



Installation and Operation Manual



IC/TIS-910 Ignition Controller with ServLink

8408-102 & 8408-702

Manual 26222

IMPORTANT



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.

DEFINITIONS

- **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

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.



Read this entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing this equipment. Practice all plant and safety instructions and precautions. Failure to follow instructions can cause personal injury and/or property damage.



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

NOTICE

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.

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*.

Contents

ELECTROSTATIC DISCHARGE AWARENESS	III
REGULATORY COMPLIANCE	IV
CHAPTER 1. GENERAL INFORMATION.....	1
Introduction.....	1
Theory of Operation.....	1
CHAPTER 2. TIMING SENSORS (MPUs).....	10
Introduction.....	10
Trigger MPU	10
Reset MPU	10
Cam MPU	12
CHAPTER 3. TIMING CONTROLS.....	13
Introduction.....	13
Manual Timing Adjustment.....	13
4–20 mA Input	13
0–5 Volt Input	14
Speed Curve.....	14
Timing Schedules A and B	14
Cylinder-to-Cylinder Timing Controls	14
CHAPTER 4. HIGH VOLTAGE SUPPLY AND PRIMARY OUTPUTS.....	15
High Voltage Power Supply.....	15
Primary Wiring	15
Odd Bank Connector	15
Even Bank Connector.....	15
Primary Wire	15
Primary Wiring Connector Pin Assignments	16
CHAPTER 5. ENERGY CONTROL.....	17
Introduction.....	17
Manual Energy Control.....	17
AUTO_E Auto Energy Control.....	17
CHAPTER 6. ENGINE CONTROLS AND SAFETY FEATURES.....	19
Introduction.....	19
Overspeed Protection.....	19
Permissive Start Output.....	19
Auxiliary Shutdown Input.....	20
Misfire Limit	20
Timing Sensor Fault Detection	20
Speed Switches.....	20
CHAPTER 7. PROGRAMMING.....	21
Introduction.....	21
Required Equipment.....	21
System Requirements	22
Definitions and Programming Parameters	22
Establishing Communications	24
Main Window	26
Making Adjustments	26
CHAPTER 8. START-UP PROCEDURE.....	42

Contents

CHAPTER 9. CANBUS INFORMATION	43
CANbus Interface with the D-1 Display	43
D-1 Display	43
CANbus Cable	43
CHAPTER 10. TROUBLESHOOTING	44
Sensor Input Faults	44
Ignition Coil Faults	45
Self Test.....	45
CHAPTER 11. SERVICE OPTIONS.....	47
Product Service Options.....	47
Woodward Factory Servicing Options	48
Returning Equipment for Repair	49
Replacement Parts	49
Engineering Services.....	50
How to Contact Woodward.....	50
Technical Assistance	51
APPENDIX. REFERENCE INFORMATION	52
LED Operation	52
IC/TIS-910 CONTROL SPECIFICATIONS	53

Illustrations and Tables

Figure 1-1. Wiring Diagram—IC/TIS-910 Timing Sensors	2
Figure 1-2a. Wiring Diagram—4–20 mA Signal	3
Figure 1-2b. Wiring Diagram—Power Wiring	3
Figure 1-3. Wiring Diagram—IC/TIS-910 Timing and Safety Controls.....	4
Figure 1-4. Wiring Diagram—16-Cylinder Example	5
Figure 1-5a. IC-910 Outline Drawing.....	6
Figure 1-5b. TIS-910 Outline Drawing.....	7
Figure 1-6a. Overall Plant Wiring Diagram.....	8
Figure 1-6b. Overall Plant Wiring Diagram.....	9
Figure 7-1. Null-Modem Cable	25

Electrostatic Discharge Awareness

All electronic equipment is static-sensitive, some components more than others. To protect these components from static damage, you must take special precautions to minimize or eliminate electrostatic discharges.

Follow these precautions when working with or near the control.

1. Before doing maintenance on the electronic control, discharge the static electricity on your body to ground by touching and holding a grounded metal object (pipes, cabinets, equipment, etc.).
2. 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.
3. Keep plastic, vinyl, and Styrofoam materials (such as plastic or Styrofoam cups, cup holders, cigarette packages, cellophane wrappers, vinyl books or folders, plastic bottles, and plastic ash trays) away from the control, the modules, and the work area as much as possible.
4. 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.

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*.

Regulatory Compliance

The IC/TIS-910 control is suitable for use in Class I, Division 2, Groups C and D, per CSA for Canada, or non-hazardous locations only.

Wiring must be in accordance with north American Class I, Division 2 wiring methods as applicable, and in accordance with the authority having jurisdiction.

A fixed wiring installation is required.

Do not connect more than one main power supply to any one fuse or circuit breaker.

 **WARNING**

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

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

 **AVERTISSEMENT**

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

Risque d'explosion—La substitution de composants peut rendre ce matériel inacceptable pour les emplacements de Classe I, Division 2.

Chapter 1.

General Information

Introduction

The purpose of this manual is to aid in the installation and operation of the IC/TIS-910 Ignition Controller.

This manual and its content assumes that the reader has a high level of expertise on the operation of spark-ignited engines and basic understanding of electronic ignition systems. DO NOT attempt to install this piece of equipment without reading and understanding this manual.

Theory of Operation

The IC/TIS-910 is a state-of-the-art high-energy ignition system. The system consists of a 16-bit CPU and other CPU related peripherals, sensor signal conditioning circuitry, a high voltage power supply, and 20 outputs. The system can be configured for two cylinders up to 20 cylinders. The unit also has all required software to be configured for any type of industrial engine. There is never a requirement for factory reprogramming of software. All user programming/ configuring is accomplished by the IC/TIS-910 Service Tool software on a PC (personal computer).

The IC/TIS-910 uses information provided by the timing sensors (position of crankshaft and speed of the engine) to precisely determine when and which cylinder should fire. The timing of the engine is controlled by operator inputs, such as a manual timing potentiometer, 4–20 mA signal, speed curve, or through a serial link (RS-232, CAN).

While the IC/TIS-910 is operating, the unit continuously monitors the health of the ignition system by verifying proper information from all timing sensors and proper operation of the primary ignition circuit. Depending on the severity of the fault, the unit will either shut down or warn the operator. In both cases, a message is transmitted via a serial link to the IC/TIS-910 Service Tool.

In addition to protecting the engine from ignition faults, the IC/TIS-910 also has a user programmable overspeed set point shutdown and two programmable speed switches.

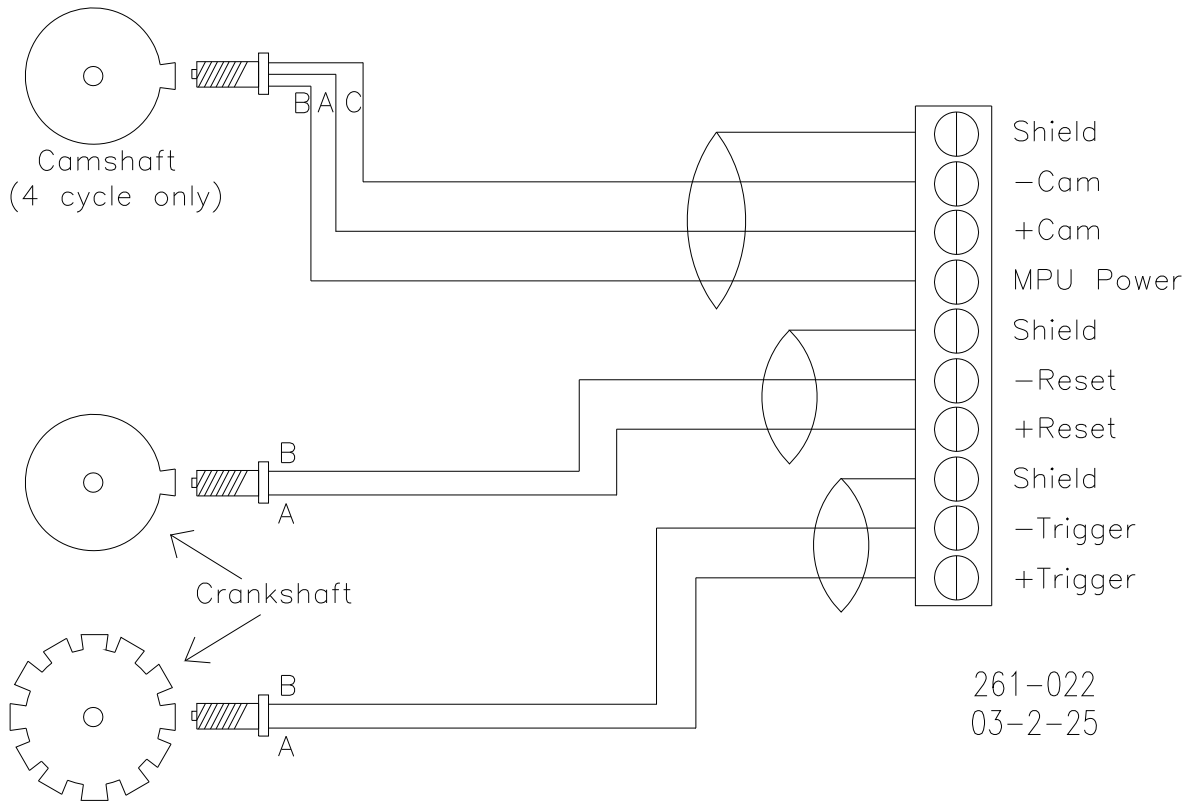


Figure 1-1. Wiring Diagram—IC/TIS-910 Timing Sensors

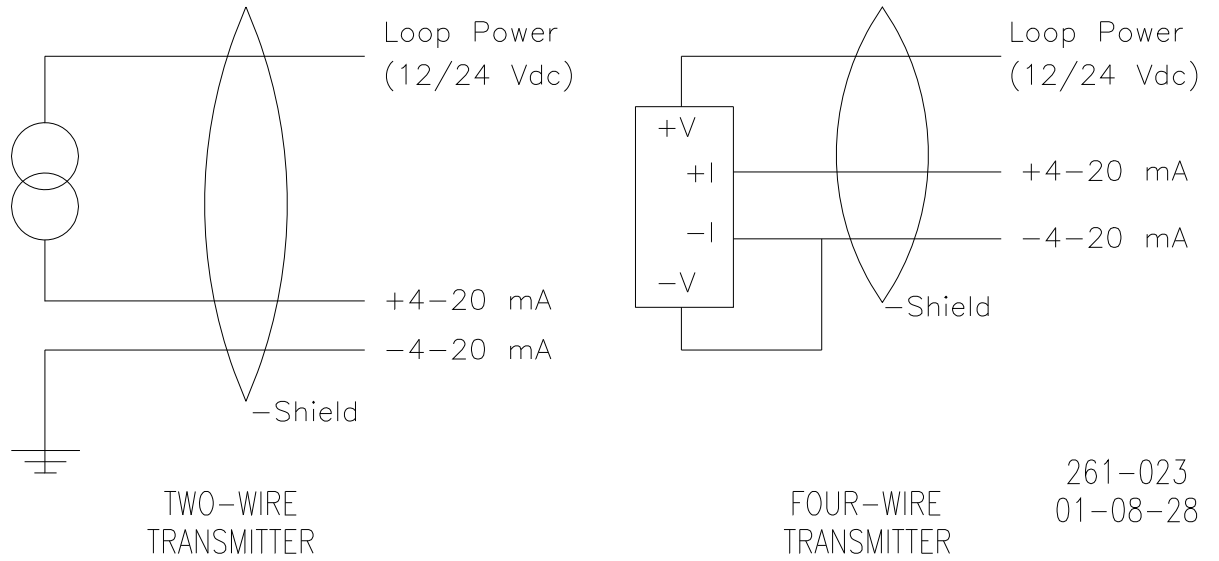
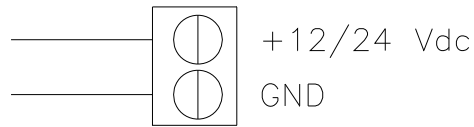


Figure 1-2a. Wiring Diagram—4-20 mA Signal



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Figure 1-2b. Wiring Diagram—Power Wiring

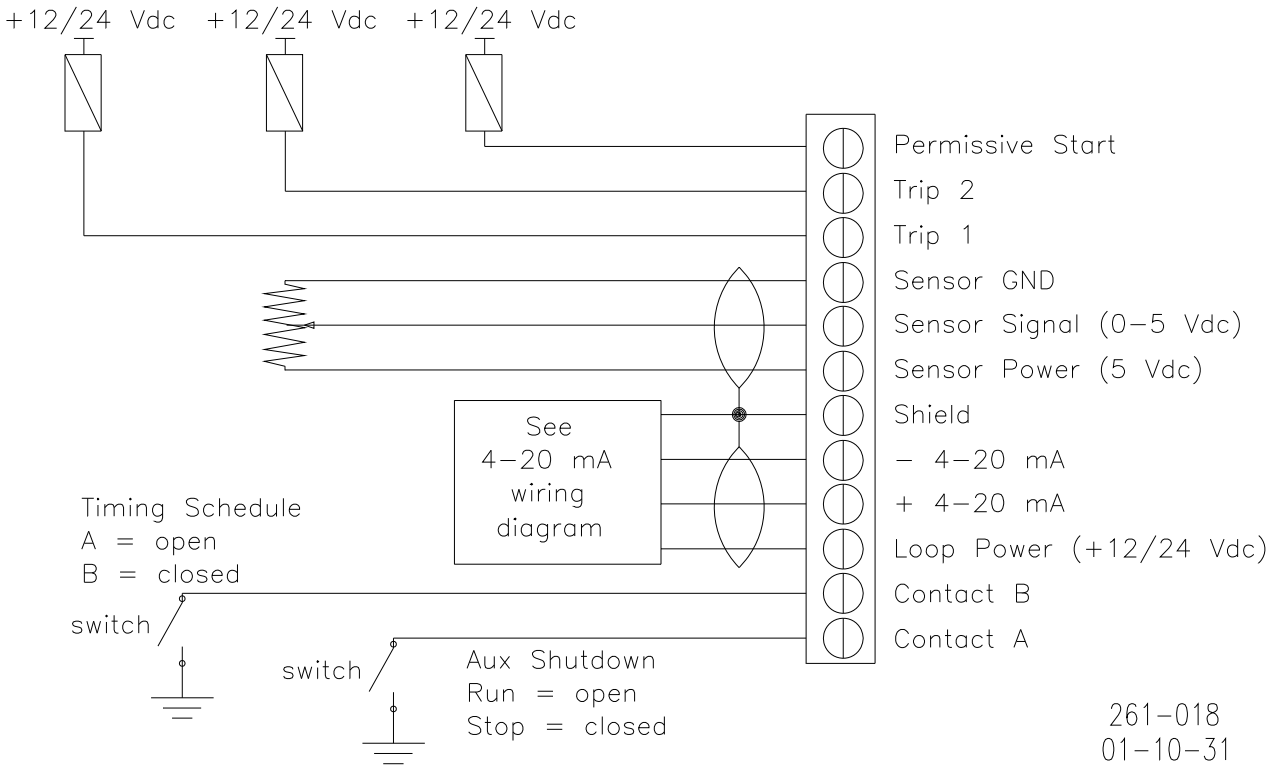


Figure 1-3. Wiring Diagram—IC/TIS-910 Timing and Safety Controls

WARNING

The permissive start output should only be used in combination with other permissive start devices. The fuel relay shutoff should not rely solely on the permissive start output of the IC/TIS-910.

Do NOT use speed switches (Trip 1, Trip 2 output) as the sole means of any critical control function, such as overspeed trip. Be sure to have a separate and independent shutdown device.

Do NOT use the Auxiliary Shutdown (Contact A) input as a primary shutdown device. Be sure to have a separate and independent shutdown device.

NOTICE

Slow-burning fuels that require more advance should use schedule B to prevent detonation in case of an open-circuit failure of the contact B input. A separate EGT (exhaust gas temperature) trip device should also be used in the system.

