



Installation and Operation Manual



TIS-910 Ignition Controller

8408-701

Manual 26139 (Revision B)

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*.

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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*.

Chapter 1.

General Information

Introduction

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

This manual and its context 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.

Regulatory Compliance

The 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.



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.



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

La substitution de composants peut rendre ce matériel inacceptable pour les emplacements de Classe I, Division 2.

Theory of Operation

The 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 via a terminal program that resides on a PC (personal computer).

The 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 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 a PC or hand held terminal.

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

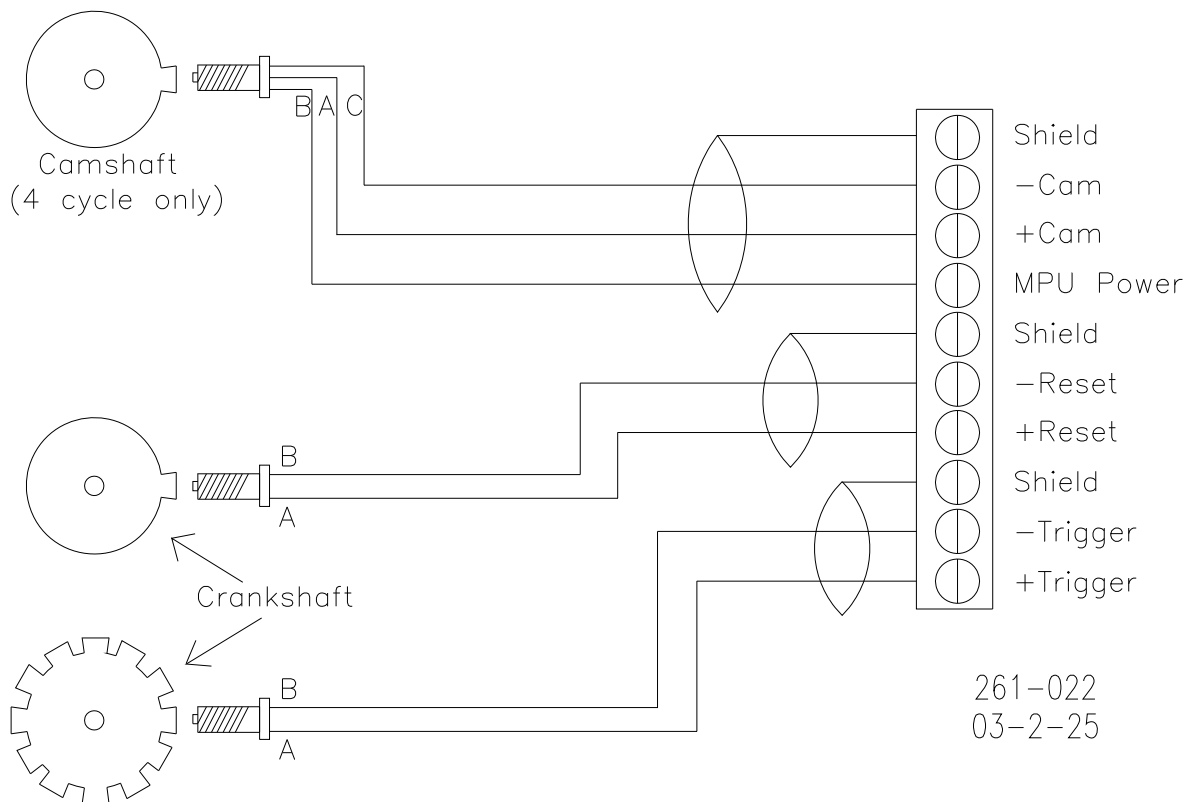


Figure 1-1. Wiring Diagram—TIS-910 Timing Sensors

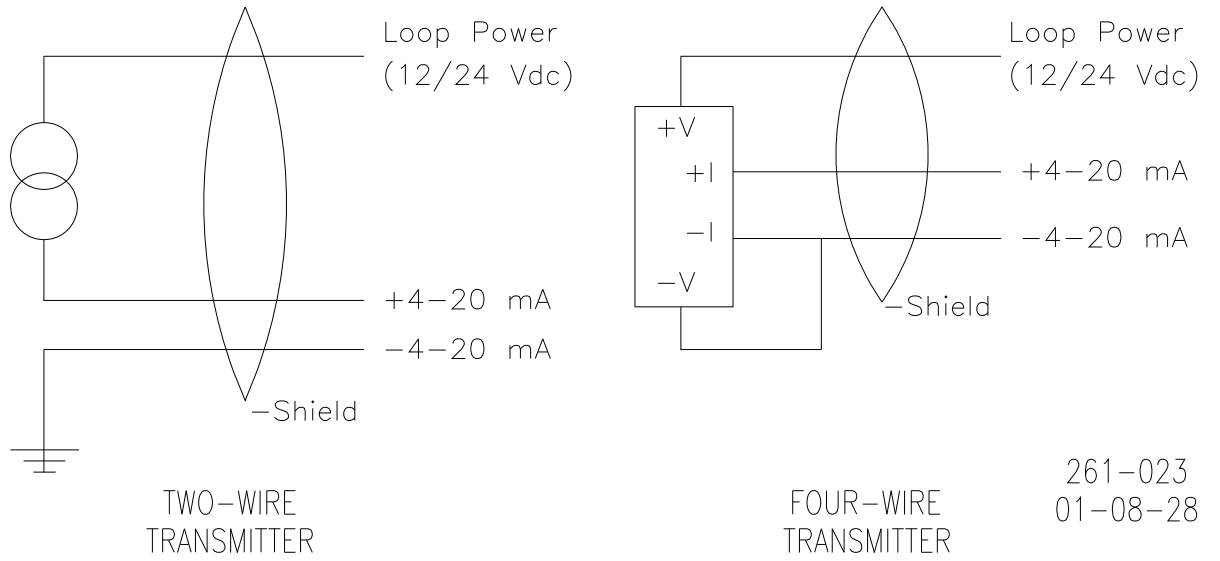
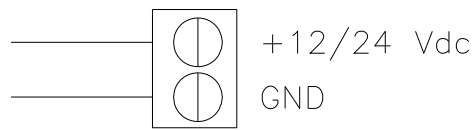


Figure 1-2a. Wiring Diagram—4-20 mA Signal



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Figure 1-2b. Wiring Diagram—Power Wiring

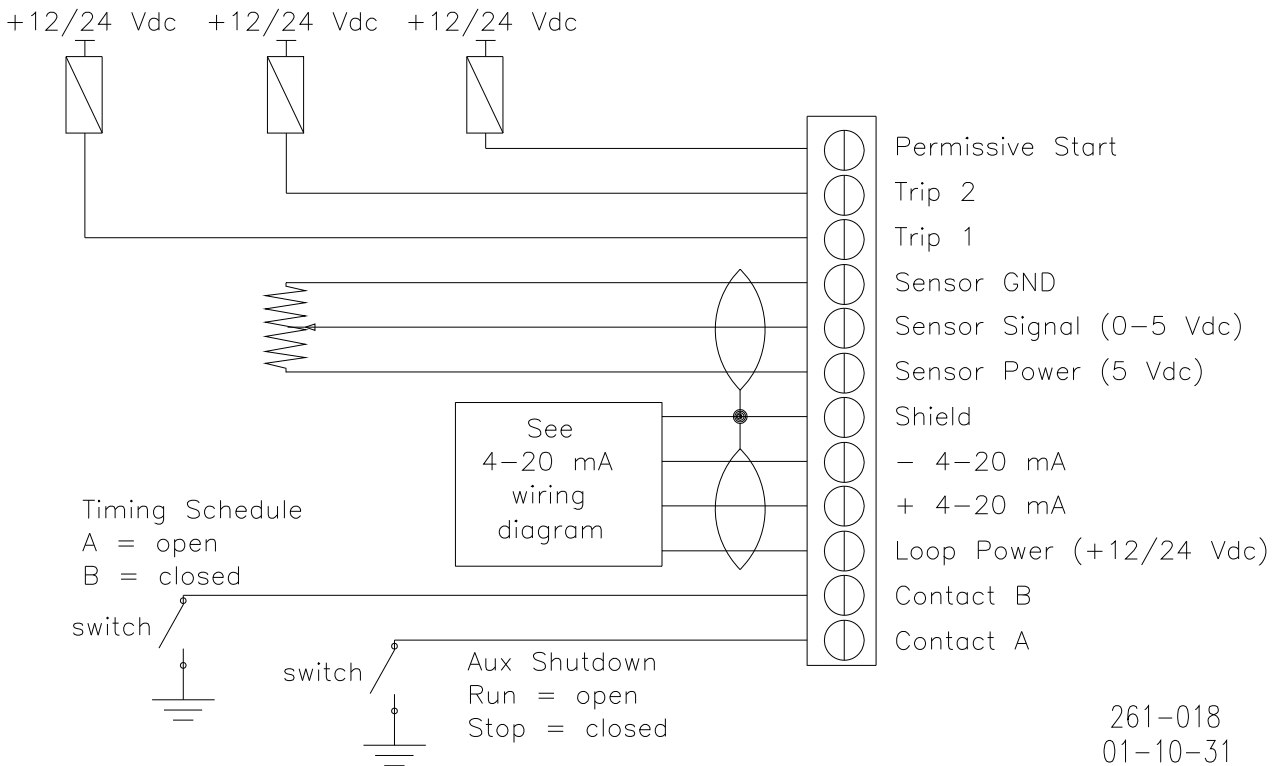


Figure 1-3. Wiring Diagram—TIS-910 Timing and Safety Controls

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 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.

