 Duration Offset #21 input [°CA]
BYTE 6 Duration Offset #22 input [°CA]
BYTE 7 Duration Offset #23 input [°CA]
BYTE 8 Duration Offset #24 input [°CA]

Range=-15.785~15.785, Resolution=1/8 per bit, Offset=-16
Transmission Rate <= 1s for all data in this PGN

PGN 65455	BYTE 1	Timing Offset #1 input [°CA]
	BYTE 2	Timing Offset #2 input [°CA]
	BYTE 3	Timing Offset #3 input [°CA]
	BYTE 4	Timing Offset #4 input [°CA]
	BYTE 5	Timing Offset #5 input [°CA]
	BYTE 6	Timing Offset #6 input [°CA]
	BYTE 7	Timing Offset #7 input [°CA]
	BYTE 8	Timing Offset #8 input [°CA]

Range=-15.785~15.785, Resolution=1/8 per bit, Offset=-16
Transmission Rate <= 1s for all data in this PGN

PGN 65454	BYTE 1	Timing Offset #9 input [°CA]
	BYTE 2	Timing Offset #10 input [°CA]
	BYTE 3	Timing Offset #11 input [°CA]
	BYTE 4	Timing Offset #12 input [°CA]
	BYTE 5	Timing Offset #13 input [°CA]
	BYTE 6	Timing Offset #14 input [°CA]
	BYTE 7	Timing Offset #15 input [°CA]
	BYTE 8	Timing Offset #16 input [°CA]

Range=-15.785~15.785, Resolution=1/8 per bit, Offset=-16
Transmission Rate <= 1s for all data in this PGN

PGN 65453	BYTE 1	Timing Offset #17 input [°CA]
	BYTE 2	Timing Offset #18 input [°CA]
	BYTE 3	Timing Offset #19 input [°CA]
	BYTE 4	Timing Offset #20 input [°CA]
	BYTE 5	Timing Offset #21 input [°CA]
	BYTE 6	Timing Offset #22 input [°CA]
	BYTE 7	Timing Offset #23 input [°CA]
	BYTE 8	Timing Offset #24 input [°CA]

Range=-15.785~15.785, Resolution=1/8 per bit, Offset=-16
Transmission Rate <= 1s for all data in this PGN

CAN WRITE messages (J1939 standard)

PGN 61444	SPN 190	Engine Speed
PGN 64851	SPN 4151	Engine Exhaust Gas Temperature Average

CAN WRITE messages (J1939 Woodward propriety)

PGN 65456	BYTE 1.1	Major Alarm
	BYTE 1.2	Minor Alarm
	BYTE 1.3	Stopped Mode
	BYTE 1.4	Click-Test Mode
	BYTE 1.5	Running Mode
	BYTE 1.6	Online Test Mode
	BYTE 1.7	EFI permissive
	BYTE 1.8	Speed Permissive
PGN 65456	BYTE 2.1	Injection Active
	BYTE 2.2	Temp Balancing Permissive
	BYTE 2.3	Temp Balancing Active
	BYTE 2.4	
	BYTE 2.5	
	BYTE 2.6	
	BYTE 2.7	
	BYTE 2.8	
PGN 65456	BYTE 3.1	EFI Output 1.1 is used
	BYTE 3.2	EFI Output 1.2 is used
	BYTE 3.3	EFI Output 1.3 is used
	BYTE 3.4	EFI Output 2.1 is used
	BYTE 3.5	EFI Output 2.2 is used
	BYTE 3.6	EFI Output 2.3 is used
	BYTE 3.7	EFI Output 3.1 is used
	BYTE 3.8	EFI Output 3.2 is used
PGN 65456	BYTE 4.1	EFI Output 3.3 is used
	BYTE 4.2	EFI Output 4.1 is used
	BYTE 4.3	EFI Output 4.2 is used
	BYTE 4.4	EFI Output 4.3 is used
	BYTE 4.5	EFI Output 5.1 is used
	BYTE 4.6	EFI Output 5.2 is used
	BYTE 4.7	EFI Output 5.3 is used
	BYTE 4.8	EFI Output 6.1 is used
PGN 65456	BYTE 5.1	EFI Output 6.2 is used
	BYTE 5.2	EFI Output 6.3 is used
	BYTE 5.3	
	BYTE 5.4	
	BYTE 5.5	
	BYTE 5.6	
	BYTE 5.7	
	BYTE 5.8	