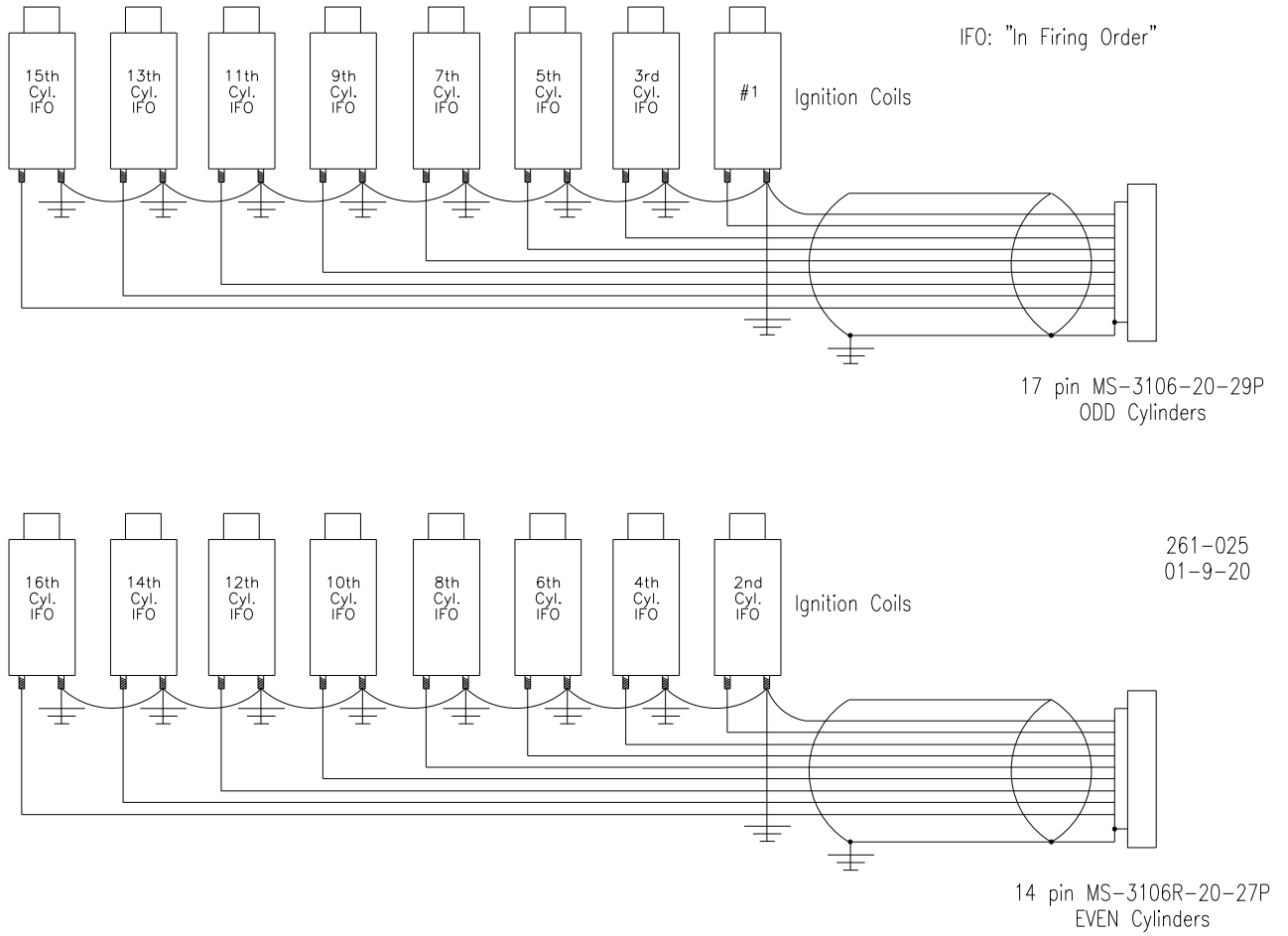


Figure 1-4. Wiring Diagram—16-Cylinder Example

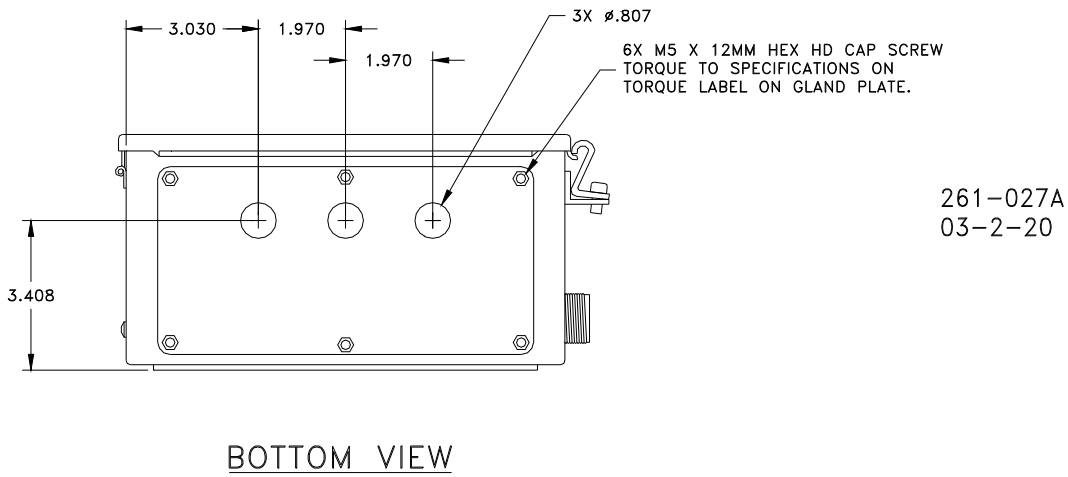
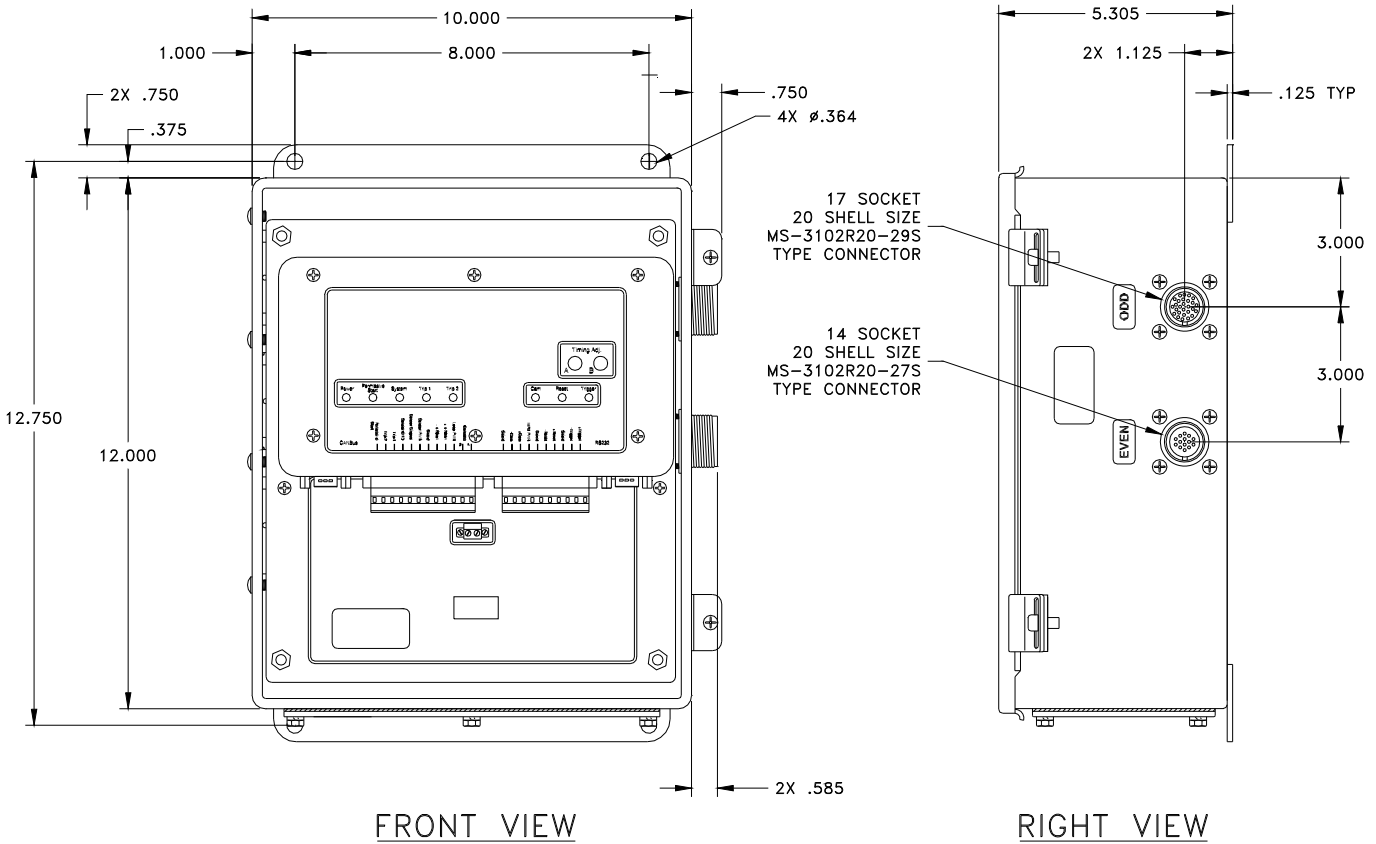


Figure 1-5a. IC-910 Outline Drawing

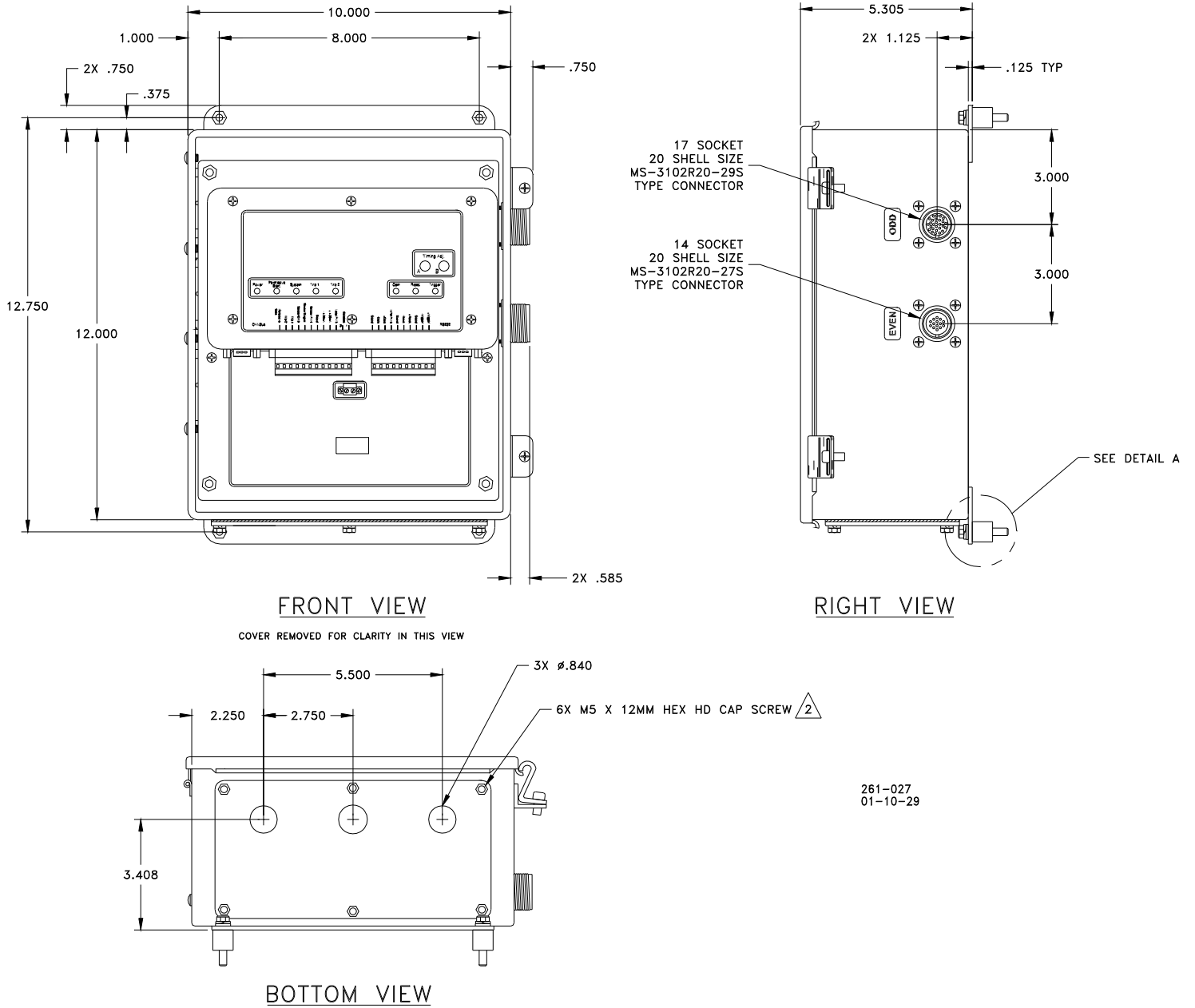
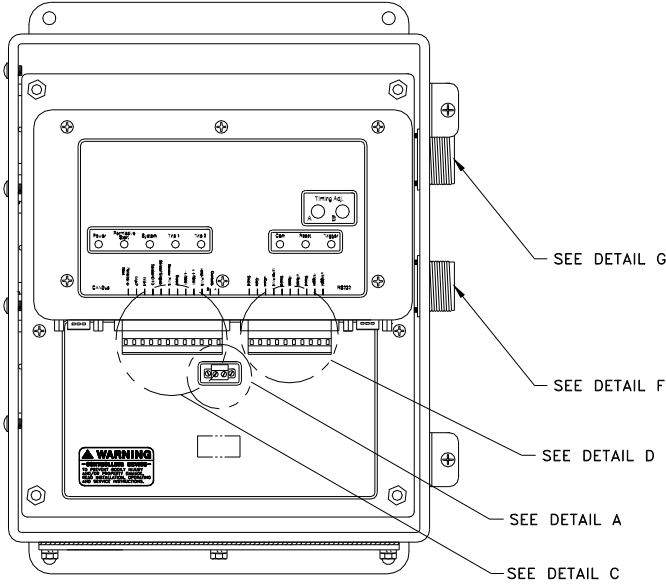


Figure 1-5b. TIS-910 Outline Drawing

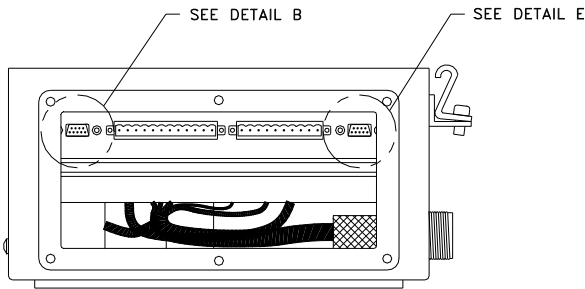
NOTES:

- 1 RECOMMENDED WIRE SIZE IS 12 AWG (3.66MM) THRU 24 AWG (.94MM).
- 2 RECOMMENDED MOUNTING HARDWARE FOR MATING CONNECTOR IS 2X #4-40 LOCK POSTS.
- 3 12/24 VDC GROUND NEEDS TO BE CONNECTED TO THE ENGINE AND THE POWER SUPPLY.