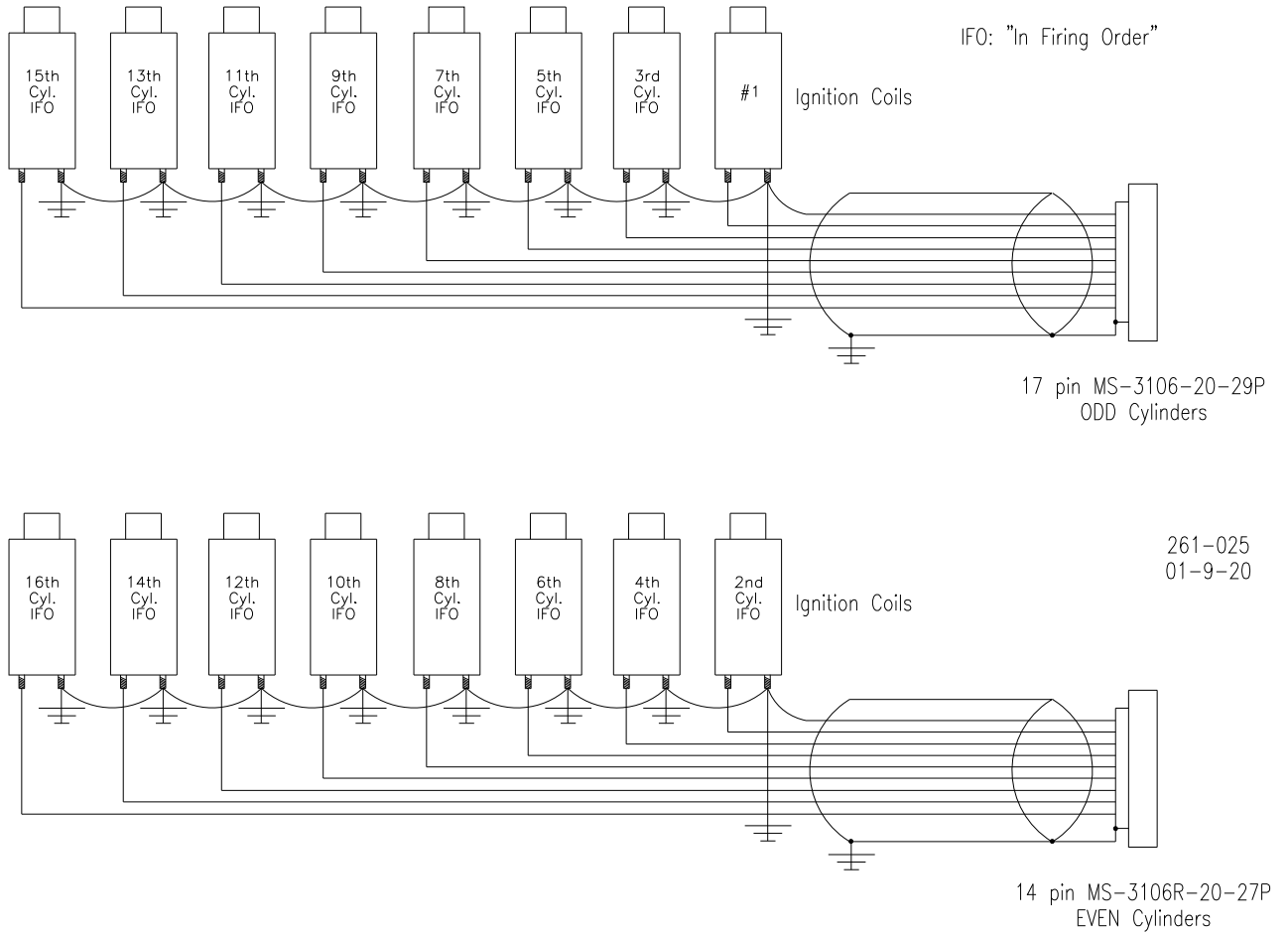