PGN 65456	BYTE 6.1	AL001 - Output 1.1 Over-Current
	BYTE 6.2	AL002 - Output 1.2 Over-Current
	BYTE 6.3	AL003 - Output 1.3 Over-Current
	BYTE 6.4	AL004 - Output 2.1 Over-Current
	BYTE 6.5	AL005 - Output 2.2 Over-Current
	BYTE 6.6	AL006 - Output 2.3 Over-Current
	BYTE 6.7	AL007 - Output 3.1 Over-Current
	BYTE 6.8	AL008 - Output 3.2 Over-Current
PGN 65456	BYTE 7.1	AL009 - Output 3.3 Over-Current
	BYTE 7.2	AL010 - Output 4.1 Over-Current
	BYTE 7.3	AL011 - Output 4.2 Over-Current
	BYTE 7.4	AL012 - Output 4.3 Over-Current
	BYTE 7.5	AL013 - Output 5.1 Over-Current
	BYTE 7.6	AL014 - Output 5.2 Over-Current
	BYTE 7.7	AL015 - Output 5.3 Over-Current
	BYTE 7.8	AL016 - Output 6.1 Over-Current
PGN 65456	BYTE 8.1	AL017 - Output 6.2 Over-Current
	BYTE 8.2	AL018 - Output 6.3 Over-Current
	BYTE 8.3	
	BYTE 8.4	
	BYTE 8.5	
	BYTE 8.6	
	BYTE 8.7	
	BYTE 8.8	

Transmission Rate ~= 160ms for all data in this PGN

PGN 65457	BYTE 1.1	AL101 - Output 1.1 Open-Coil
	BYTE 1.2	AL102 - Output 1.2 Open-Coil
	BYTE 1.3	AL103 - Output 1.3 Open-Coil
	BYTE 1.4	AL104 - Output 2.1 Open-Coil
	BYTE 1.5	AL105 - Output 2.2 Open-Coil
	BYTE 1.6	AL106 - Output 2.3 Open-Coil
	BYTE 1.7	AL107 - Output 3.1 Open-Coil
	BYTE 1.8	AL108 - Output 3.2 Open-Coil
PGN 65457	BYTE 2.1	AL109 - Output 3.3 Open-Coil
	BYTE 2.2	AL110 - Output 4.1 Open-Coil
	BYTE 2.3	AL111 - Output 4.2 Open-Coil
	BYTE 2.4	AL112 - Output 4.3 Open-Coil
	BYTE 2.5	AL113 - Output 5.1 Open-Coil
	BYTE 2.6	AL114 - Output 5.2 Open-Coil
	BYTE 2.7	AL115 - Output 5.3 Open-Coil
	BYTE 2.8	AL116 - Output 6.1 Open-Coil
PGN 65457	BYTE 3.1	AL117 - Output 6.2 Open-Coil
	BYTE 3.2	AL118 - Output 6.3 Open-Coil
	BYTE 3.3	
	BYTE 3.4	
	BYTE 3.5	
	BYTE 3.6	
	BYTE 3.7	
	BYTE 3.8	

PGN 65457	BYTE 4.1	AL201 - Output 1.1 CPD Deviation
	BYTE 4.2	AL202 - Output 1.2 CPD Deviation
	BYTE 4.3	AL203 - Output 1.3 CPD Deviation
	BYTE 4.4	AL204 - Output 2.1 CPD Deviation
	BYTE 4.5	AL205 - Output 2.2 CPD Deviation
	BYTE 4.6	AL206 - Output 2.3 CPD Deviation
	BYTE 4.7	AL207 - Output 3.1 CPD Deviation
	BYTE 4.8	AL208 - Output 3.2 CPD Deviation
PGN 65457	BYTE 5.1	AL209 - Output 3.3 CPD Deviation
	BYTE 5.2	AL210 - Output 4.1 CPD Deviation
	BYTE 5.3	AL211 - Output 4.2 CPD Deviation
	BYTE 5.4	AL212 - Output 4.3 CPD Deviation
	BYTE 5.5	AL213 - Output 5.1 CPD Deviation
	BYTE 5.6	AL214 - Output 5.2 CPD Deviation
	BYTE 5.7	AL215 - Output 5.3 CPD Deviation
	BYTE 5.8	AL216 - Output 6.1 CPD Deviation
PGN 65457	BYTE 6.1	AL217 - Output 6.2 CPD Deviation
	BYTE 6.2	AL218 - Output 6.3 CPD Deviation
	BYTE 6.3	
	BYTE 6.4	
	BYTE 6.5	
	BYTE 6.6	
	BYTE 6.7	
	BYTE 6.8	
PGN 65457	BYTE 7.1	AL301 - Temperature 1.1
	BYTE 7.2	AL302 - Temperature 1.2
	BYTE 7.3	AL303 - Temperature 1.3
	BYTE 7.4	AL304 - Temperature 2.1
	BYTE 7.5	AL305 - Temperature 2.2
	BYTE 7.6	AL306 - Temperature 2.3
	BYTE 7.7	AL307 - Temperature 3.1
	BYTE 7.8	AL308 - Temperature 3.2
PGN 65457	BYTE 8.1	AL309 - Temperature 3.3
	BYTE 8.2	AL310 - Temperature 4.1
	BYTE 8.3	AL311 - Temperature 4.2
	BYTE 8.4	AL312 - Temperature 4.3
	BYTE 8.5	AL313 - Temperature 5.1
	BYTE 8.6	AL314 - Temperature 5.2
	BYTE 8.7	AL315 - Temperature 5.3
	BYTE 8.8	AL316 - Temperature 6.1