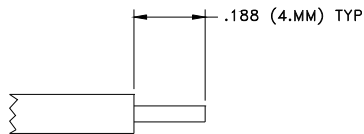
FRONT VIEW

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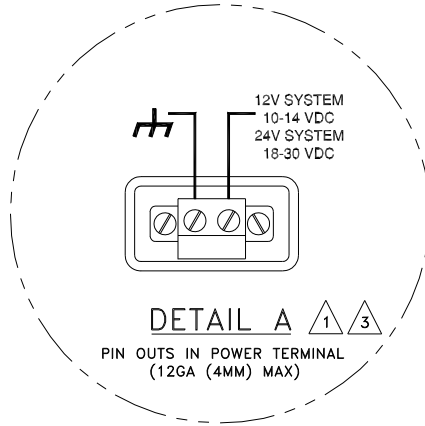


BOTTOM VIEW

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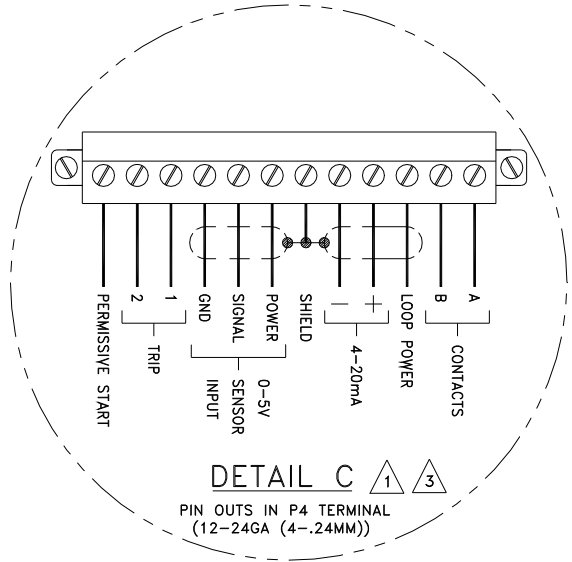


INSULATION STRIP LENGTH DETAIL



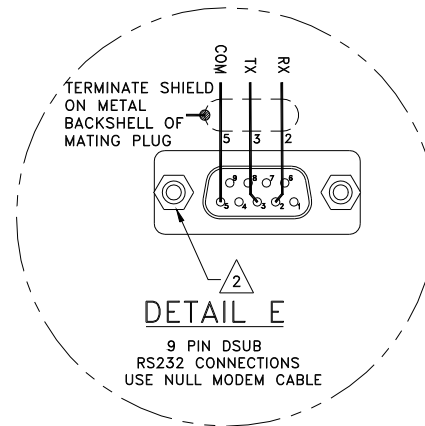
DETAIL A 1 3

PIN OUTS IN POWER TERMINAL (12GA (4MM) MAX)



DETAIL C 1 3

PIN OUTS IN P4 TERMINAL (12-24GA (4-.24MM))



DETAIL E

9 PIN DSUB RS232 CONNECTIONS USE NULL MODEM CABLE

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Figure 1-6a. Overall Plant Wiring Diagram

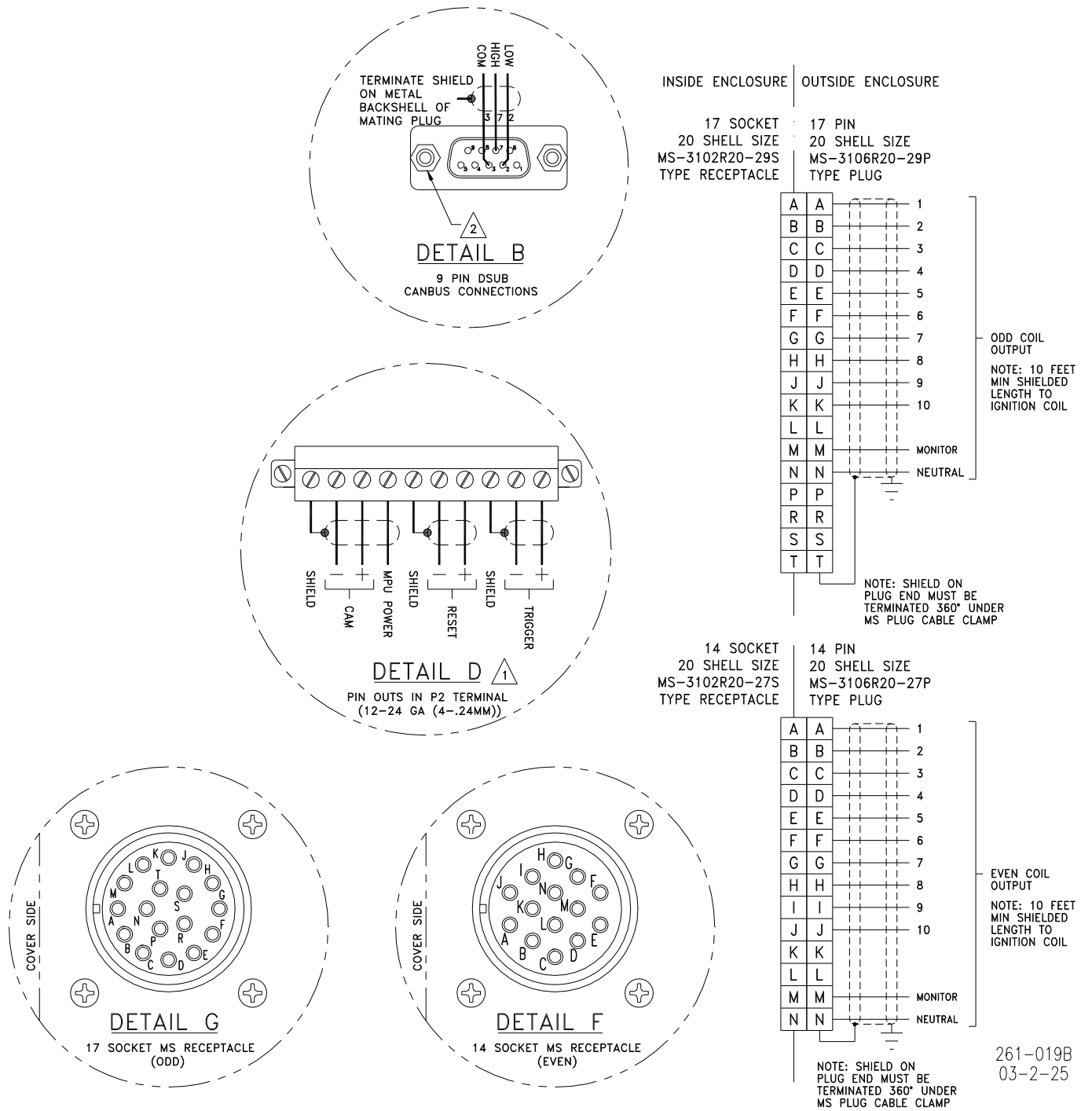


Figure 1-6b. Overall Plant Wiring Diagram

Chapter 2.

Timing Sensors (MPUs)

Introduction

The IC/TIS-910 requires two timing sensors (magnetic pick-ups/MPUs) for a two-cycle engine and three MPUs for a four-cycle engine.

Trigger MPU

The trigger MPU senses teeth or holes in the flywheel or ring gear. The trigger MPU performs two functions: It measures engine speed, and it is used to determine the position of the crankshaft.

Type—Normally the MPU is a variable reluctance type (passive), but other types can be used (passive or active). Contact your representative for MPUs supplied by Woodward.

Location—The location, relative to TDC (top dead center) of the engine, is not critical.

Mounting—The preferred orientation of the sensor is orthogonal (at a right angle) to the circumference of the flywheel/ring gear. In small and mid-size engines there is usually a place on the housing/shroud of the ring gear for a hole to be drilled & tapped (5/8"-18) for the sensor. This is an ideal location. If a mounting bracket is required, it must be designed to be as stiff as possible. A vibrating bracket could cause erroneous signals to be generated by the sensor that will be detected by the IC/TIS-910. An erroneous signal will cause the IC/TIS-910 to shut down.

Wiring—See Figure 1-1.

Air Gap—0.030 to 0.060 inch (0.76 to 1.52 mm) (1/2 to 1 turn).

Reset MPU

The reset MPU is used to identify a starting location from which *all* measurements of the trigger MPU starts. This MPU is used to sense an index marker or event (hole or projection) on the flywheel. Only *one event per revolution (360 degrees)* is permitted. This marker should be between 20 and 120 degrees advance from TDC. The exact location is not critical, but the actual positions must be programmed into the IC/TIS-910. Also, *the location must be at least 10 degrees more advanced than the most advanced running condition of the engine.*

Location—The location, relative to TDC of the engine is not critical, but the relationship must be known. The IC/TIS-910 is designed to use existing MPU arrangements that are used on most modern ignition systems.

Example:

If the engine runs at 22 degrees BTDC (before TDC), then the reset position must be at least $22+10= 32$ degrees BTDC. In this example the reset location could be anywhere from 32° to 120° BTDC.

Type—Normally the MPU is a variable reluctance type (passive), but other types can be used (passive or active).
HCI P/N: same as trigger MPU

Mounting—The proper location of the reset MPU is relatively easy if the following steps are followed:

1. Locate where you want to mount the reset MPU, inspect the entire circumference of the flywheel to ensure that there are no gouges, dents, or barring holes that could be detected by the sensor. Once you are satisfied that the surface is clean, perform the following:
2. Drill a small pilot hole in the flywheel housing where the reset MPU is to be mounted. Drill and tap necessary holes and secure the reset MPU mounting bracket to the engine frame or floor.
3. Manually rotate the engine until the timing mark is aligned with your most advanced running condition.
4. Rotate the engine at least 10 degrees opposite the normal rotation of the engine. Record the sum of number of degrees rotated plus the most advanced timing.

Example:

If the most advanced is 22 degrees BTDC and the engine was rotated an additional 10 degrees, record 32 degrees ($32=22+10$).

5. Now inspect the location of the trigger MPU relative to the teeth or holes it is sensing. For optimum performance, the trigger MPU should be equally spaced between teeth when the reset MPU is aligned with its target. If this is not the case, manually rotate the engine an additional amount so that the trigger MPU is between two teeth. Then, with the same small drill bit, using the previously drilled pilot hole in the shroud/bracket as a guide, drill into the flywheel. Once the depth of the hole is sufficiently deep to act as a guide, the engine may be rotated to get better access to the flywheel to complete the drilling.

If the surface area is smooth and free of any nicks, burrs, or gouges, then a hole could be used as the index or target. The hole should be enlarged to 0.5 inch (13 mm) diameter with a depth of at least 3/8 inch (9.5 mm). If the surface is not free of nicks, burrs, and gouges, then the index or target needs to be above the rotating surface of the flywheel. One easy method to do this is to drill tap a hex head bolt (1/4-20, 6 mm or similar). With an additional locking (jam) nut, screw in the bolt. The height of the hex head should be at least 3/4 inch (19 mm) above any nicks, burrs, or gouges. Lock the bolt in place by tightening the jam nut.

6. Now drill and tap the pilot hole for the reset MPU.

NOTICE

Manually rotate the engine one complete revolution to ensure that there is enough clearance between the bolt and any part of the housing, shroud or other mechanical part of the engine.

Wiring—See Figure 1-1.

Air Gap—0.045 to 0.090 inch (1.14 to 2.29 mm) (3/4 to 1-1/4 turn).

Cam MPU

The cam MPU is required only for four-stroke engines. If your engine is two-stroke, skip this section.

The cam MPU is used to determine what cycle the engine is on. This MPU must be mounted to sense an event that occurs *once per 720 degrees (two revolutions) of engine rotation*.

Location—The mounting location is relative to the reset MPU location and the cycle of the engine. The cam MPU should be mounted 20 to 50 degrees more advanced than the reset MPU on the compression stroke of the number one cylinder.

Air Gap—0.030 to 0.060 inch (0.76 to 1.52 mm) (1/2 to 1 turn).

Example:

If the engine runs at 22 degrees BTDC, then the reset position must be at least $22+10=32^\circ$ BTDC. In this example, the reset location could be mounted anywhere from 32 to 120° BTDC. Then the cam MPU should be located 52 to 170° BTDC.

Type—Normally the cam MPU is a zero-velocity MPU (active). Contact your representative for MPUs supplied by Woodward.

Mounting—Identify a gear or shaft that rotates at cam speed (1/2 engine speed). Choose a location such that the MPU can be mounted at a right angle to the target (hole/bolt).

Wiring—See Figure 1-1.

Chapter 3. Timing Controls

Introduction

The IC/TIS-910 has embedded in its operating program sophisticated yet simple-to-use timing control features:

- Manual timing potentiometers (2)
- 4–20 mA or 0–5 Vdc input
- Timing vs. Speed curve
- Timing controlled via CANbus network
- Cylinder-to-cylinder timing variations

IMPORTANT

The actual timing of the engine could be controlled by any single control input or any combination. The 4–20 mA and potentiometer timing adjustment are disabled in CAN mode.

NOTICE

The IC/TIS-910 must be correctly programmed for the engine application prior to any attempt to start the engine. All the features in this chapter require proper timing ranges to be set. See Chapter 7 (Programming).

Manual Timing Adjustment

The IC/TIS-910 has two integrally mounted four-turn potentiometers to adjust the timing. The span is controlled by limits programmed by the user. An authorization code (password) must be used to change the limits (see Chapter 7). The default condition (contact B open) is for potentiometer A to be active. If contact B is switched to ground and schedule B is enabled in the programming menu, then potentiometer B is active. The operator sets the span of each potentiometer by programming the desired timing at the fully counterclockwise (CCW) and clockwise (CW) positions (see Chapter 7). Additionally, the total timing of the potentiometer + 4-20mA + 0-5Volt + Speed Curve timing is limited by the programmed maximum advance and maximum retard settings. The manual timing adjustments programmed are relative to TDC of the engine.

4–20 mA Input

The 4–20 mA input is normally used to provide a means to adjust the timing automatically by measuring a certain engine performance parameter. A good example of this would be a pressure-to-current (P/I) converter that measures the boost pressure or manifold air pressure. The change in timing based on the change in current is user programmable. The operator programs the desired timing at 4 mA and at 20 mA. The IC/TIS-910 interpolates between these two points. Timing changes caused by the 4–20 mA input are relative to the timing established by the manual timing adjustment.

IMPORTANT

The user is also required to input a default 4–20 mA timing, if a loss of the signal occurs.

0–5 Volt Input

The 0–5 Volt input is normally used to provide a means to adjust the timing automatically by measuring a certain engine performance parameter. A good example of this would be a manifold air pressure sensor. The change in timing based on the change in voltage is user programmable. The operator programs the desired timing at 0 V and at 5 V. The IC/TIS-910 interpolates between these two points. Timing changes caused by the 0–5 Volt input are relative to the timing established by the manual timing adjustment.

Speed Curve

The IC/TIS-910 has the ability to change the timing of the engine based on the speed of the engine. Normally this is a non-linear relationship, therefore the IC/TIS-910 provides up to five breakpoints to assist in establishing a piece-wise linear relationship (see Chapter 7). Timing changes caused by the speed curve are relative to the timing established by the manual timing adjustment.

Timing Schedules A and B

The IC/TIS-910 also provides the ability to program two different timing schedules: Schedule A and Schedule B. The schedules are selected by a contact closure (Contact B). Pot A is tied to schedule A, and Pot B is tied to schedule B. These schedules could be related to the type of fuel used or for troubleshooting. A good example of the use of dual timing schedules includes applications where two different types of fuel are used (for example, methane and propane).

Example:

Schedule A timing could consist of: Pot A+4–20 mA+Speed Curve.

Schedule B timing could consist of only Pot B.

NOTICE

Slow-burning fuels that require more advance should use schedule B to prevent detonation in case of an open-circuit failure of the contact B input. A separate EGT (exhaust gas temperature) trip device should also be used in the system.

Cylinder-to-Cylinder Timing Controls

The timing of any cylinder can be changed by a fixed amount relative to the Global Timing (pot, 4–20 mA, or speed curve). The primary purpose of this control is to negate any ill effect of manifold design or other factors that generally cause one or two cylinders to be more sensitive to detonations than others. This feature allows the operator to run the engine at a more advanced timing setting than it would normally be able to, by retarding the one or two cylinders that tend to detonate first. Refer to Chapter 7, “Adjusting Individual Cylinder Timing Offset Settings” for adjustment instructions.

Chapter 4.

High Voltage Supply and Primary Outputs

High Voltage Power Supply

The IC/TIS-910 has two high voltage power supplies that are capable of approximately 300 Vdc. One supply is dedicated to the odd cylinders and the other supply is dedicated to the even cylinders. The energy level control for each power supply is independent of the other.

The range of adjustment is 100 V (10% energy) to 300 V (100% energy). This voltage can be monitored on pin "M" of each primary connector. The signal present on pin "M" is a 10:1 reduction of the actual voltage.

NOTICE

A separate EGT (exhaust gas temperature) trip device should also be used in the system to detect misfires resulting from any primary wiring fault.

Primary Wiring

See Figure 1-4 for a 16-cylinder wiring example (not shielded) and Figure 1-5 for the complete connector wiring diagram. Additionally, there is a chart on the following page with connector pin and the corresponding primary output.

Odd Bank Connector

The connector for the odd bank of cylinders is a 17-pin connector. The cylinders associated with this connector are 1st cylinder in firing order, 3rd cylinder in firing order, 5th cylinder in firing order, and so forth. These connections are made to the positive terminal on the primary of the ignition coil.

Even Bank Connector

The connector for the even bank of cylinders is a 14-pin connector. The cylinders associated with this connector are 2nd cylinder in firing order, 4th cylinder in firing order, 6th cylinder in firing order, and so forth. These connections are made to the positive terminal on the primary of the ignition coil.

Primary Wire

Minimum size: 18 AWG (1 mm²), voltage rating: 600 V.

NOTICE

When replacing an existing ignition system, carefully inspect primary wiring. If the insulation shows any sign of wear or fatigue, the wiring should be replaced.