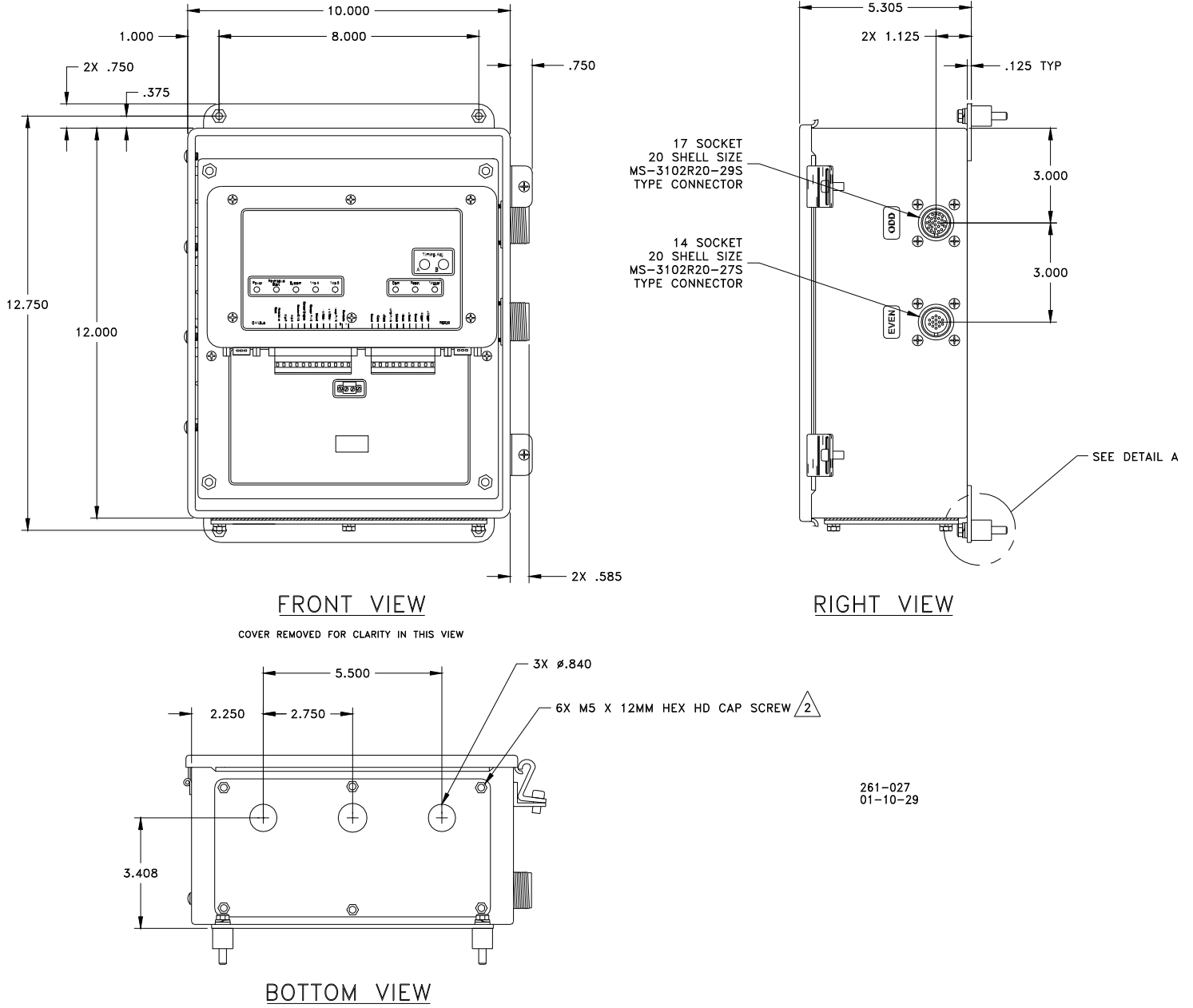