Transmission Rate ~= 160ms for all data in this PGN

PGN 65458	BYTE 1.1	AL317 - Temperature 6.2
	BYTE 1.2	AL318 - Temperature 6.3
	BYTE 1.3	
	BYTE 1.4	
	BYTE 1.5	
	BYTE 1.6	
	BYTE 1.7	
	BYTE 1.8	

PGN 65458	BYTE 2.1	AL401 - Timing Input Fault
	BYTE 2.2	AL402 - Duration Input Fault
	BYTE 2.3	AL403 - Speed #1 Fault
	BYTE 2.4	AL404 - Speed #2 Fault
	BYTE 2.5	AL405 - TDC #1 Fault
	BYTE 2.6	AL406 - TDC #2 Fault
	BYTE 2.7	AL407 - PHS #1 Fault
	BYTE 2.8	
PGN 65458	BYTE 3.1	AL411 - Multiplexer #1 Over-Current
	BYTE 3.2	AL412 - Multiplexer #2 Over-Current
	BYTE 3.3	AL413 - Multiplexer #3 Over-Current
	BYTE 3.4	AL414 - Multiplexer #4 Over-Current
	BYTE 3.5	AL415 - Multiplexer #5 Over-Current
	BYTE 3.6	AL416 - Multiplexer #6 Over-Current
	BYTE 3.7	
	BYTE 3.8	
PGN 65458	BYTE 4.1	AL421 - Multiplexer #1 Injection Limit
	BYTE 4.2	AL422 - Multiplexer #2 Injection Limit
	BYTE 4.3	AL423 - Multiplexer #3 Injection Limit
	BYTE 4.4	AL424 - Multiplexer #4 Injection Limit
	BYTE 4.5	AL425 - Multiplexer #5 Injection Limit
	BYTE 4.6	AL426 - Multiplexer #6 Injection Limit
	BYTE 4.7	
	BYTE 4.8	
PGN 65458	BYTE 5.1	AL431 - Driver Supply Voltage Low
	BYTE 5.2	AL432 - Driver Supply Voltage High
	BYTE 5.3	AL433 - Driver Temperature High
	BYTE 5.4	AL434 - Driver EFI Voltage Low
	BYTE 5.5	AL435 - Driver MCU Alarm
	BYTE 5.6	AL436 - Driver System Alarm
	BYTE 5.7	AL437 - Driver Modbus Fault
	BYTE 5.8	AL438 - Driver CAN Fault
PGN 65458	BYTE 6.1	
	BYTE 6.2	
	BYTE 6.3	
	BYTE 6.4	
	BYTE 6.5	
	BYTE 6.6	
	BYTE 6.7	
	BYTE 6.8	
PGN 65458	BYTE 7.1	SD501 - Output 1.1 Over-Current
	BYTE 7.2	SD502 - Output 1.2 Over-Current
	BYTE 7.3	SD503 - Output 1.3 Over-Current
	BYTE 7.4	SD504 - Output 2.1 Over-Current
	BYTE 7.5	SD505 - Output 2.2 Over-Current
	BYTE 7.6	SD506 - Output 2.3 Over-Current
	BYTE 7.7	SD507 - Output 3.1 Over-Current
	BYTE 7.8	SD508 - Output 3.2 Over-Current

PGN 65458	BYTE 8.1	SD509 - Output 3.3 Over-Current
	BYTE 8.2	SD510 - Output 4.1 Over-Current
	BYTE 8.3	SD511 - Output 4.2 Over-Current
	BYTE 8.4	SD512 - Output 4.3 Over-Current
	BYTE 8.5	SD513 - Output 5.1 Over-Current
	BYTE 8.6	SD514 - Output 5.2 Over-Current
	BYTE 8.7	SD515 - Output 5.3 Over-Current
	BYTE 8.8	SD516 - Output 6.1 Over-Current