Primary Wiring Connector Pin Assignments

Odd Bank Connector (17-pin)

Pin	Output
A	#1 cylinder in firing order
B	#3 cylinder in firing order
C	#5 cylinder in firing order
D	#7 cylinder in firing order
E	#9 cylinder in firing order
F	#11 cylinder in firing order
G	#13 cylinder in firing order
H	#15 cylinder in firing order
J	#17 cylinder in firing order
K	#19 cylinder in firing order
L	#21 cylinder in firing order
P	#23 cylinder in firing order
M	monitor output (10:1)
N	engine ground

Even Bank Connector (14-pin)

Pin	Output
A	#2 cylinder in firing order
B	#4 cylinder in firing order
C	#6 cylinder in firing order
D	#8 cylinder in firing order
E	#10 cylinder in firing order
F	#12 cylinder in firing order
G	#14 cylinder in firing order
H	#16 cylinder in firing order
I	#18 cylinder in firing order
J	#20 cylinder in firing order
K	#22 cylinder in firing order
L	#24 cylinder in firing order
M	monitor output (10:1)
N	engine ground

See Figure 1-5 for connector locations.

Chapter 5. Energy Control

Introduction

The IC/TIS-910 is capable of delivering a substantial amount of energy to the ignition coil/spark plug. Most rich burn or lean burn engines with pre-combustion chambers do not need substantial amounts of energy with new spark plugs. Lean burn engines without pre-combustion chambers will need more spark energy to ensure proper ignition of the leaner air/fuel mixture.

Because of unique circumstances for each engine configuration, the IC/TIS-910 provides two means to adjust and control the energy:

- Manual energy control
- AUTO_E™ energy control

Refer to Chapter 7, “Adjusting Energy Control Settings” for adjustment instructions.

Manual Energy Control

For manual energy adjustments, make sure Auto Energy is not selected. The normal procedure for determining the amount of energy needed is:

1. Set the Even and Odd Energy Maximum value on the IC/TIS-910 for 100% energy.
2. Start the engine and apply 100% rated load.
3. SLOWLY reduce the energy maximum value on one bank of outputs (odd or even) until slight misfires are detected.
4. Increase the energy maximum value by 1.25–1.5 (25–50% higher than the displayed value).
5. Set the odd and even energy maximum values equal.

AUTO_E Auto Energy Control

For optimum operation, the correct Coil type must be selected in the configuration menu. This needs to be done at 0 rpm in the configuration mode.

To more precisely balance either the duration or energy level between coils in Auto_E, it may be necessary to add or subtract an offset to a particular coil spark duration feedback signal. The Energy Control screen shows the spark duration feedback signal used by the software for each coil. Offset adjustments increase or decrease the spark duration feedback value. These offsets are provided to make the controlled duration measured by an oscilloscope equal across the engine with new spark plugs. This is typically a “one-time” adjustment that corrects for hardware tolerances within the IC/TIS-910. The offsets should not be adjusted to balance duration if it is not possible to measure the actual duration with an oscilloscope. Offset adjustments may also be used to balance the energy level (%) across the engine instead of balancing spark duration.

AUTO_E Setup Procedure

1. New and properly gapped spark plugs must be installed to make this procedure effective. Install new plugs before proceeding.
2. Disable the Auto_E feature and set odd/even energy maximum to 100%.
3. Start and load the engine (100%).
4. SLOWLY reduce the energy maximum value on one bank of outputs (odd or even) until slight misfires are detected.
5. Increase energy maximum value by 1.2 (20%) For example, if the misfire level is 45% energy, increase the energy maximum value to $1.2 \times 45 = 54\%$.
6. SLOWLY reduce the amount of energy maximum value on the other bank to the same level established in step 5. Verify the engine continues to operate without misfiring. If needed increase the energy maximum value on the odd and even banks equally to eliminate any misfiring.

IMPORTANT

This establishes the minimum energy level required for firing new spark plugs.

7. Optional: If desired to more precisely balance either the duration or energy level between coils, the offset adjustments described above may be made at this time. Before making any offset adjustments, it is best to view the spark duration of each coil to see how each compares to the "Average Energy". Adjust offsets for those coils that are noticeably higher/lower than the average first.
8. Record the "Average Energy" (this will be used later).
9. Reset the energy maximum value for both odd and even banks to 100%.
This is important, see NOTE below.
10. Multiply the "Average Energy" by 1.5 and enter that value as the "Spark Duration Setpoint".
11. Enable Auto_E.
12. Read the "Average Energy". Compare this value to that in step 8. It should be higher.
13. Decrease the "Spark Duration Setpoint" in increments of 25 or 50 until the "Average Energy" is equal or a little higher than the value in step 8.
14. Recheck all the settings and make sure the odd/even energy maximum settings are at 100%.

The IC/TIS-910 is now configured for AUTO_E control. If properly programmed, the IC/TIS-910 should reduce the energy (voltage) delivered to each cylinder until the desired spark duration is achieved. As the load is decreased from 100% load, the IC/TIS-910 should automatically reduce the energy to the cylinders. As the spark plugs erode, the energy should automatically increase.

IMPORTANT

When Auto Energy is enabled, the maximum energy allowed is the Energy Maximum percent programmed for the Even and Odd banks. For example, if the Even and Odd Energy Maximum values are set to 50% and Auto Energy is enabled, the energy will be limited to a maximum of 50%.

Chapter 6.

Engine Controls and Safety Features

Introduction

The IC/TIS-910 has built-in features that protect the engine if any malfunction related to the ignition system is detected:

- Overspeed Protection
- Permissive Start Output
- Auxiliary Shutdown Input
- Misfire Limit
- Timing Sensor Fault Detection

Overspeed Protection

Integral to the IC/TIS-910 is overspeed protection. The user can program the exact speed at which the ignition should stop (see Chapter 7).



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.

Permissive Start Output

Integral to the IC/TIS-910 is a solid-state output, capable of sinking 250 mA, that should be used to enable/disable fuel flow to the engine directly or in combination with other devices (lube oil pressure, etc.). Anytime the ignition stops due to normal stop sequence, overspeed, or when a fault is detected, the Permissive Start output will de-energize. Upon start-up, the Permissive Start output will not energize until all timing signals are verified correct and the ignition is starting to fire. An LED is also provided as a visual indication of the status of the Permissive Start output (see Chapter 7).



The permissive start output should only be used in combination with other permissive start devices. The fuel relay shutoff should not rely solely on the permissive start output of the IC/TIS-910.

Auxiliary Shutdown Input

The IC/TIS-910 provides a low voltage, low current means of shutting down the ignition system using a PLC or similar device. If Contact A of the control inputs is closed to ground, the ignition outputs will not fire. If the contact is closed above the security speed, it is necessary for the rpm to go to zero before the outputs will fire. If the contact is open below the security speed, the ignition will fire immediately if the trigger, reset, and cam signals are correct (see Figure 1-3).

WARNING

Do NOT use the Auxiliary Shutdown input as a primary shutdown device. Be sure to have a separate and independent shutdown device.

Misfire Limit

Integral to the IC/TIS-910 is primary misfire detection and monitoring circuitry. The IC/TIS-910 measures and displays the misfires per second. When misfire is detected on an output, the status changes state on the IC/TIS-910 Service Tool “Misfire” screen and on the CAN device (D-1 display) displays a text message.

See Chapter 7 “Monitoring Misfires” for more IC/TIS-910 Service Tool information.

Timing Sensor Fault Detection

The IC/TIS-910 constantly scans the timing inputs for a fault. If a fault is detected, the ignition will shut down. The IC/TIS-910 sends the fault information to the IC/TIS-910 Service Tool “Ignition Status” over the RS-232 comm port and to the CAN device (display) over the CANbus serial link.

See Chapter 10 for error screens and messages.

Speed Switches

The IC/TIS-910 provides two speed switches, called “Trip 1” and “Trip 2”. The trip point of each switch is adjustable from 0 to 5000 rpm. The switch action can be configured either “Normally Open” or “Normally Closed”.

Refer to Chapter 7 “Editing Speed Switch Settings” for adjustment instructions

WARNING

Do NOT use the Trip 1 and Trip 2 speed switches as the sole means of any critical control function, such as overspeed trip. Be sure to have a separate and independent shutdown device.

See Figure 1-3 for the Timing and Safety wiring diagram.

Chapter 7.

Programming

Introduction

The IC/TIS-910 is a versatile ignition control that is user configurable for a variety of engine installations. A single IC/TIS-910 ignition control can be configured to fit numerous engine makes, models, and sizes.

The IC/TIS-910 Service Tool is a Windows-based software tool that is used to configure, monitor, and troubleshoot a IC/TIS-910 ignition system. It runs on a personal computer and communicates with the IC/TIS-910 ignition control through a serial connection.

The IC/TIS-910 Service Tool software can be downloaded at no charge from the Woodward web site at <http://www.woodward.com/ic/software> under 'Ignition System Tools'. Click 'More Info' for download instructions.

All configuration settings are shown in an intuitive graphical interface format. Configuration, for initial setup or replacement, is a straightforward process. Settings can be saved directly into the IC/TIS-910 EEPROM or to a file. Settings from a file can be loaded into the IC/TIS-910 ignition control for quickly configuring ignition controls for all like engines within a manufacturing facility, a plant, or a system.

WARNING

An improperly calibrated ignition could cause extensive damage to the engine. To prevent engine damage and possible serious injury from an improperly calibrated control, read this entire procedure before starting the engine.

Read the entire manual and all other publications pertaining to the work to be performed before installing, operating, or servicing the IC/TIS-910 Ignition System. Practice all plant and safety instructions and precautions. Failure to follow instructions can cause personal injury and/or property damage.

NOTICE

The IC/TIS-910 must be programmed and the Start-up Procedure in Chapter 8 must be performed prior to any attempt to start the engine. It is important and critical that all parameters be set correctly for the engine application.

Required Equipment

- 12 to 24 Vdc power supply
- RS-232 null modem cable
- PC / Laptop
- IC/TIS-910 Service Tool software

System Requirements

- Microsoft Windows 95, 98, Me, NT 4.0, 2000, XP
- 300 MHz Pentium CPU
- 64 MB RAM
- 800 by 600 pixel screen
- Serial Port

Definitions and Programming Parameters

Ignition Status—Displays a text message the current status including faults.

Engine Speed—Displays current speed in rpm.

Total Timing—Displays overall ignition timing with all offsets applied.

Engine Run Time—Displays cumulative running hours of the engine.

Average Energy—Displays the average energy level of all outputs as a % of the maximum capacitor voltage.

Contact A—Displays condition of the Contact A input as opened (Run) or closed (Stop).

Number of Coils—Actual number of coils fired by the IC/TIS-910. In some applications there are two coils per cylinder. The number of coils must be correct for the configured Firing Interval.

Firing Interval—The crank angle degrees between coil firing events. Zero degrees offset from the ignition timing setting of the #1 output is implied as the first firing event. Firing events continue at the configured firing intervals and repeat until the ignition is stopped. Use the engine specifications to determine the correct Firing Interval. The Firing Interval must be correct for the number of coils programmed.

Ignition Coil Manufacturer—Identifies the coil manufacturer to select an optimized curve for the Auto Energy feature.

Ignition Coil Model—Identifies the coil model to select an optimized curve for the Auto Energy feature.

Number of Teeth—Number of teeth on the ring gear or the number of holes or pins in the flywheel that the trigger MPU senses during one revolution of the engine crankshaft. Minimum acceptable number is 60.

Reset Position—The location of the reset MPU relative to TDC of cylinder #1 (output #1). This value is adjusted to precisely set ignition timing of cylinder #1.

Disable schedule selection through Contact B—Schedule A timing will be used exclusively when this box is checked. Uncheck this box to make Schedule B timing available. If unchecked, opening the contact B input selects schedule A timing and closing the contact B input to ground selects schedule B timing.

Maximum Advance—Sets an absolute maximum ignition timing advance limit for all timing commands. Limits for schedule A and schedule B are separate.

Maximum Retard—Sets an absolute maximum ignition timing retard limit for all timing commands. Limits for schedule A and schedule B are separate.

Manual Timing Range

Counterclockwise—Sets the timing limit for the maximum counterclockwise rotation of the timing adjustment potentiometers. Limits for schedule A and schedule B potentiometers (Pot A and Pot B) are separate.

Clockwise—Sets the timing limit for the maximum clockwise rotation of the timing adjustment potentiometers. Limits for schedule A and schedule B potentiometers (Pot A and Pot B) are separate.

No Analog Input—Check to ignore the analog input in any timing scheme.

Analog Input 4–20 mA—Check to use the 4–20 mA analog input signal in a timing scheme. Timing varies linearly between the 4 and 20 mA settings.

Analog Input 0–5 Vdc—Check to use the 0–5 Vdc analog input signal in a timing scheme. Timing varies linearly between the 0 and 5 Vdc settings.

Timing at 4 mA—This is the Timing OFFSET to be applied to the manual ignition timing setting of Pot A or Pot B (whichever is configured and selected) with 4 mA applied to the analog input. This is NOT an absolute timing setting.

Timing at 20 mA—This is the Timing OFFSET to be applied to the manual ignition timing setting of Pot A or Pot B (whichever is configured and selected) with 20 mA applied to the analog input. This is NOT an absolute timing setting.

Signal Loss Timing—This is the Timing OFFSET to be applied to the manual ignition timing setting of Pot A or Pot B (whichever is configured and selected) if the mA analog input is failed. This is NOT an absolute timing setting.

Timing at 0 Vdc—This is the Timing OFFSET to be applied to the manual ignition timing setting of Pot A or Pot B (whichever is configured and selected) with 0 Vdc applied to the analog input or if the Vdc analog input is failed. This is NOT an absolute timing setting.

Timing at 5 Vdc—This is the Timing OFFSET to be applied to the manual ignition timing setting of Pot A or Pot B (whichever is configured and selected) with 5 Vdc applied to the analog input. This is NOT an absolute timing setting.

Include analog input in:

Schedule A—Check to include the analog input as part of Schedule A timing scheme. The analog input offsets are combined (\pm) with other offset.

Schedule B—Check to include the analog input as part of Schedule B timing scheme. The analog input offsets are combined (\pm) with other offset.

Speed Curve

Speed—List of engine speeds for each ignition timing breakpoint. Up to 5 breakpoints can be entered. Engine speeds must be entered in increasing order.

Timing—This is the Timing OFFSET to be applied to the manual ignition timing setting of Pot A or Pot B (whichever is configured and selected) for the adjacent speed setting. This is NOT an absolute timing setting.

Units—Select either Advance or Retard for applying the timing offset setting.

Include speed curve in:

Schedule A—Check to include the speed curve as part of Schedule A timing scheme. The speed curve offsets are combined (\pm) with other offset.

Schedule B—Check to include the speed curve as part of Schedule B timing scheme. The speed curve offsets are combined (\pm) with other offset.

Speed Switch 1,2

Trip Point—Speed at which the Trip output is activated. Can be set to normally opened or normally closed.

Hysteresis—Amount of rpm below the Speed Switch Trip Point RPM needed to reset the output.

Normally Open—Check to make output open to ground below the trip point.

Normally Closed—Check to make output closed to ground below the trip point.

Engine Control

Shutdown if maximum misfire rate is exceeded—Check to enable a maximum misfire rate shutdown.

Maximum Misfire Rate—The number of misfires per second that is permissible before the engine shuts down due to excessive misfire.

Safety

Overspeed—The rpm at which the ignition will shut down if exceeded.

Fuel Shutoff Threshold—This is essentially a programmable ‘Run’ speed setting that governs operation of the Contact A (Run/Stop) input. Fuel shutoff threshold is rendered inoperable when the Contact A input is not connected.

The Contact A (Run/Stop) enables or disables the primary outputs.

- **Below** the fuel shutoff threshold speed but above 30 rpm (approx.), the primary outputs will fire or stop firing each time the Run/Stop Contact is opened to ground (Run) or closed to ground (Stop).
- **Above** the fuel shutoff threshold speed the primary outputs will stop firing when the Run/Stop Contact is closed to ground and will not fire again when the contact is opened until the engine has come to a full stop (zero rpm is sensed) and the engine is re-started.
- **Above** the fuel shutoff threshold speed the primary outputs will fire if the Run/Stop Contact was closed to ground then opened for the first time. This allows engine starting when the fuel shutoff threshold speed is set below cranking speed.

Typically the fuel shutoff threshold speed is set above cranking speed but below minimum or idle speed.

Start Energy

Speed Threshold—The engine rpm, below which, the Start Energy Level is active.

Energy Level—The energy level used when the engine rpm is below the Start Energy Speed Threshold.