Figure 1-4. Wiring Diagram—16-Cylinder Example

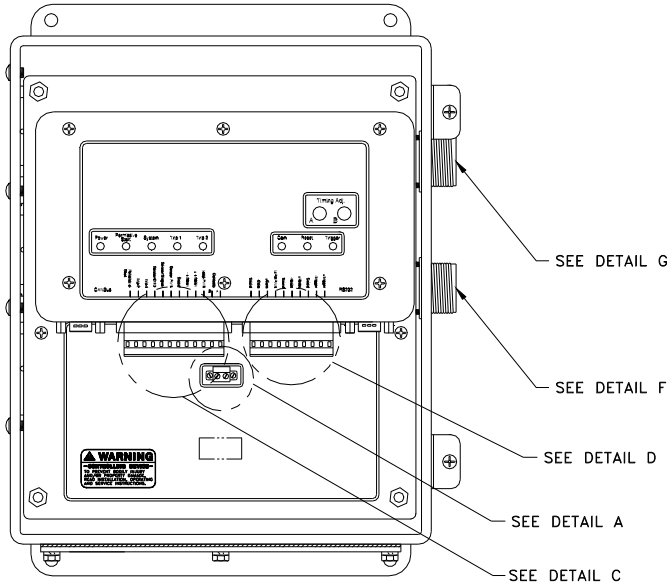


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Figure 1-5. TIS-910 Outline Drawing

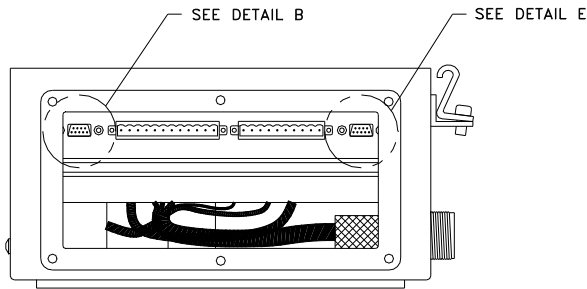
NOTES:

- 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.



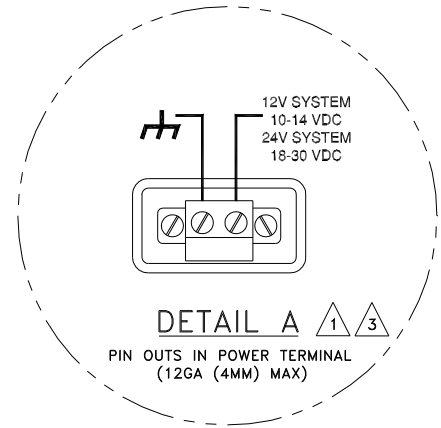
FRONT VIEW

COVER REMOVED FOR CLARITY IN THIS VIEW



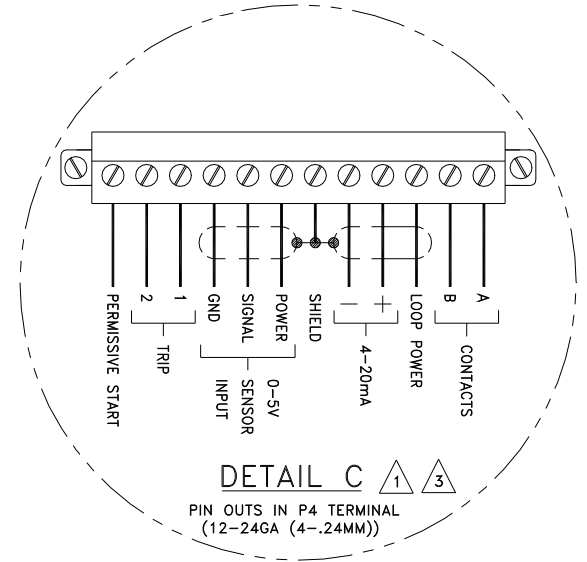
BOTTOM VIEW

COVER AND GLAND PLATE REMOVED FOR CLARITY IN THIS VIEW



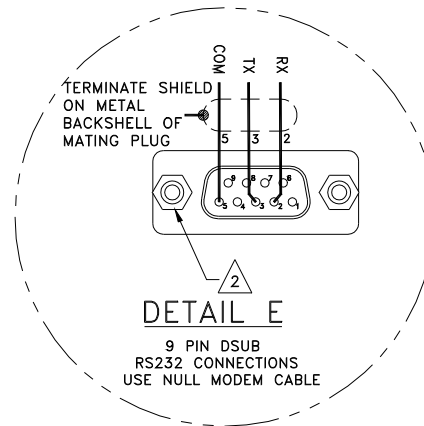
DETAIL A 1 3

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



DETAIL C 1 3

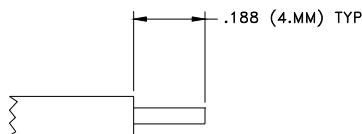
PIN OUTS IN P4 TERMINAL (12-24GA (4-.24MM))



DETAIL E

9 PIN DSUB RS232 CONNECTIONS USE NULL MODEM CABLE

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INSULATION STRIP LENGTH DETAIL