Transmission Rate ~= 160ms for all data in this PGN

PGN 65459	BYTE 1.1	SD517 - Output 6.2 Over-Current
	BYTE 1.2	SD518 - Output 6.3 Over-Current
	BYTE 1.3	
	BYTE 1.4	
	BYTE 1.5	
	BYTE 1.6	
	BYTE 1.7	
	BYTE 1.8	
PGN 65459	BYTE 2.1	SD601 - Output 1.1 Open-Coil
	BYTE 2.2	SD602 - Output 1.2 Open-Coil
	BYTE 2.3	SD603 - Output 1.3 Open-Coil
	BYTE 2.4	SD604 - Output 2.1 Open-Coil
	BYTE 2.5	SD605 - Output 2.2 Open-Coil
	BYTE 2.6	SD606 - Output 2.3 Open-Coil
	BYTE 2.7	SD607 - Output 3.1 Open-Coil
	BYTE 2.8	SD608 - Output 3.2 Open-Coil
PGN 65459	BYTE 3.1	SD609 - Output 3.3 Open-Coil
	BYTE 3.2	SD610 - Output 4.1 Open-Coil
	BYTE 3.3	SD611 - Output 4.2 Open-Coil
	BYTE 3.4	SD612 - Output 4.3 Open-Coil
	BYTE 3.5	SD613 - Output 5.1 Open-Coil
	BYTE 3.6	SD614 - Output 5.2 Open-Coil
	BYTE 3.7	SD615 - Output 5.3 Open-Coil
	BYTE 3.8	SD616 - Output 6.1 Open-Coil
PGN 65459	BYTE 4.1	SD617 - Output 6.2 Open-Coil
	BYTE 4.2	SD618 - Output 6.3 Open-Coil
	BYTE 4.3	
	BYTE 4.4	
	BYTE 4.5	
	BYTE 4.6	
	BYTE 4.7	
	BYTE 4.8	
PGN 65459	BYTE 5.1	SD701 - Output 1.1 CPD Deviation
	BYTE 5.2	SD702 - Output 1.2 CPD Deviation
	BYTE 5.3	SD703 - Output 1.3 CPD Deviation
	BYTE 5.4	SD704 - Output 2.1 CPD Deviation
	BYTE 5.5	SD705 - Output 2.2 CPD Deviation
	BYTE 5.6	SD706 - Output 2.3 CPD Deviation
	BYTE 5.7	SD707 - Output 3.1 CPD Deviation
	BYTE 5.8	SD708 - Output 3.2 CPD Deviation

PGN 65459	BYTE 6.1	SD709 - Output 3.3 CPD Deviation
	BYTE 6.2	SD710 - Output 4.1 CPD Deviation
	BYTE 6.3	SD711 - Output 4.2 CPD Deviation
	BYTE 6.4	SD712 - Output 4.3 CPD Deviation
	BYTE 6.5	SD713 - Output 5.1 CPD Deviation
	BYTE 6.6	SD714 - Output 5.2 CPD Deviation
	BYTE 6.7	SD715 - Output 5.3 CPD Deviation
	BYTE 6.8	SD716 - Output 6.1 CPD Deviation
PGN 65459	BYTE 7.1	SD717 - Output 6.2 CPD Deviation
	BYTE 7.2	SD718 - Output 6.3 CPD Deviation
	BYTE 7.3	
	BYTE 7.4	
	BYTE 7.5	
	BYTE 7.6	
	BYTE 7.7	
	BYTE 7.8	
PGN 65459	BYTE 8.1	SD751 - Temperature 1.1
	BYTE 8.2	SD752 - Temperature 1.2
	BYTE 8.3	SD753 - Temperature 1.3
	BYTE 8.4	SD754 - Temperature 2.1
	BYTE 8.5	SD755 - Temperature 2.2
	BYTE 8.6	SD756 - Temperature 2.3
	BYTE 8.7	SD757 - Temperature 3.1
	BYTE 8.8	SD758 - Temperature 3.2

Transmission Rate ~= 160ms for all data in this PGN

PGN 65460	BYTE 1.1	SD759 - Temperature 3.3
	BYTE 1.2	SD760 - Temperature 4.1
	BYTE 1.3	SD761 - Temperature 4.2
	BYTE 1.4	SD762 - Temperature 4.3
	BYTE 1.5	SD763 - Temperature 5.1
	BYTE 1.6	SD764 - Temperature 5.2
	BYTE 1.7	SD765 - Temperature 5.3
	BYTE 1.8	SD766 - Temperature 6.1
PGN 65460	BYTE 2.1	SD767 - Temperature 6.2
	BYTE 2.2	SD768 - Temperature 6.3
	BYTE 2.3	
	BYTE 2.4	
	BYTE 2.5	
	BYTE 2.6	
	BYTE 2.7	
	BYTE 2.8	
PGN 65460	BYTE 3.1	SD801 - Timing Input Fault
	BYTE 3.2	SD802 - Duration Input Fault
	BYTE 3.3	SD803 - Speed #1 Fault
	BYTE 3.4	SD804 - Speed #2 Fault
	BYTE 3.5	SD805 - TDC #1 Fault
	BYTE 3.6	SD806 - TDC #2 Fault
	BYTE 3.7	SD807 - PHS #1 Fault
	BYTE 3.8	