Write values through the CAN Port—Used to enable/disable CAN write values capability. Enabling CAN write values makes the discrete and analog inputs inactive. This should NOT be checked for simply monitoring the IC/TIS-910 with a CANbus device (read only). This should be checked to write values to the IC/TIS-910 with a CANbus device (read/write) and to ignore the discrete and analog inputs.

CAN Identifier—Used only for CAN communication.

Edit Graph Levels—Password protected. Used to edit energy failure and alarm level settings associated with the Energy Levels bar graph display.

Edit Energy Control—Password protected. Used to set the Manual or Auto energy mode, the Spark Duration Setpoint, Even Energy Maximum, Odd energy Maximum and Spark Duration Offsets.

Change Configuration—Password protected. Used to Edit the configuration in the IC/TIS-910 Service Tool. The configuration opened in the IC/TIS-910 Service Tool may be new, from a file or from a control.

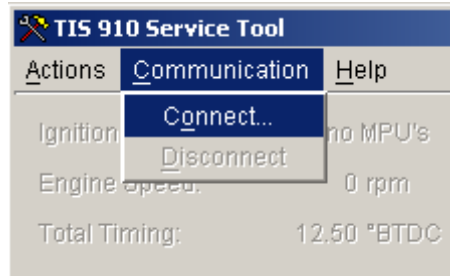
Edit Timing Offsets—Password protected. Used to edit cylinder-to-cylinder timing offsets. Set to zero to disable an offset.

IMPORTANT

The screen shots shown in this manual are subject to change and may be modified without notice.

Establishing Communications

To establish communication between the IC/TIS-910 Service Tool and the IC/TIS-910 ignition control, connect a null modem cable (see Figure 7-1) between the RS-232 port of the IC/TIS-910 and a serial port on the personal computer. Connect a +12/24 Vdc supply to the IC/TIS-910. Refer to Figure 1-3. From the IC/TIS-910 Service Tool menu select ‘Communication’ then ‘Connect...’.



NOTICE

The IC/TIS-910 has two DB9 connectors. Identify and use the one marked "RS-232".

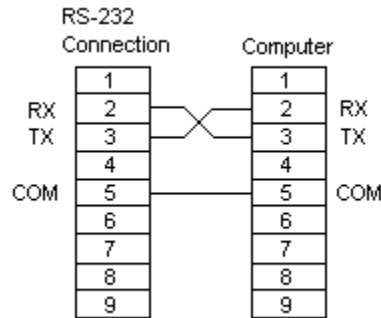


Figure 7-1. Null-Modem Cable

You will be prompted to select a serial port. The service tool will attempt to connect to the IC/TIS-910 using the selected serial port, and the communication status message in the status bar will change to "Connecting".

Once the connection is established, the communication status message in the status bar will change to "Connected" and the service tool will begin to display live information from the IC/TIS-910.

If the communication connection is lost, the service tool attempts to re-establish the connection. While the service tool is re-establishing the connection, the communication status bar displays "Connecting". A connection will be lost if the IC/TIS-910 loses power or the serial cable is disconnected.

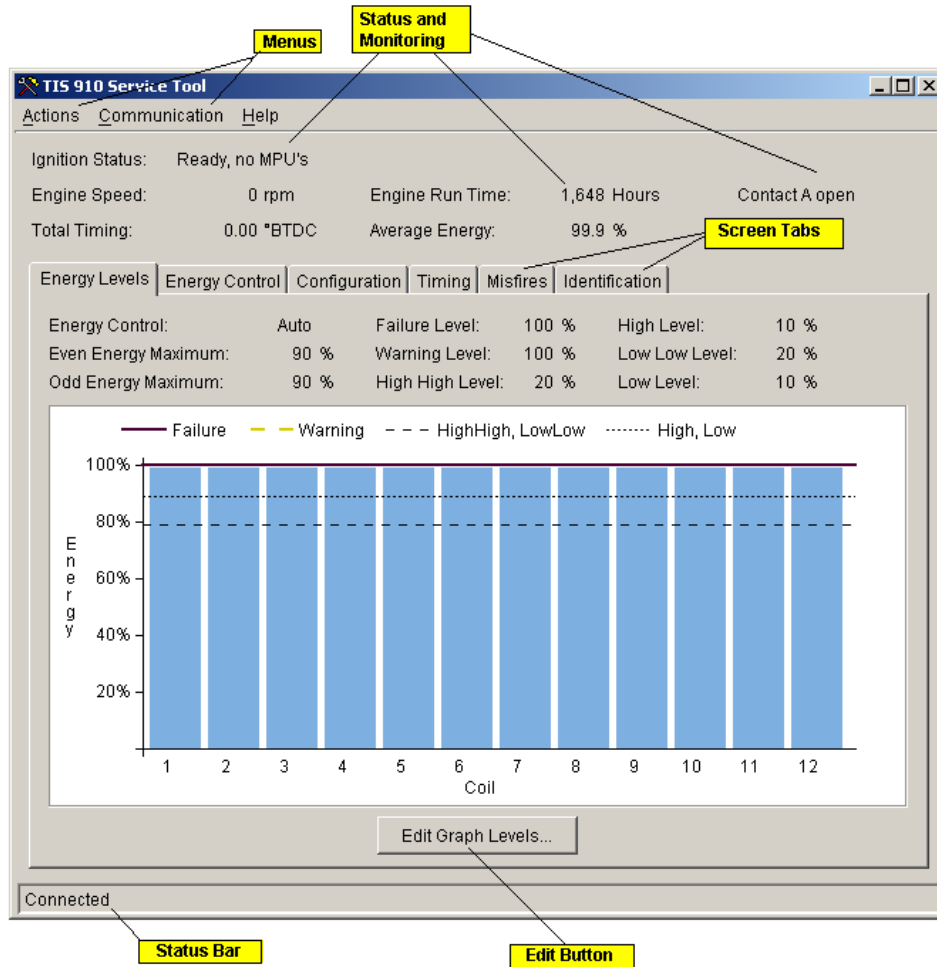
You may stop communication between the service tool and IC/TIS-910 at any time by selecting 'Communication' then 'Disconnect' from the menu of the IC/TIS-910 Service Tool window. The window is grayed with parameters frozen at their last value when the service tool is disconnected.

WARNING

Switching the serial cable from one IC/TIS-910 to another while the communication status is "Connected" may result in invalid data being read from and/or written to the IC/TIS-910. Always "Disconnect" before plugging the serial cable into a different IC/TIS-910.

Main Window

The Main Window appears once the IC/TIS-910 Service Tool is running and connected. The main window is always visible while the service tool is running however values are not displayed until the service tool is connected.



The Main Window opens with the Energy Level screen visible as shown above. This screen generally displays the output energy level (%) to each coil. Click a screen tab above the screen to open a different screen. Parameters and values displayed above the tabs are visible for all screen choices. Menu selections are available across the top of the window and a status bar is shown at the bottom.

Making Adjustments

The IC/TIS-910 Service Tool is used to create, edit and load all configuration settings into the IC/TIS-910 ignition control.



WARNING The IC/TIS-910 must be configured prior to any attempt to start the engine. It is important and critical that all parameters be set correctly for the engine application. An improperly calibrated ignition could cause extensive engine damage and possible serious injury.

Configuring the IC/TIS-910

Configurations can be created, opened, edited, and loaded to the IC/TIS-910 using the Configuration Editor window. There are a number of configuration methods available for creating, opening, editing and loading the IC/TIS-910 configuration:

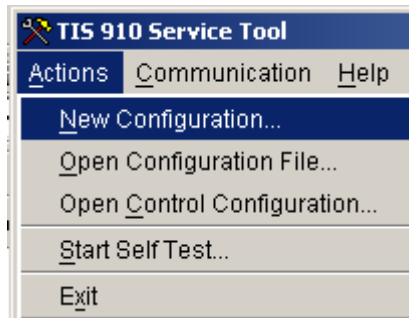
- Create a New Configuration
- Open and Edit a Saved Configuration File
- Open and Edit the Existing Control Configuration
- Loading a Configuration File

Editing a configuration does not require a connection to the IC/TIS-910. However, changes to a configuration in the Configuration Editor do not take affect until the configuration is loaded to the IC/TIS-910.

The following describes the various methods that can be used to configure the IC/TIS-910:

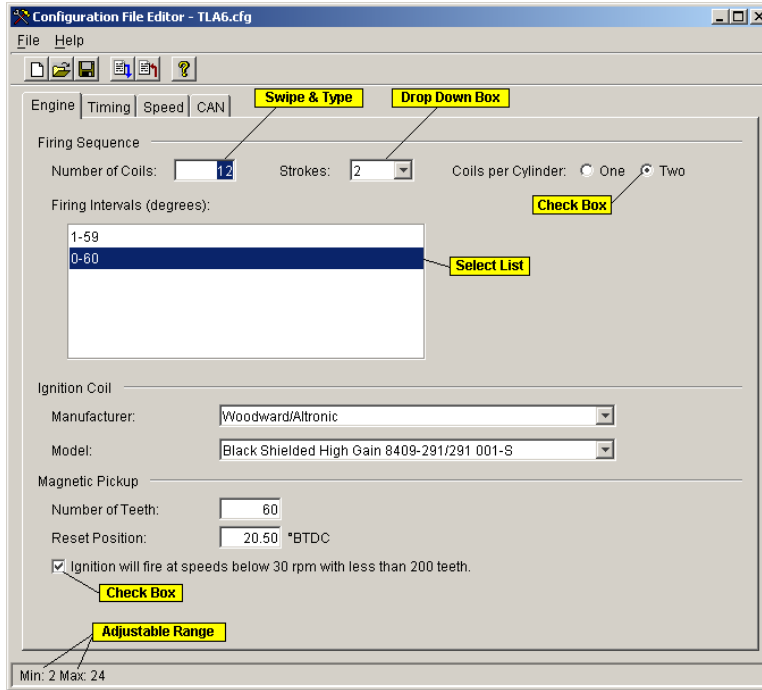
Create a New Configuration

On the menu of the IC/TIS-910 Service Tool window, select 'Actions' and then select 'New Configuration....'.

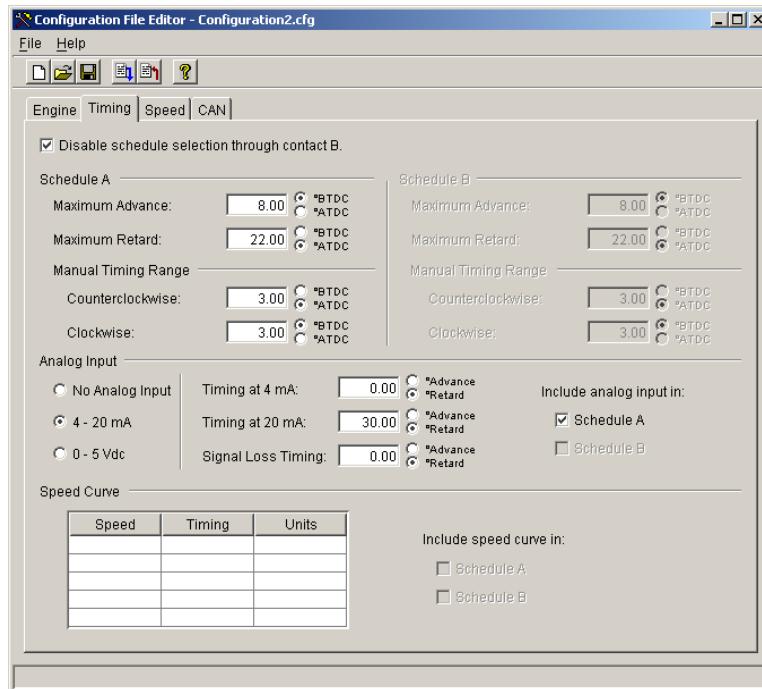


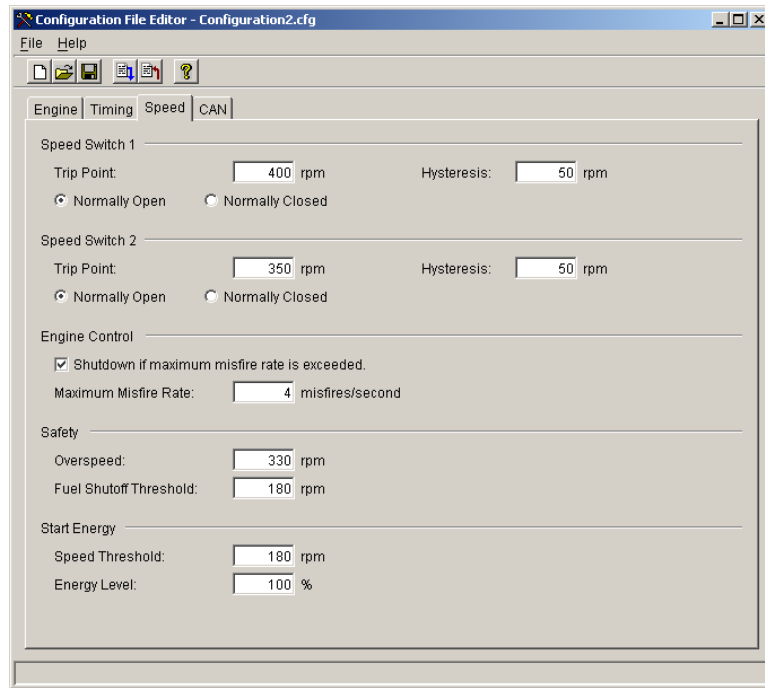
The 'Configuration File Editor' window opens with an incomplete configuration that is ready to be edited for creating a new configuration.

The Configuration File Editor window organizes configuration settings into a set of tabbed pages. As shown below, there are four (4) tabbed configuration pages: 'Engine', 'Timing', 'Speed' and 'CAN'.



IMPORTANT All the parameters described in this section have acceptable ranges. Numbers entered outside of the range will cause the last valid entry to be used. A valid range is given for each screen.





To edit a configuration, click on an appropriate page tab that makes those settings available for change. When editing a numeric parameter, the range of valid values that can be entered is displayed on the status bar at the bottom of the Configuration Editor window. Values outside of the range are not accepted. When editing numeric parameters, the Enter key must be pressed or another setting must be selected for changes to occur.

In general, simply entering a new value for the particular setting changes the configuration settings. In other cases, editing configuration settings is more complex. These cases are detailed below.

- **Firing Sequence**

The firing sequence is not entered directly but instead it is derived from the number of coils and firing intervals. Click on the engine tab in the configuration editor window. Enter the number of coils used by the engine and press enter.

Select the correct firing interval for the engine being configured. The firing interval list box only displays valid intervals based on the number of coils entered and the filter criteria. Editing the filter criteria shortens or lengthens the list of firing intervals making it easier to choose the proper interval for the engine. If filtering the list of firing intervals is desired, select the number of strokes and/or the number of coils per cylinder for the engine being configured. Click on the correct firing interval then press enter. The selected firing interval remains highlighted.

- **Editing the Ignition Coil Type**

Selecting a coil manufacturer and the manufacturers model derives the ignition coil type. Click on the engine tab in the configuration editor window. Select the coil manufacturer from the manufacturer drop down list.

The Model drop down list shows coil models for the selected Manufacturer. Select the appropriate coil model.

- **Editing Analog Input Settings**

The analog input settings are used to choose an appropriate analog input source for controlling the ignition timing. Click on the timing tab in the configuration editor window.

Choose the analog input source by selecting the appropriate radio button. If no analog input will be used, select the "No Analog Input" button. Choosing an analog input radio button on the timing page changes the settings that are displayed for the analog input. Only settings appropriate for the selected radio button are displayed.

- **Editing Speed Curve Settings**

The speed curve table can be used to enter timing offsets at different engine speeds. Click on the timing tab in the configuration editor window.

- Enter a new speed curve setting by double-clicking in the next available cell in the 'Speed' column of the table and enter the desired speed.
- Double-click and enter the timing offset in the 'Timing' column of the table adjacent to the speed.
- Select whether the timing offset should advance or retard the timing in the 'Units' column of the table.

Speed	Timing	Units
0	0.00	*Advance
25	8.00	*Retard
100	8.00	*Retard
500	0.00	*Advance

Include speed curve in:

Schedule A

Schedule B

Speed curve settings must be entered by the order of speed in the table. For instance, if a speed of 500 rpm already exists in the table, the next speed setting must be greater than or equal to 500 rpm. If a lower speed is desired, the higher speed settings must first be removed from the table and re-entered after the lower speed is entered.

To remove a speed curve setting, delete the value of the speed curve 'Speed' in the table. Speed curve settings can only be deleted one at a time starting with the last speed setting row in the table.