Figure 1-6a. Overall Plant Wiring Diagram

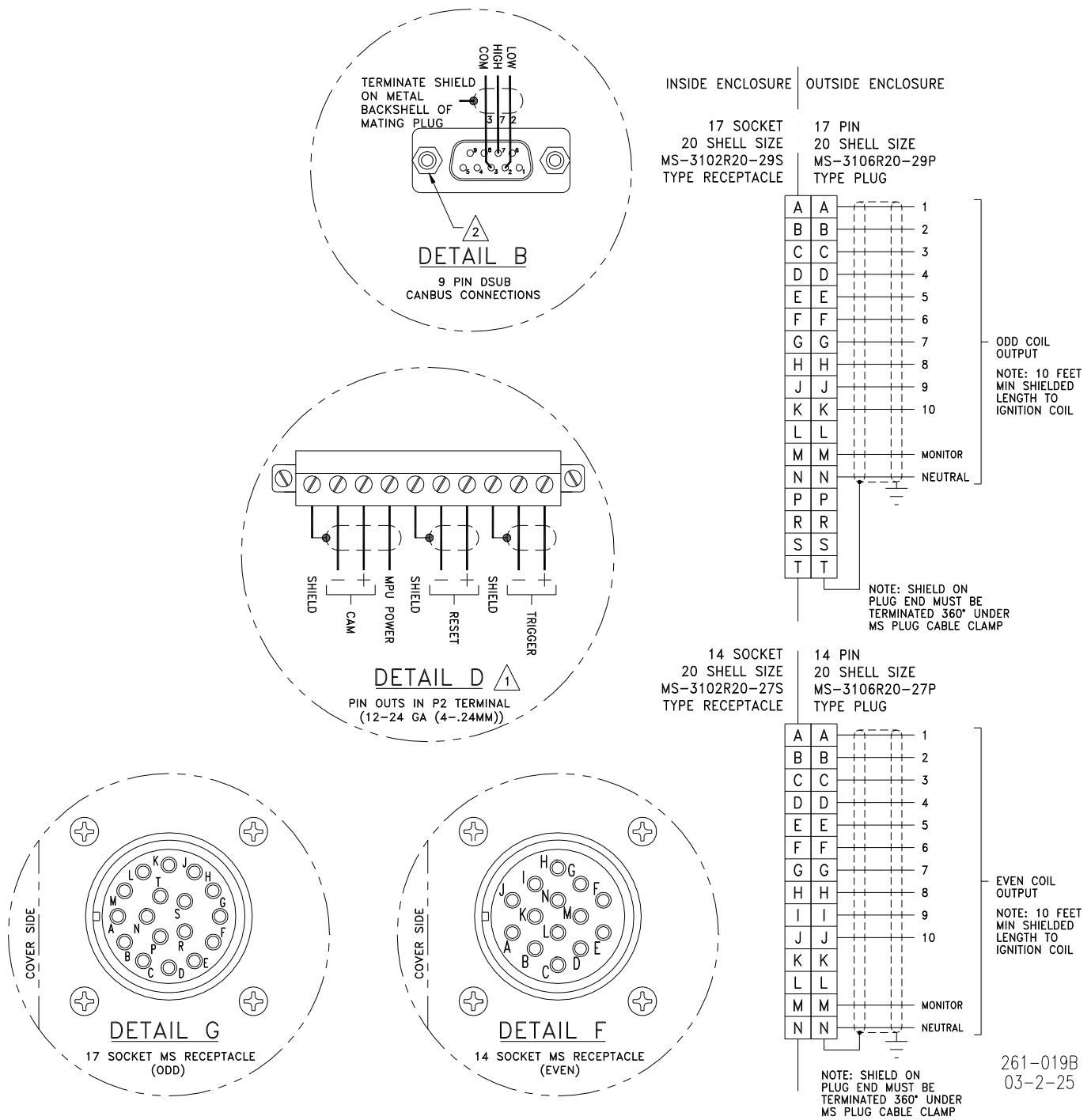


Figure 1-6b. Overall Plant Wiring Diagram

Chapter 2.

Timing Sensors (MPUs)

Introduction

The 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 TIS-910. An erroneous signal will cause the 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 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 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 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 CAN bus 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 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 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 maximum advance and maximum amount retarded that is programmed. 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 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 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. The 0–5 Volt input may be viewed by pressing the number 5 on the keyboard or keypad. To switch back to the 4–20 reading on the display, press the number 4.

Speed Curve

The 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 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 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.