PGN 65460	BYTE 4.1	SD811 - Multiplexer #1 Over-Current
	BYTE 4.2	SD812 - Multiplexer #2 Over-Current
	BYTE 4.3	SD813 - Multiplexer #3 Over-Current
	BYTE 4.4	SD814 - Multiplexer #4 Over-Current
	BYTE 4.5	SD815 - Multiplexer #5 Over-Current
	BYTE 4.6	SD816 - Multiplexer #6 Over-Current
	BYTE 4.7	
	BYTE 4.8	
PGN 65460	BYTE 5.1	SD821 - Multiplexer #1 Injection Limit
	BYTE 5.2	SD822 - Multiplexer #2 Injection Limit
	BYTE 5.3	SD823 - Multiplexer #3 Injection Limit
	BYTE 5.4	SD824 - Multiplexer #4 Injection Limit
	BYTE 5.5	SD825 - Multiplexer #5 Injection Limit
	BYTE 5.6	SD826 - Multiplexer #6 Injection Limit
	BYTE 5.7	
	BYTE 5.8	
PGN 65460	BYTE 6.1	SD831 - Driver Supply Voltage Low
	BYTE 6.2	SD832 - Driver Supply Voltage High
	BYTE 6.3	SD833 - Driver Temperature High
	BYTE 6.4	SD834 - Driver EFI Voltage Low
	BYTE 6.5	SD837 - Driver Modbus Fault
	BYTE 6.6	SD838 - Driver CAN Fault
	BYTE 6.7	
	BYTE 6.8	
PGN 65460	BYTE 7.1	
	BYTE 7.2	
	BYTE 7.3	
	BYTE 7.4	
	BYTE 7.5	
	BYTE 7.6	
	BYTE 7.7	
	BYTE 7.8	
PGN 65460	BYTE 8.1	EV901 - Driver Stopped Mode
	BYTE 8.2	EV902 - Driver Running Mode
	BYTE 8.3	EV903 - Online Test Mode
	BYTE 8.4	EV904 - Driver Click-Test Mode
	BYTE 8.5	EV905 - Temperature Balancer Active
	BYTE 8.6	
	BYTE 8.7	
	BYTE 8.8	

Transmission Rate ~= 160ms for all data in this PGN

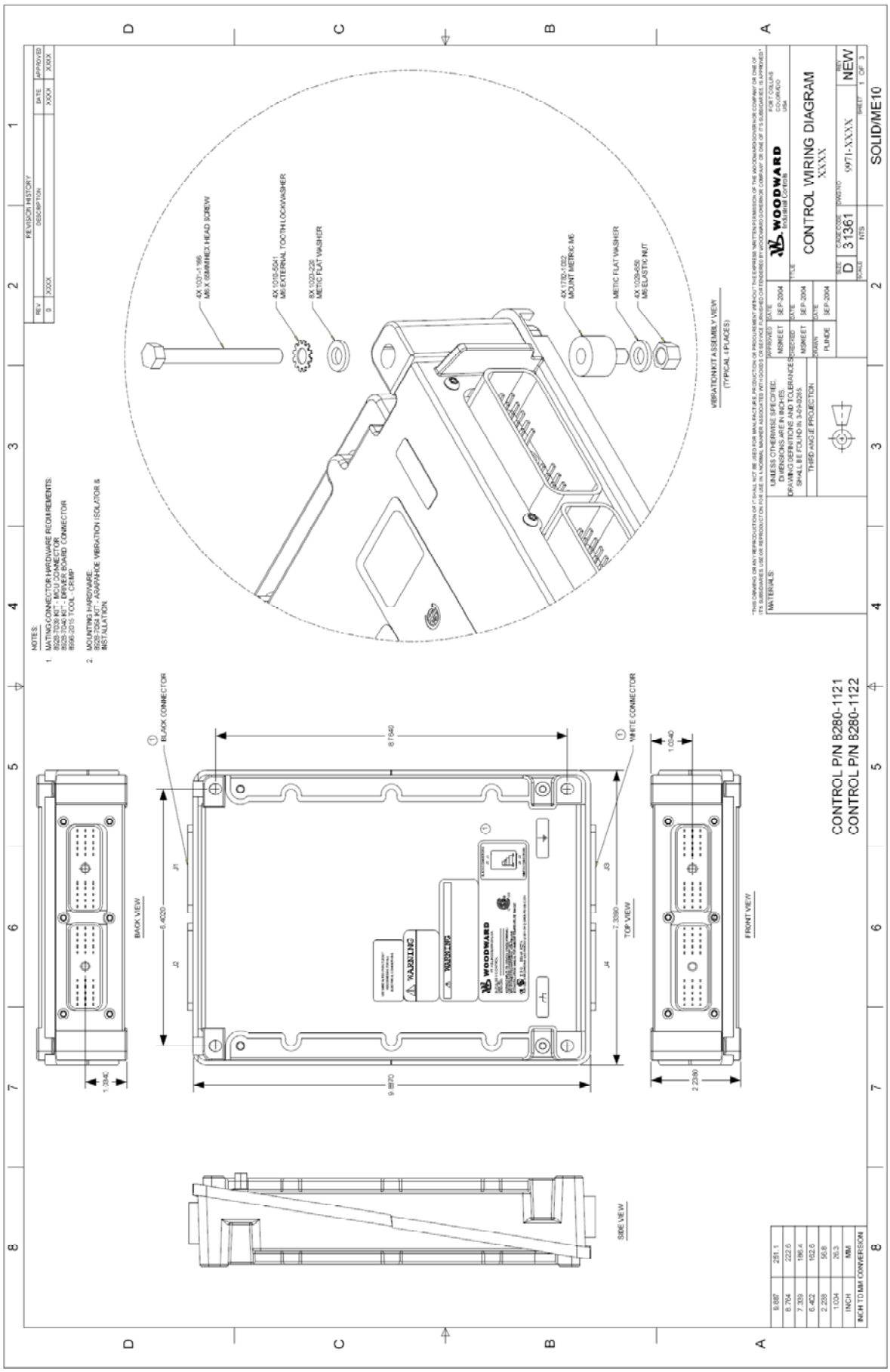
PGN 65461 BYTE 1&2 Average CPD time [ms]
Range=0-100, Resolution=1/512 per bit, Offset=0