- **Editing Speed Switch Settings**

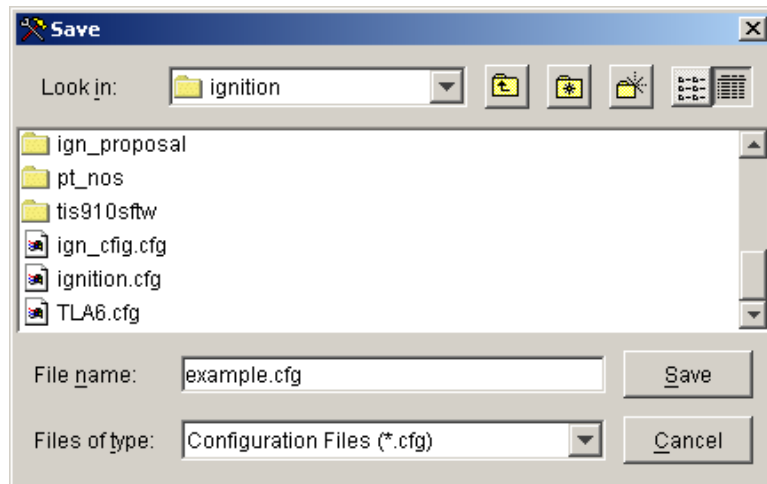
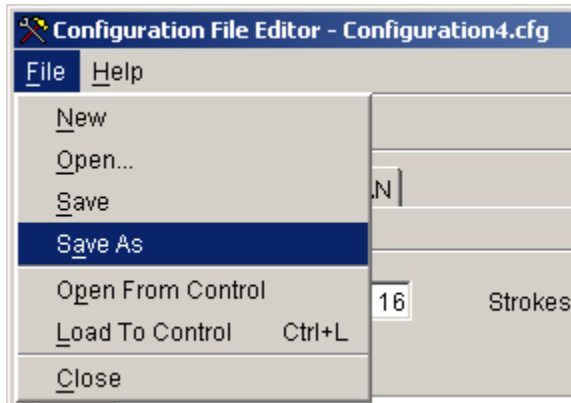
The IC/TIS-910 provides two speed switches, called "Trip 1" and "Trip 2". The trip point of each switch is adjustable from 0 to 5000 rpm. Each speed switch has a separately adjustable "hysteresis" trip point, with a range from 0 to 400 rpm. The switch changes states when engine speed exceeds the "trip" point, and the switch is reset when engine speed goes below the trip point minus the "hysteresis" value. If the hysteresis value is equal to or greater than the trip speed setting, the output is reset at 0 rpm.

The switch action can be configured either "Normally Open" or "Normally Closed". If the switch is configured normally open, the output will be open to ground below the trip point rpm and closed to ground above the trip point rpm. If the switch is configured normally closed, the output will be closed to ground below the trip point rpm and open to ground above the trip point rpm. The Trip1 and Trip 2 status LEDs reflect this operation. At 0 rpm, they are both on if configured normally closed and both off if configured normally open.

Once all configuration settings have been entered the configuration can be loaded to the IC/TIS-910 ignition control and/or saved to a file. Refer to 'Loading a Configuration File' instructions for loading the configuration to the IC/TIS-910 ignition control.

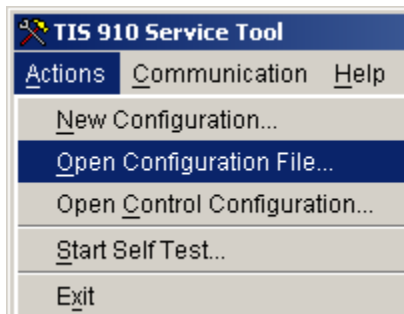
- **Saving a Configuration**

Selecting 'File, Save' saves the configuration to the existing file when it was initially opened from a file. Selecting 'File Save As' prompts for a file name to save the configuration. Use the browser to select a folder in which to save the configuration and enter an appropriate file name.

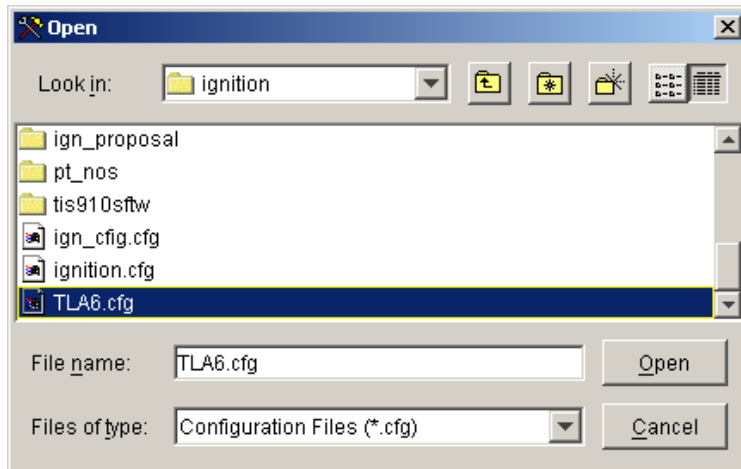


- **Open and Edit a Saved Configuration File**

This choice makes possible offline editing of a saved configuration file. These saved files may be opened and edited without connecting the service tool to a IC/TIS-910 ignition control. On the menu of the IC/TIS-910 Service Tool window, select 'Actions' and then select 'Open Configuration File'.



You will be prompted to choose a saved configuration file. (e.g., TLA6.cfg). Use the browser to find, select and open the desired configuration file.



The chosen configuration file is opened in the Configuration File Editor window. This configuration is now available in the IC/TIS-910 Service Tool for use 'as-is' to load into a IC/TIS-910 ignition control or to edit before loading the configuration. If editing is necessary, select or enter the correct value or setting for each parameter listed on all 4 configuration screens.

Select 'File, Save' to save the edited configuration to the existing file. Select 'File, Save As' to save the configuration to a new file. Use the browser to select a folder in which to save the configuration and enter an appropriate file name.

Open and Edit the Existing Control Configuration

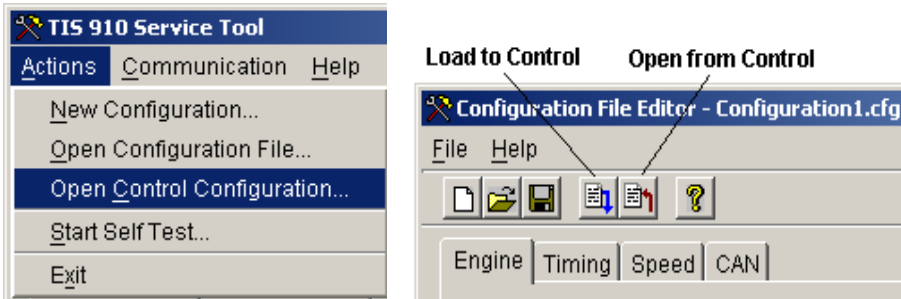
This choice uploads the existing IC/TIS-910 Control Configuration into the IC/TIS-910 Service Tool. Once this file is made available in the IC/TIS-910 Service Tool, the configuration settings can be saved to a file, downloaded 'as-is' into another IC/TIS-910 or edited first, then saved to a file or downloaded.

The IC/TIS-910 Service Tool must be in communication with the IC/TIS-910 ignition control before the control configuration can be opened. The control configuration can be safely opened while the engine is running. Configuration changes made in the IC/TIS-910 Service Tool do not take effect in the IC/TIS-910 ignition control until the changes are loaded from the service tool into the control.

IMPORTANT

Configuration changes made in the IC/TIS-910 Service Tool cannot be loaded to the control while the engine is running.

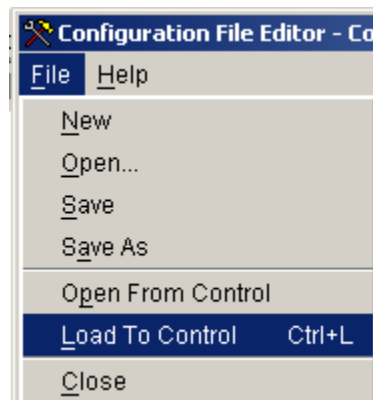
On the menu of the IC/TIS-910 Service Tool window, select 'Actions', then select 'Open Control Configuration' or click the 'Change Configuration' button on the Configuration screen, then click the 'Open from Control' icon.



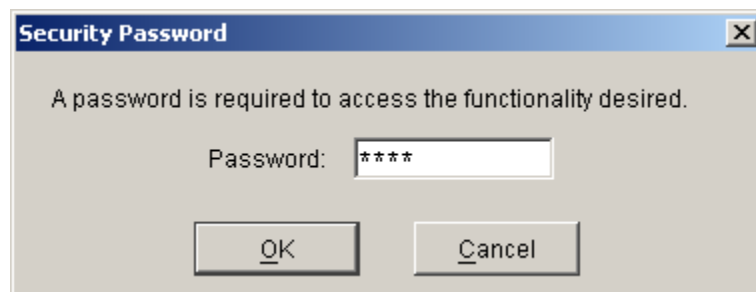
The uploaded IC/TIS-910 configuration is opened in the 'Configuration File Editor' window. If editing is necessary, select or enter the correct value or setting for each parameter listed on all 4 configuration screens. To save the revised configuration, select 'File Save' or 'File Save As'.

Loading a Configuration File

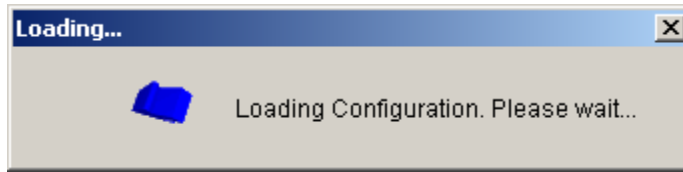
Configuration changes made in the IC/TIS-910 Service Tool do not take effect in the IC/TIS-910 control until the configuration is loaded into the control. To load a completed configuration to the IC/TIS-910 control, the engine must be stopped and the IC/TIS-910 Service Tool must be connected to the IC/TIS-910 ignition control. At the File Menu select 'Load To Control', or press the 'Ctrl + L' hot key for 'Load To Control', or click the 'Load To Control' icon. Any of these actions will load the current configuration open in the IC/TIS-910 Service Tool into the IC/TIS-910 ignition control.



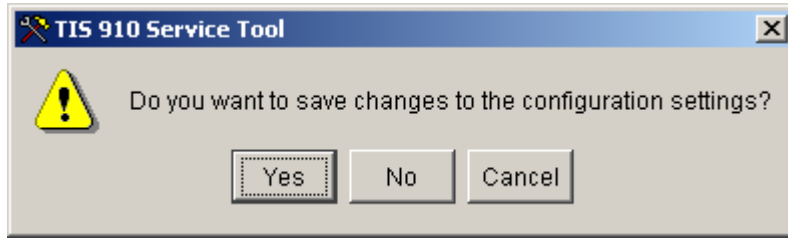
You will be prompted for a password.



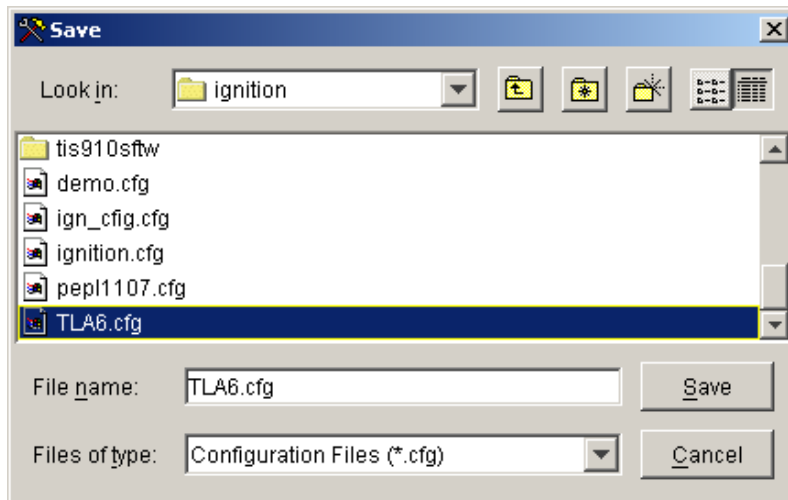
Enter the password and select OK. The password is hours + 10. The following screen appears while configuration settings are loading.



Once loading is completed the new configuration settings take affect. Upon closing the Configuration File Editor screen you will be prompted to save or not save the configuration settings to a file.



Select 'Yes' to save the configuration to a file. Select 'No' if you do not want to save the configuration to a file. When 'Yes' is selected, the following 'Save' window opens.



Browse to an appropriate folder and enter a 'new' file name to create a new file or select an existing file name to overwrite (e.g., TLA6.cfg) then click 'Save'.

Adjusting Energy Control Settings

The energy settings provide the ability to achieve optimum ignition system performance. These settings include two energy operating modes:

- Manual
- Auto E.

In the Manual mode the energy level is set to operate at a fixed energy level. The Manual energy level setting is also a high limit setting for the Auto E mode.

In Auto E mode the energy level of each output is, by design, individually and automatically adjusted to produce constant spark duration at a minimum level sufficient for optimum combustion stability. Auto E regulates the energy level, between high and low limits, to control the measured duration to a tunable duration setpoint. Energy levels change automatically as spark plugs erode to maintain optimum combustion stability and maximize spark plug life.

To adjust the Energy Control Settings, click on the Energy Control tab on the main service tool window and press the Edit Energy Control button. Energy settings are password protected. A valid password must be entered before changes are allowed.

Coil	Offset μ s	Spark Durat...
1	0	0
2	0	0
3	0	0
4	25	0
5	-15	0
6	25	0
7	0	0
8	0	0
9	0	0
10	0	0
11	15	0
12	0	0

After the correct password is entered, the Energy Control window shown above is opened to allow energy setting changes.



WARNING The coils are listed by firing order sequence and not engine cylinder number sequence. Be sure to make the correct correlation to an actual cylinder before adjusting duration offsets.

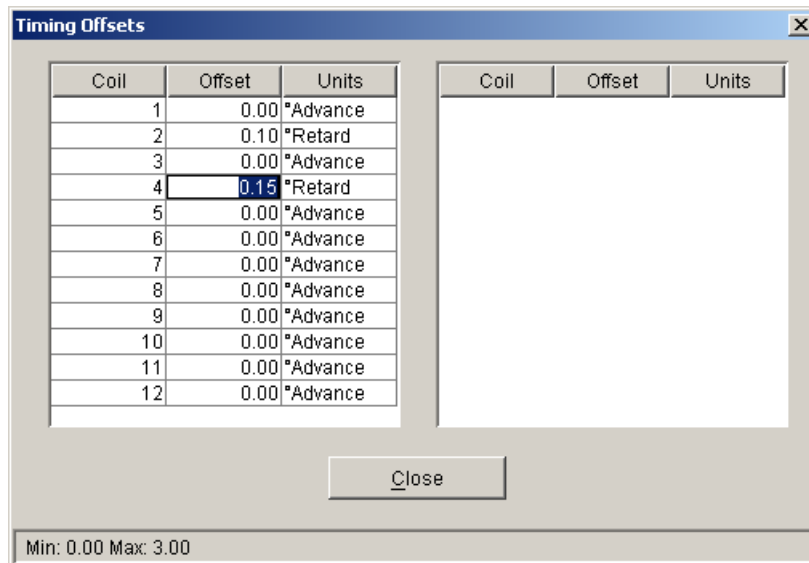
To change the Energy Control mode, click either the Manual or Auto radio button. Refer to Chapter 6 for detailed instructions concerning all Energy Control settings including the Auto E Setup Procedure.

When editing a numeric parameter, the range of valid values that can be entered will be displayed on the status bar at the bottom of the Energy Control window. The service tool will not accept values outside of this range. When editing numeric parameters, you must press Enter or select another item for the change to take place. The duration changes take affect immediately in the IC/TIS-910. After all changes have been made for each output, click on the Close button to permanently save the new offsets in the IC/TIS-910 control.

Adjusting Individual Cylinder Timing Offset Settings

The individual cylinder timing offset settings provide a means of achieving precise ignition timing for each cylinder or for offsetting the timing of a particular cylinder to possibly compensate for combustion anomalies (e.g., detonation).

To adjust the individual cylinder Timing Offsets, click the Timing tab on the main service tool window and press the Edit Timing Offsets button. Timing Offset settings are password protected. A valid password must be entered before changes are allowed.



IMPORTANT

All cylinder-to-cylinder timing changes are relative to the global timing established by timing schedules A and B.