To enter the cylinder-to-cylinder timing screen, press “C” from the main screen.
On the TIS-910, the Password screen should appear:

Password Screen

The Password is Hours
+10. If the hours are not
known, press ESC to exit
the password screen,

```
ENTER PASSWORD FOR
PROGRAM MENU:
THEN ESC OR
ENTER WHEN DONE
```

then ‘H’ from the main screen for the hour screen.

```
CYL #: 1      0.00 ADV (RET)
F1: CHANGE  F2: NEXT
F3: PREVIOUS F5: SAVE
```

Cylinder-to-Cylinder Screen

Cylinder-to-Cylinder Timing Procedure—From the cylinder-to-cylinder screen, press F2 until the cylinder that is going to be changed is displayed (remember it is the firing order, NOT the actual cylinder number). Then press F1. Enter the new timing point, press ENTER, then F1 to advance or F2 to retard the cylinder timing. Press F5 to save the desired value when done. Repeat the above process until all the cylinders that need to be changed are done.

The keys ‘C’, ‘E’, ‘H’, ‘S’, ‘M’ are toggles for their screens. Pressing the key once displays the screen, pressing the key while its screen is active exits to the main screen. The ESC key can be used to exit a screen if the CAN communication is off.

IMPORTANT

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

Chapter 4.

High Voltage Supply and Primary Outputs

High Voltage Power Supply

The TIS-910 has two high voltage power supplies that are capable of 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 100 V (10%) to 300 V (100%). 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 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 a substantial amount of energy with new spark plugs. Lean burn engines without pre-combustion chambers need more spark energy to ensure proper ignition of the fuel-air mixture. Because of the unique set of circumstances for each engine configuration, the TIS-910 provides two means to adjust the energy: manual energy control and AUTO_E™ auto energy control.

Manual Energy Control

Using the TIS-910 monitor program (see programming), the energy for both the odd bank and even bank can adjusted. From the main screen press "E".

IMPORTANT

This can be done with the engine running!

To enter the energy adjustment screen, press "E" from the main screen. On the TIS-910, the Password screen should appear:

Password Screen

```
ENTER PASSWORD FOR
PROGRAM MENU:
THEN ESC OR
ENTER WHEN DONE
```

The Password is Hours +10. If the hours are not known, press ESC to exit the password screen, then 'H' from the main screen

for the hour screen. 'E' can be pressed from the Hour screen or main screen.

Enter the Password and the following screen should appear:
Program Even Energy Screen

```
EVEN ENERGY: XX%
F1: CHANGE      F2: NEXT
F3: PREVIOUS    F5: SAVE
S.D. AVERAGE XXXX
```

Programming Sequence:

1. Press F1 to change Even energy level.
2. Enter desired Even energy level, then press ENTER. Valid Range: 10-100
3. Press F5 to save.
4. Press F2 to program next parameter.

Program Odd Energy Screen

ODD ENERGY: XX%	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F5: SAVE
S.D. AVERAGE XXXX	

Programming Sequence:

1. Press F1 to change Odd energy level.
2. Enter desired Odd energy level, then press ENTER. Valid Range: 10-100
3. Press F5 to save.
4. Press F2 to program next parameter.

For manual energy adjustment, make sure the Auto Energy is DISABLED on this screen. If it is not, disable it and recheck the Odd and Even energy levels on the previous menus.

Program AUTO_E Enable Screen

AUTO ENERGY ENABLED (disabled)	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F5: SAVE

Programming Sequence:

1. Press F1 to change the enabled/disabled status.
2. Press F2 to disable, F1 to enable the AUTO_E feature.
3. Press F5 to save.

The keys 'C', 'E', 'H', 'S', 'M' are toggles for their screens. Pressing the key once displays screen, pressing the key while its screen is active exits to the main screen. The ESC key can be used to exit a screen if CAN communication is off.

The normal procedure for determining the amount of energy needed is:

1. Program TIS-910 for 100% energy.
2. Start engine and apply 100% load.
3. SLOWLY reduce the amount of energy on one of the banks (odd or even) until slight misfires are detected.
4. Increase energy setting 25–50% higher than displayed value. (Be sure to program both the odd and even banks.)

AUTO_E™ Auto Energy Control

The AUTO_E (patent pending) feature of the TIS-910 allows the energy level to be automatically adjusted based on the spark plug voltage. This feature can be enabled or disabled while the engine is running. The screen that enables/disables the feature can be accessed after Pressing "E" from the main screen and then pressing F2 twice.

Program AUTO_E Enable Screen

AUTO ENERGY ENABLED (disabled)	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F5: SAVE

Programming Sequence:

4. Press F1 to change enabled/disabled status.
5. Press F1 to enable, F2 to disable the AUTO_E feature.
6. Press F5 to save.
7. Press F2 to program set point.