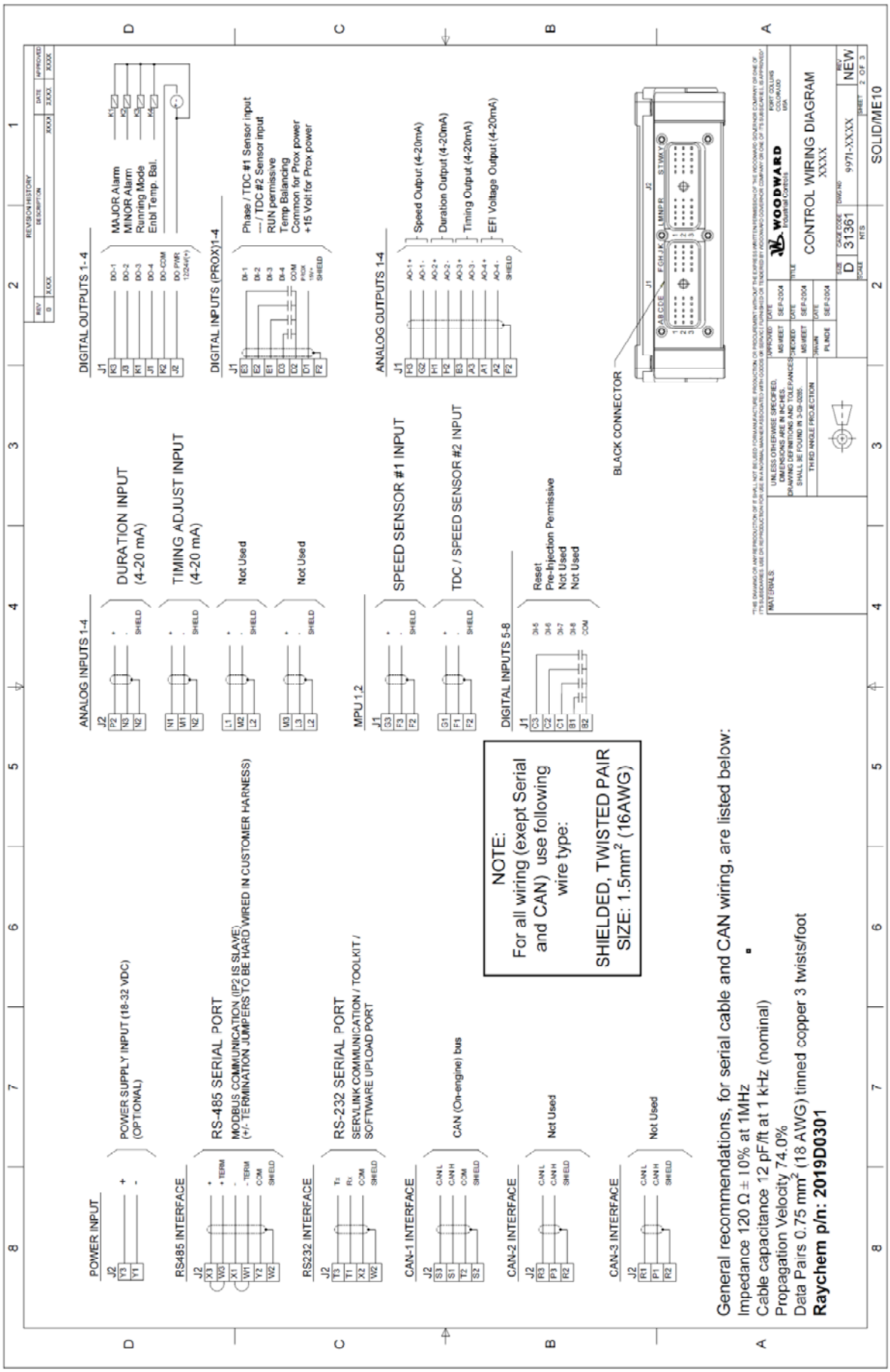
BYTE 3~8

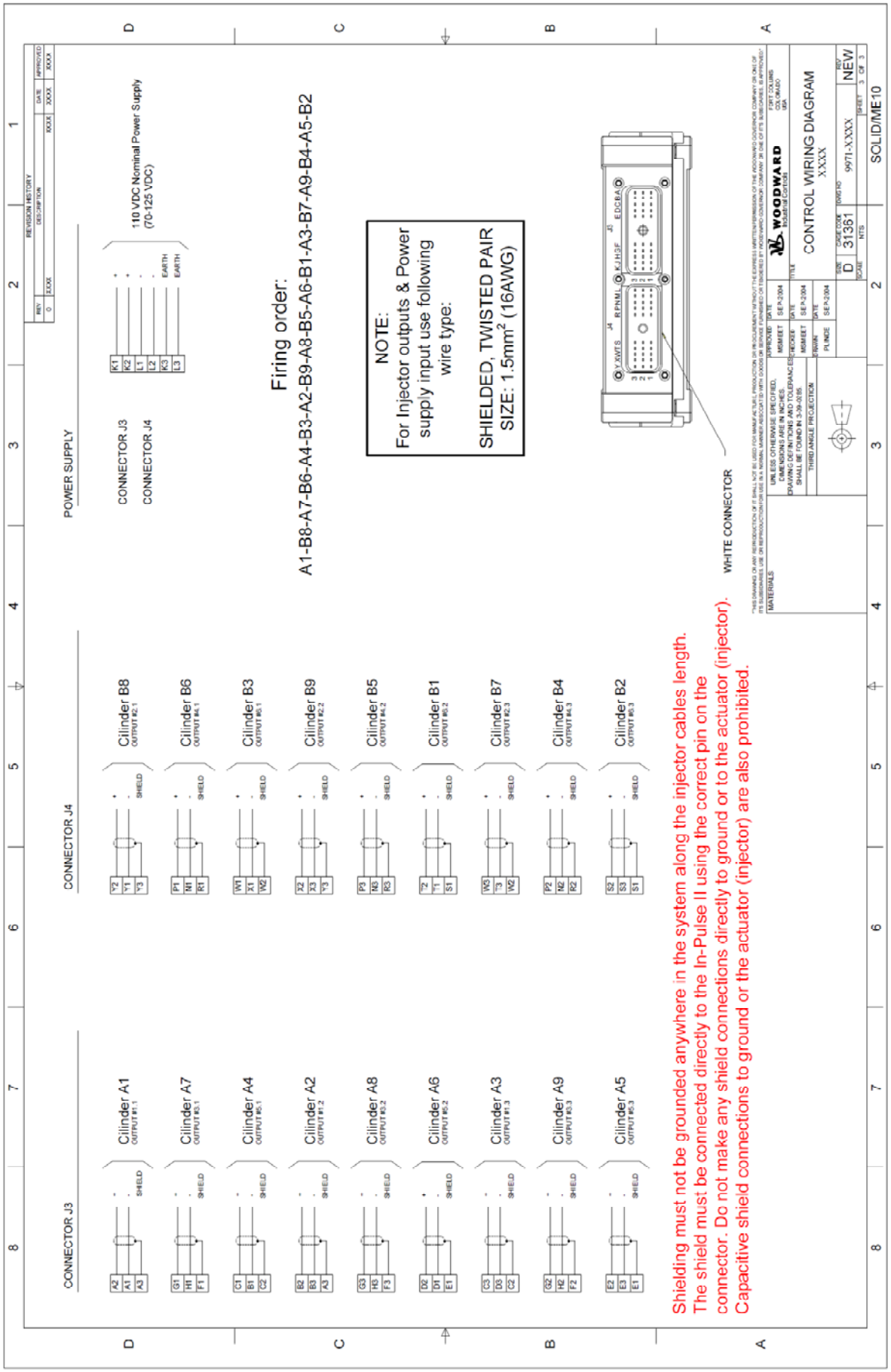
Transmission Rate ~= 160 ms for all data in this PGN

Chapter 8.
Wiring Diagram

This chapter contains a typical Wiring Diagram for the IP2.