After the correct password is entered, the Timing Offsets window shown above opens to allow timing offset setting changes.

WARNING

The coils are listed by firing order sequence and not engine cylinder number sequence. Be sure to make the correct correlation to an actual engine cylinder before adjusting timing offsets.

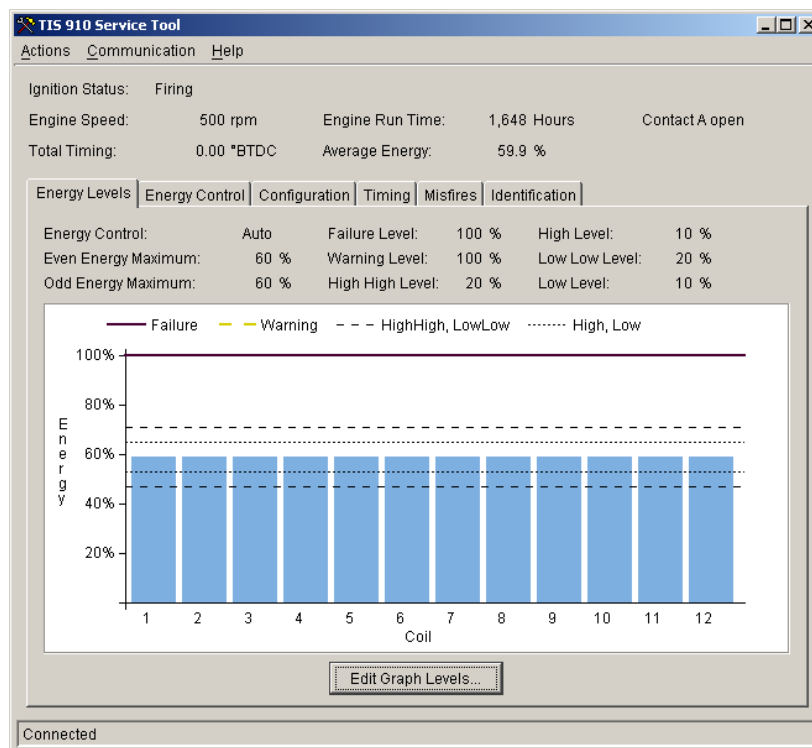
When editing a numeric parameter, the range of valid values that can be entered will be displayed on the status bar at the bottom of the Timing Offsets window. The service tool will not accept values outside of this range. When editing numeric parameters, you must press Enter or select another item for the change to take place. The Units (° Advance, ° Retard) are selected by drop-down menu.

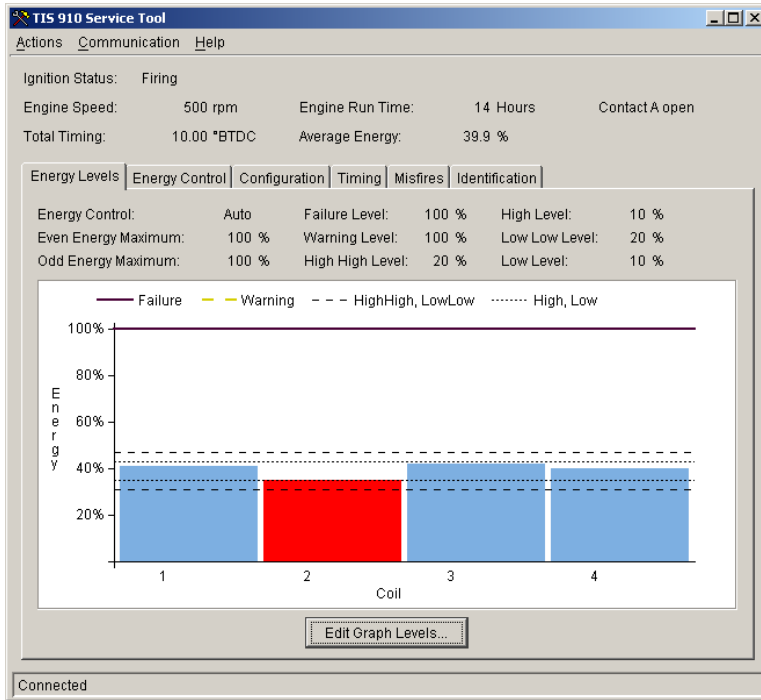
Timing offsets changes take affect immediately in the IC/TIS-910. This allows verification of correct timing with a timing light before closing the Timing Offsets window. After all changes have been made for each cylinder, click on the Close button to permanently save the new offsets in the IC/TIS-910 control.

Adjusting Energy Graph Level Settings

Energy graph level alarms are provided and set on a global basis. While various conditions can trigger an alarm condition, the most common conditions are listed. The alarm condition identifies a particular output with some sort of trouble. The alarm settings appear as dashed lines on the graph in the Energy Levels window as shown below. An alarm condition toggles the individual energy level bar color from light blue to red. The following alarm functions are provided:

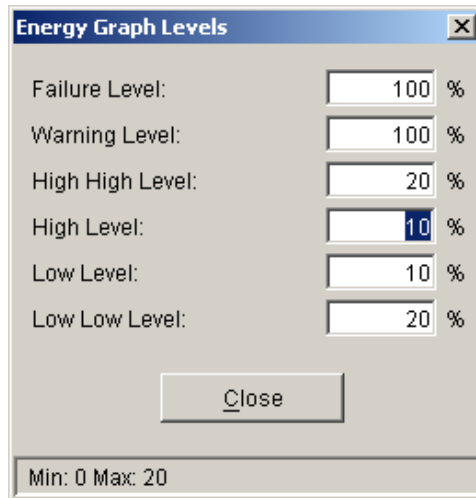
- The **Failure Level** is an absolute energy level setting that indicates a maximum energy level has been demanded and there is no remaining energy in reserve. This alarm typically indicates the spark plug is completely worn out and should be replaced immediately.
- The **Warning Level** is an absolute energy level setting that indicates a maximum energy level is being approached. This alarm typically indicates the spark plug condition has deteriorated significantly and will need replaced soon.
- The **High High Level** and **Low Low Level** settings are differential alarms that indicate a significant deviation from the average energy level. A high high level alarm typically indicates an open primary. A low low level alarm typically indicates a shorted primary or open secondary. The low low alarm is usually accompanied by a misfire indication.
- The **High Level** and **Low Level** are differential alarms that indicate a small deviation from the average energy level. A high level alarm typically indicates the spark plug may be wearing at a faster rate than the others. A low level alarm typically indicates the spark plug has a direct path to ground through the insulator.





Example of the energy level bar graph when Coil 2 primary is shorted.

To adjust the Energy Graph Level Settings, click the Energy Levels tab on the main service tool window and press the Edit Graph Levels button. Graph Level settings are password protected. A valid password must be entered before changes are allowed.



After the correct password is entered, the Energy Graph Levels window shown above is opened to allow alarm level setting changes.

When editing a numeric parameter, the range of valid values that can be entered will be displayed on the status bar at the bottom of the Energy Graph Levels window. The service tool will not accept values outside of this range. When editing numeric parameters, you must press Enter or select another item for the change to take place.

Alarm level changes take affect immediately. After all changes have been made for each alarm level setting, click on the Close button to permanently save the new alarm level settings in the IC/TIS-910 Service Tool.

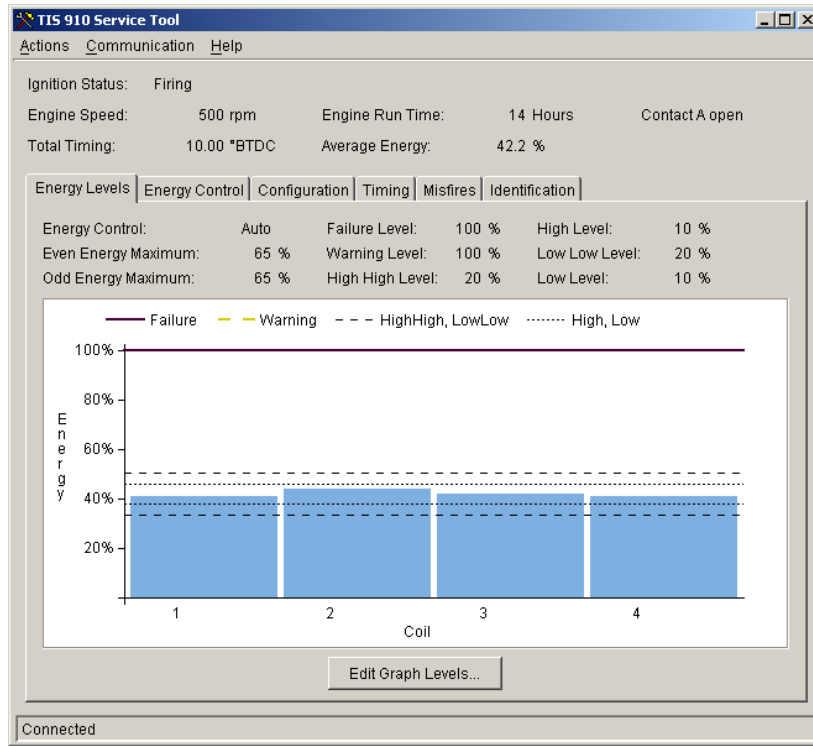
Monitoring the IC/TIS-910

The service tool main window organizes information about the IC/TIS-910 into a overview section and a set of tabbed pages, which contain detailed information. To view information on a page, click on the page tab.

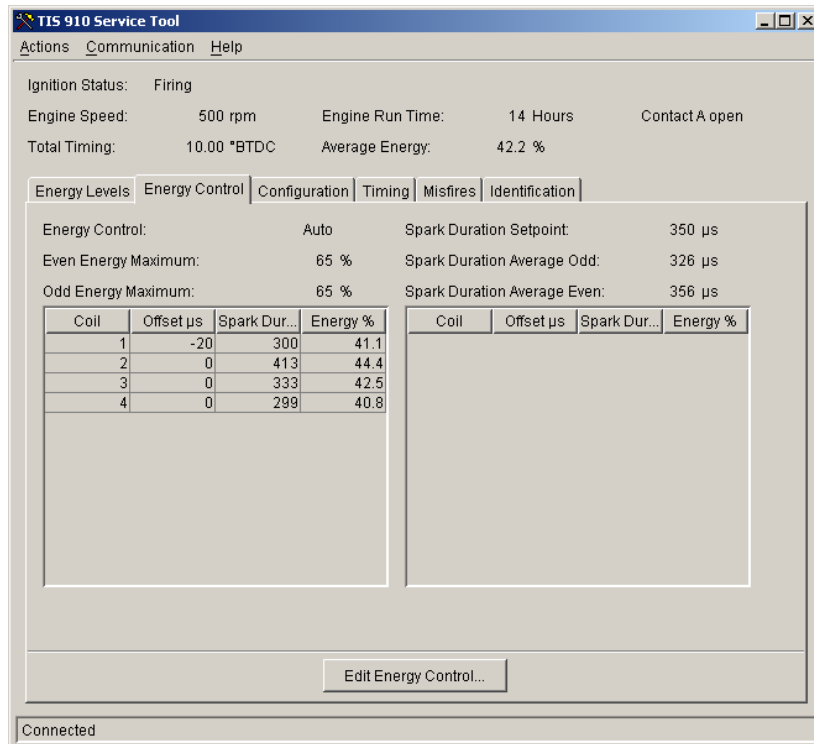
The overview parameters are common to all pages. These include Ignition Status, Engine Speed, Total Timing, Engine Run Time, Average Energy and the shutdown Contact A position.

Monitoring Energy Levels

The IC/TIS-910 continuously monitors the primary output energy level and spark duration to each coil. The energy level is shown as bar graph and digital displays. The spark duration is shown as a digital display only.



To view the energy level bar graph display and alarm level settings as shown above click the Energy Levels tab of the main window.



To view the digital display of the energy levels, the individual spark durations and the Spark Duration Average Odd and Spark Duration Average Even click the Energy Control tab of the main window.

Viewing IC/TIS-910 Configuration

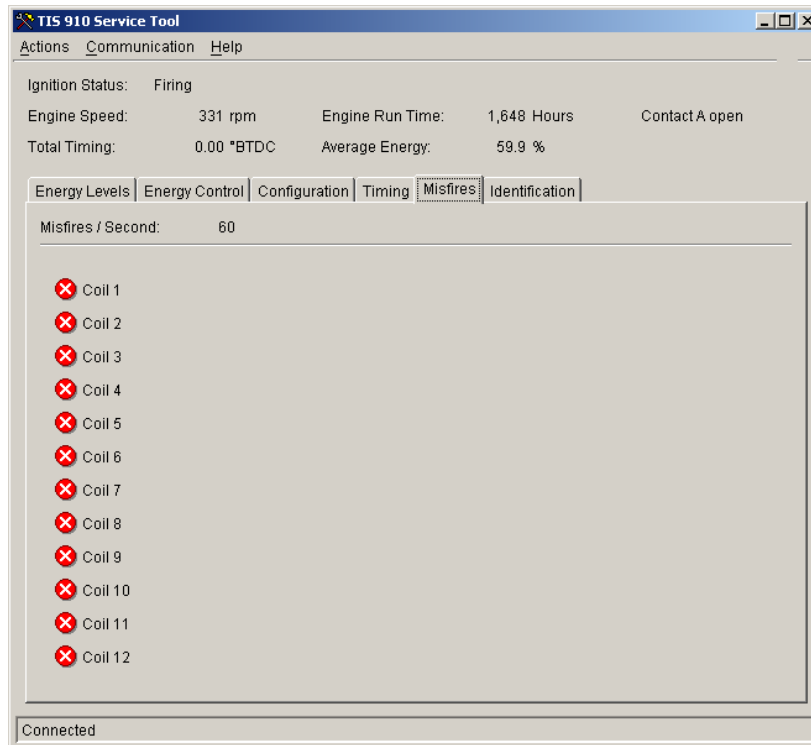
The IC/TIS-910 configuration can be viewed at any time by clicking the Configuration tab of the main window. A scroll bar is provided on this screen to allow viewing all configuration settings.

Configuration can also be opened from the control while the engine is running for editing or saving to a file. An existing, new or modified Configuration cannot be loaded to the control while the engine is running. The engine must be stopped to load Configuration to the control.

Monitoring Misfires

The IC/TIS-910 continuously monitors the primary discharge of the energy storage capacitor. Failure to discharge the capacitor, when demanded, causes a misfire indication. While this also causes a combustion misfire, other factors related to the air and fuel delivery systems can also cause combustion misfire. The latter causes are not detected by the ignition misfire.

To monitor ignition misfires, click on the "Misfires" tab of the main window. Indicators adjacent to each coil are gray when there is not a misfire and these change to a bold red when misfire occurs.



Identifying the IC/TIS-910 Software and Serial Number

To identify the software loaded into the control or to retrieve the serial number, click on the "Identification" tab of the main window. This page displays the part number and revision level of the software in the IC/TIS-910 ignition control. Refer to this part number and revision level in any correspondence with Woodward.

Chapter 8.

Start-up Procedure

I. Before applying power to the IC/TIS-910, check and verify the following:

1. Fuel valve is shut off.
2. The firing interval (sequence number) is correct for the engine type. If you are not sure, contact your engine manufacturer.
3. Cylinder firing order is known and the ignition coils are wired in accordance with the Connector Pin Assignments chart(s) in Chapter 4.
4. All timing sensors are properly gapped and tightened.
5. All timing sensors are wired in accordance with Figure 1-1.

II. Apply power to the IC/TIS-910 (fuel valve still in the off position):

1. Check and verify that the IC/TIS-910 is programmed correctly (see Chapter 7).
2. Perform the normal engine start-up procedure (prelube, etc.), except that the fuel must remain OFF.
3. With a timing light connected to the #1 cylinder, verify that the cylinder is firing within ± 2 degrees of the programmed setting. If not, refer to Chapter 10.
4. Check all remaining cylinders for proper timing. If not correct, stop the engine and recheck wiring and sequence number for correctness.
5. Disengage the starter. Continue with step III if no problems are encountered.

III. Set the fuel valve to its normal position and re-start the engine.

1. If the engine fails to start, refer to Chapter 10.
2. If the engine starts, verify timing of #1 cylinder.
3. Increase engine speed to normal operating speed.
4. Check timing of #1 cylinder and compare measured timing to the displayed timing (PC/laptop with IC/TIS-910 Service Tool).
5. If the IC/TIS-910 is measuring too high, the reset position needs to be reduced by the difference.