CONTROL WIRING DIAGRAM
XXXX
9971-XXXX
CONTROL P/N 8280-1121
CONTROL P/N 8280-1122
SOLID/ME10
BACK VIEW
FRONT VIEW
TOP VIEW
SIDE VIEW
BLACK CONNECTOR
WHITE CONNECTOR
VIBRATION KIT ASSEMBLY VIEW
(TYPICAL 4 PLACES)
NOTES:
1. MATING CONNECTOR HARDWARE REQUIREMENTS:
8928-7036 KIT - MCU CONNECTOR
8928-7040 KIT - DRIVER BOARD CONNECTOR
8990-2015 TOOL - CRIMP
2. MOUNTING HARDWARE:
8928-7004 KIT - ARAPAHOE VIBRATION ISOLATOR & INSTALLATION


POWER INPUT
POWER SUPPLY INPUT (18-32 VDC) (OPTIONAL)
RS485 INTERFACE
RS-485 SERIAL PORT
MODBUS COMMUNICATION (IP2 IS SLAVE)
(+/- TERMINATION JUMPERS TO BE HARD WIRED IN CUSTOMER HARNESS)
RS232 INTERFACE
RS-232 SERIAL PORT
SERVLINK COMMUNICATION / TOOLKIT / SOFTWARE UPLOAD PORT
CAN-1 INTERFACE
CAN (On-engine) bus
CAN-2 INTERFACE
Not Used
CAN-3 INTERFACE
Not Used
ANALOG INPUTS 1-4
DURATION INPUT (4-20 mA)
TIMING ADJUST INPUT (4-20 mA)
Not Used
Not Used
MPU 1,2
SPEED SENSOR #1 INPUT
TDC / SPEED SENSOR #2 INPUT
DIGITAL INPUTS 5-8
Reset
Pre-Injection Permissive
Not Used
Not Used
NOTE:
For all wiring (exept Serial and CAN) use following wire type:
SHIELDED, TWISTED PAIR
SIZE: 1.5mm² (16AWG)
DIGITAL OUTPUTS 1-4
MAJOR Alarm
MINOR Alarm
Running Mode
Enbl Temp. Bal.
DIGITAL INPUTS (PROX)1-4
Phase / TDC #1 Sensor input
— / TDC #2 Sensor input
RUN permissive
Temp Balancing
Common for Prox power
+15 Volt for Prox power
ANALOG OUTPUTS 1-4
Speed Output (4-20mA)
Duration Output (4-20mA)
Timing Output (4-20mA)
EFI Voltage Output (4-20mA)
BLACK CONNECTOR
CONTROL WIRING DIAGRAM
XXXX
9971-XXXX
NEW
SOLID/ME10
General recommendations, for serial cable and CAN wiring, are listed below:
Impedance 120 Ω ± 10% at 1MHz
Cable capacitance 12 pF/ft at 1 kHz (nominal)
Propagation Velocity 74.0%
Data Pairs 0.75 mm² (18 AWG) tinned copper 3 twists/foot
Raychem p/n: 2019D0301


CONNECTOR J3
CONNECTOR J4
POWER SUPPLY
CONNECTOR J3
CONNECTOR J4
110 VDC Nominal Power Supply (70-125 VDC)
Firing order:
A1-B8-A7-B6-A4-B3-A2-B9-A8-B5-A6-B1-A3-B7-A9-B4-A5-B2
NOTE:
For Injector outputs & Power supply input use following wire type:
SHIELDED, TWISTED PAIR
SIZE: 1.5mm² (16AWG)
WHITE CONNECTOR
Cilinder A1
Cilinder A7
Cilinder A4
Cilinder A2
Cilinder A8
Cilinder A6
Cilinder A3
Cilinder A9
Cilinder A5
Cilinder B8
Cilinder B6
Cilinder B3
Cilinder B9
Cilinder B5
Cilinder B1
Cilinder B7
Cilinder B4
Cilinder B2
Shielding must not be grounded anywhere in the system along the injector cables length.
The shield must be connected directly to the In-Pulse II using the correct pin on the connector. Do not make any shield connections directly to ground or to the actuator (injector).
Capacitive shield connections to ground or the actuator (injector) are also prohibited.
WOODWARD
CONTROL WIRING DIAGRAM
XXXX
9971-XXXX
NEW
SOLID/ME10

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

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.

Revision History

Changes in Revision B—

- Added 8280-1222 system on page 1
- Corrected pin-outs on page 5

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 91525B.

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

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