Example:

If the IC/TIS-910 monitor is displaying 22.0 Adv. and the measured timing is 20.5 Adv., the reset position will have to be reduced by 1.5 degrees (22–20.5). If the reset position is 50 Adv., the reset position will have to be changed to 48.5 degrees.

6. If the IC/TIS-910 is measuring too low, the reset position will have to be increased by the difference.
7. Shut down the engine using the normal shutdown procedure and make any reset position changes required (see Chapter 7).
8. Re-start the engine and verify that the #1 cylinder is firing at the correct position.
9. Check all remaining cylinders for proper timing. If not correct, stop the engine and recheck wiring and firing intervals for correctness.
10. If all cylinders are operating properly, gradually apply full load to the engine.
11. Verify that all cylinders are still operating properly and that all are carrying the load. If not refer to Chapter 10.
12. Installation is complete. Save the IC/TIS-910 Configuration to a file for future reference in a secure location.

Chapter 9.

CANbus Information

CANbus Interface with the D-1 Display

There are two modes for the CANbus: read only and read/write. The write mode is enabled with the IC/TIS-910 Service Tool by checking "WRITE VALUES THROUGH THE CAN PORT". If the IC/TIS-910 is set to "WRITE VALUES THROUGH THE CAN PORT", it will be possible to read and write values on the CANbus. If the IC/TIS-910 is not set to "WRITE VALUES THROUGH THE CAN PORT", it will only be possible to read the values on the CANbus. If the CANbus is enabled, writing of all engine parameters is allowed.

Read/Write Mode

If the IC/TIS-910 is set to "WRITE VALUES THROUGH THE CAN PORT", the CANbus operation is set to read/write mode. It is possible to program any of the configuration data, cylinder-to-cylinder timing, or energy information.

In order to set any configuration data, the ignition must be set to "disable run." This allows configuration data to be changed/set to the desired values. It is also a signal to the CPU that the configuration may be changed and that the primary outputs are disabled. Once the entire configuration is set correctly, setting the "run" parameter to "enable run," saves any configuration data that was changed to non-volatile memory. It also checks for errors between parameters dependent on each other like the number of cylinders and the firing intervals, Reset position and most advanced timing limit, and the speed curve set points. If there are no errors, the ignition is set to "enable run" and will start firing as soon as valid MPU inputs are sensed. In this mode it is necessary to set the ignition to "enable run" before the outputs will fire.

In order for the CANbus to function properly, the correct CAN ID must be used. With the D-1 display, this number is 2.

D-1 Display

To make the number of cylinders displayed on the D-1 match the number of cylinders programmed on the IC/TIS-910, refer to the D-1 manual section "Configuration of D-1." If you are familiar with the D-1 configuration screens, select "configure base ?" = NO, then "config. Ignition controlling" = YES. The next screen is "number of cylinders" and set this to the same number as the IC/TIS-910. This does not set the number of cylinders in the IC/TIS-910, it just sets up the D-1 display so the number of cylinders match the number programmed in the IC/TIS-910.

IMPORTANT

The D-1 display has fewer parameters than the programming menus with the IC/TIS-910 Service Tool. Since it is necessary to make sure the CANbus is enabled or disabled with the IC/TIS-910 Service Tool, it is best to make sure all the parameters are set up with the IC/TIS-910 Service Tool initially.

CANbus Cable

Refer to the CANbus cable diagram in the D-1 display manual (Woodward manual 26143).

Chapter 10.

Troubleshooting

Sensor Input Faults

- **TRIGGER MPU**—The IC/TIS-910 measured the number of teeth/events between two successive reset MPU signals. If the IC/TIS-910 detects that the programmed number of teeth do not match the measured number of teeth, an error will be detected. Two type of faults exist:
 1. **WRONG NUMBER OF TEETH PROGRAMMED**—This error occurs if the IC/TIS-910 never detects the correct number of programmed teeth. Corrective action: 1) Verify tooth count and program in correct number of teeth. 2) Inspect flywheel/ring gear for gouges or other deformities that might generate a signal from the trigger MPU or reset MPU.
 2. **“RING GEAR MPU ERROR”**—Once the engine is running and if an erroneous tooth count is detected, a missing ring gear message will appear (rpm greater than 200). Corrective action: Inspect flywheel/ring gear for gouges or other deformities that might generate a signal from the trigger MPU or reset MPU.

The gear count number above is an indicator of where the problem occurred. If it is consistently the same number for two or three times, there is a problem that many teeth from the reset.
- **RESET MPU**—The IC/TIS-910 measured the number of events between two successive reset cam signals. If the IC/TIS-910 detects that the number of events does not match the expected number of events, an error will be detected.
- **CAM MPU (4 cycle only)**—The IC/TIS-910 measured the number of events between three successive reset MPU signals. If the IC/TIS-910 detects that the number of events does not match the expected number of events, an error will be detected.

Programming Errors —

Generally it is not possible to program values that are not within a valid range for a parameter. It is not possible to program more than 24 cylinders. However, it is possible to program 10 cylinders and a sequence that is not correct for 10 cylinders. This example error is illustrated below. There are other parameters such as “RESET BTDC” that have a range of 10-120, but if the “MAX ADV A” is set to 20.00 ADV, it is not possible to set the RESET BTDC to less than 30.00. If it is not possible to set other parameters to the desired value, check the range for the parameter in the programming section of Chapter 7.

It is possible to program valid numbers for ignition parameters but the relationship between dependent numbers can create errors. It is necessary to correct these before the ignition can be enabled. The following are two examples of this.

The “NUMBER OF CYLINDERS WRONG FOR FIRING INTERVAL” error occurs if the number of cylinders is incorrect for the sequence programmed. It is necessary to check the number of cylinders and sequence number.

The “ADVANCE, RETARD, RESET TIMING IN SCHED B” error results when the “MAX ADV B” parameter is greater than “RESET BTDC” (10.00).

Ignition Coil Faults

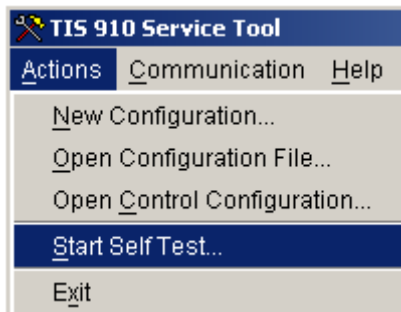
If an ignition coil problem is suspected, the IC/TIS-910 provides two means of detecting the problem:

- Primary Misfire Detection
- Self-Test Feature

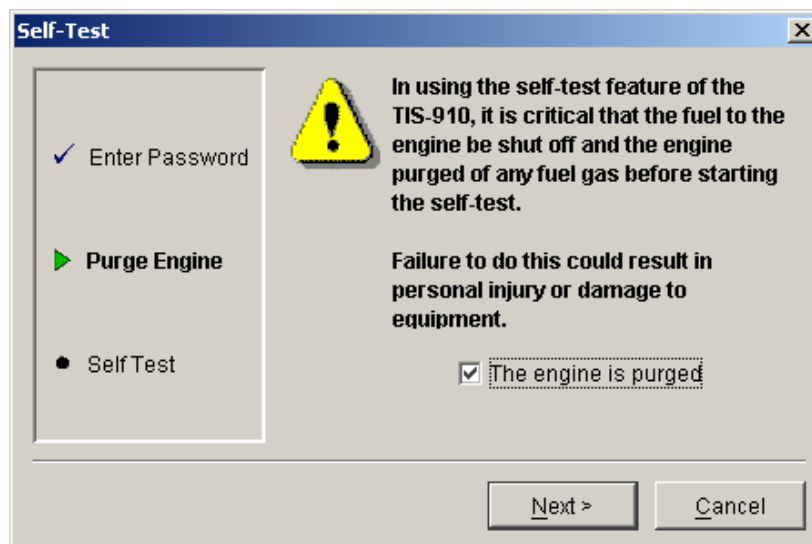
Self Test

The self-test feature of the IC/TIS-910 allows the installer, operator or mechanic to conduct performance checks on the primary wiring to the coil, the ignition coil, high tension leads, and spark plugs by discharging the energy stored in the high voltage capacitor into each coil in successive order. The IC/TIS-910 will “fire” a primary output every 0.1 second. The energy delivered to each coil is determined by the manual energy level setting. The engine must be stopped and a valid password must be entered before Self Test operation is allowed.

To run the self-test feature of the IC/TIS-910, select Actions from the service tool main menu and then select Start Self Test.



The service tool displays a step by step Self Test wizard. First you will be prompted to enter a password.



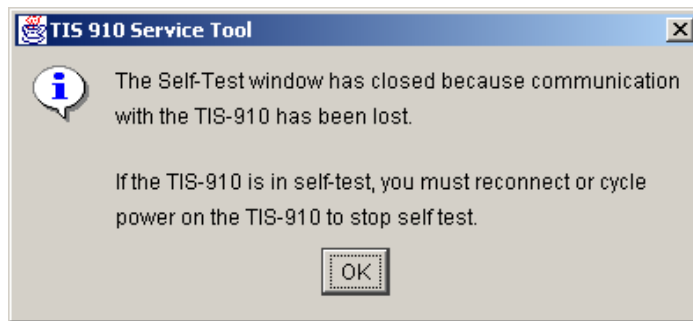
**WARNING**

In using the self-test feature of the IC/TIS-910, it is critical that the fuel to the engine be shut off and the engine purged of any fuel gas before starting the self-test. Failure to do this could result in personal injury or damage to equipment.

After the correct password is entered, you will be prompted to verify the engine is purged. Be sure the fuel is shut-off and the engine is purged of any raw fuel.

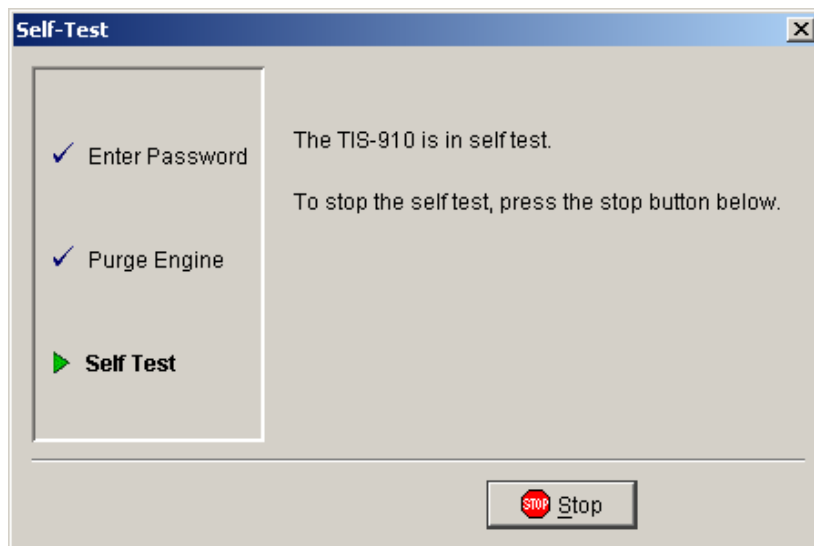
After the engine is purged check the check-box then 'Next". Self Test will begin to sequentially fire each output at 0.1 second intervals and will continue until the STOP icon is clicked or the Alt + S hot key is pressed.

Cycling power also stops self test. The following message is displayed if power to the IC/TIS-910 ignition module is interrupted or if communication is lost during self test. It is very important to be prepared to interrupt power should communications be lost since the service tool cannot stop self test without a communications link.

**WARNING**

Power to the IC/TIS-910 must be interrupted to stop self test if the communications link between the IC/TIS-910 and the IC/TIS-910 Service Tool is lost. Make any necessary preparations for this.

Click the STOP icon or press the Alt + S hot keys to stop Self Test operation.



Chapter 11.

Service Options

Product Service Options

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

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

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

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

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

A current list of Woodward Business Partners is available at www.woodward.com/support.

Woodward Factory Servicing Options

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

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

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

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

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

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

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

Returning Equipment for Repair

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

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

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

Packing a Control

Use the following materials when returning a complete control:

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

NOTICE

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

Replacement Parts

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

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

Engineering Services

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

- Technical Support
- Product Training
- Field Service

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

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

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

For information on these services, please contact us via telephone, email us, or use our website and reference www.woodward.com/support, and then **Customer Support**.

How to Contact Woodward

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

Electrical Power Systems

Facility	Phone Number
Australia	+61 (2) 9758 2322
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany:	
Kempen	+49 (0) 21 52 14 51
Stuttgart	+49 (711) 78954-0
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
Poland	+48 12 618 92 00
United States	+1 (970) 482-5811

Engine Systems

Facility	Phone Number
Australia	+61 (2) 9758 2322
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany:	
Stuttgart	+49 (711) 78954-0
India	+91 (129) 4097100
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
United States	+1 (970) 482-5811

Turbine Systems

Facility	Phone Number
Australia	+61 (2) 9758 2322
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
United States	+1 (970) 482-5811

You can also contact the Woodward Customer Service Department or consult our worldwide directory on Woodward's website (www.woodward.com/support) for the name of your nearest Woodward distributor or service facility.

For the most current product support and contact information, please refer to the latest version of publication **51337** at www.woodward.com/publications.

Technical Assistance

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

General

Your Name _____
Site Location _____
Phone Number _____
Fax Number _____

Prime Mover Information

Engine/Turbine Model Number _____
Manufacturer _____
Number of Cylinders (if applicable) _____
Type of Fuel (gas, gaseous, steam, etc) _____
Rating _____
Application _____

Control/Governor Information

Please list all Woodward governors, actuators, and electronic controls in your system:

Woodward Part Number and Revision Letter _____
Control Description or Governor Type _____
Serial Number _____

Woodward Part Number and Revision Letter _____
Control Description or Governor Type _____
Serial Number _____

Woodward Part Number and Revision Letter _____
Control Description or Governor Type _____
Serial Number _____

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

Appendix.

Reference Information

LED Operation

Permissive Start LED

This LED indicates whether the ignition primary outputs are active. If it is **ON**, the ignition is firing and the primary outputs are active. It is the same as the permissive start contact to ground. If the LED is on, the contact is closed/connected to ground on the ignition. If the LED is off, the contact is not connected to ground and the ignition is not firing the primary outputs.

System LED

This is a status LED and is not associated with any contact pin.
1 short flash per second indicates either "Ready" mode without CAN communication

or

CAN Communication is on and the ignition is firing with valid MPU inputs.

Ready mode is: MPUs are not active, the ignition is not firing, there are no errors or warnings, and the configuration programming screen/mode is not active.

2 short flashes indicate the ready mode with the CAN communication active.

Always on: The System LED is always on if the configuration menu is enabled or if there is an error or warning. If CAN communication is active, it will cause a flicker once per second.

Always off: The ignition is firing and the CAN communication is not active.

IC/TIS-910 Control Specifications

Power Consumption	12 V operation: 10–14 Vdc (5.1 A max.) 24 V operation: 18–30 Vdc (3.6 A max.)
	Notes: <ol style="list-style-type: none">1. Average current is dependent on the number of cylinders, input power, energy level, and engine speed.2. Peak current is dependent only on energy level; 100% energy = 25 A peak
Trigger Input	Variable reluctance (passive) +2 Vdc min., 80 V p-p max., 10 Hz to 10 kHz
Reset Input	Same as Trigger Input
CAM Input	Active Inductive type or Hall Effect type, 10–32 Vdc supply voltage from IC/TIS-910, PNP or NPN @20 mA accepted, 0–10 kHz
Discrete Inputs (Contacts A & B)	24 V @5 mA: 13–30 V is logic 1, 0–5 V is logic 0
Process Input	4–20 mA
Sensor Input	0–5 V sensors
Speed Trip Outputs (solid-state outputs)	open collector (NPN) 60 V max., 100 mA max.
Permissive Start (solid-state output)	open collector (NPN) 60 V max., 250 mA max.
Communications Ports	CAN, RS-232
Ambient Operating Temperature	–40 to +65 °C (–40 to +149 °F)
Storage Temperature	–40 to +100 °C (–40 to +212 °F)
Humidity	95%, no moisture condensation
Equipment Classification	Class 1 (grounded equipment)
Air Quality	Pollution Degree II
Installation Overvoltage	Category II
Ingress Protection	IP56

Regulatory Compliance

European Compliance for CE Mark:	
EMC Directive	Declared to 89/336/EEC COUNCIL DIRECTIVE of 03 May 1989 on the approximation of the laws of the member states relating to electromagnetic compatibility.
Low Voltage Directive	Declared to the 73/23/EEC COUNCIL DIRECTIVE of 19 February 1973 on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits.

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication **26222**.



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as well as authorized distributors and other authorized service and sales facilities throughout the world.**

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