Program Energy Setpoint Screen

ENERGY SETPOINT: XXXX	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F5: SAVE

Programming Sequence:

1. Press F1 change Energy set point.
2. Enter desired Energy set point, then press ENTER (see Set-up procedure).
Valid Range: 0-5000.
Working range is around 100 for a very low energy level and 800-1000 will essentially use 100% energy.
3. Press F5 to save.
4. Press F2 to program next parameter.

For optimum operation, the correct Coil type must be selected in the program menu. This needs to be done at 0 rpm. See the appendix to match the coil type number to the coil being used. The descriptions of the offset viewing/adjustment on the next page is intended for users who can measure the duration for each cylinder and want to fine tune the Auto_E. It is not necessary for the proper operation of the Auto_E.

To help balance either the duration or energy level between cylinders in Auto_E, it may be necessary to add or subtract an offset to any particular cylinder. To adjust the offsets, the following two screens are used.

View Offsets Screen

VIEW OFFSETS OFF (ON)	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F5: SAVE

Programming Sequence:

1. Press F1 to change the view off/on status.
2. Press F2 to not view the offsets, (OFF), F1 to view the offsets (ON).
3. Press F5 to save.
4. Press F2 to program next parameter.

CYL #: 1 + 0 F1: CHANGE F2: NEXT F3: PREVIOUS F5: SAVE S.D. VALUE 500
--

Cylinder Offset Screen

Programming Sequence:

1. Press F1 to change the offset.
2. Enter desired offset. Valid Range: 0-25.
3. Press F2 for negative offset, F1 for positive offset.
4. The offset either adds or subtracts from the S.D. VALUE. A maximum of 25 is allowed to be added or subtracted at a time. If the offset is at +25, it is possible to set the offset to 50 by adding 25.
5. Press F5 to save.
6. Press F2 to program or view the next offset.

A negative offset will increase the duration/energy level for a particular cylinder, and a positive offset will decrease the duration/energy level. The "S.D. VALUE" shows a value that is representative of the length of the duration that the software uses to determine whether to increase or decrease the energy to a cylinder. With this feature it is possible to overcome some variations in the feedback from the cylinders. It should only be used if it is possible to measure the actual durations.

AUTO_E Setup Procedure (to be used with new gapped spark plugs)

1. Disable the AUTO_E feature and set odd/even manual energy to 100%.
2. Start and load the engine (100%).
3. SLOWLY reduce the amount of energy on one of the banks (odd or even) until slight misfires are detected.
4. Increase energy by an additional 20%.
This has established the minimum energy required to fire the new spark plugs.
5. Optional: To compensate for differences in each cylinder's feedback path, it is possible to set an offset for cylinders that may be more or less sensitive.

Set View Offsets to VIEW OFFSETS ON. Then add/subtract to any cylinders that deviate from the average. Before making any adjustments, it is best to view each offset and see how they trend toward the "S.D. AVERAGE" for the even and odd cylinder banks. Then start with any cylinders that are noticeably higher/lower than the average and adjust them.

6. Record the displayed "S.D. AVERAGE" for both the even and odd screens (this will be used later).
7. Reset energy level to 100%. **This is important, see note below.**
8. Press "F2" until the Energy Setpoint Screen is displayed.
9. Multiply the "S.D. AVERAGE" by 1.5 and enter that value as the Energy Setpoint (**remember F5 to save!**).
10. Press "F3" for the AUTO_E Disabled Screen.
11. Enable AUTO_E (Press F1 twice and remember F5 to save).

12. Press "F3" to look at the Odd bank "S.D. AVERAGE." Compare this value to that in step 6. Also look at the Even bank "S.D. AVERAGE" and compare that number to the value in step 6. It should be higher. Press "F2" until the "ENERGY SETPOINT:" is displayed. Decrease this number in steps of 25 or 50 until the odd/even "S.D. AVERAGE" is equal or a little higher than the values in step 6. Press F5 at the "ENERGY SETPOINT" screen to save the value.
13. Recheck all the screens and make sure the odd/even energy levels are at 100%.
14. The Energy screens are exited by pressing an 'E' (or if the CAN Bus is not used, ESC works also).

The TIS-910 is now configured for AUTO_E control. If properly programmed, the 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 TIS-910 should automatically reduce the energy to the cylinders. As the spark plugs erode, the energy should automatically increase.

IMPORTANT

Important information: When Auto Energy is enabled, the maximum energy allowed is the percent programmed for the odd and even banks. If the odd and even energy are set to 50% and the Auto Energy is enabled, the energy will never be greater than 50%.

Chapter 6.

Engine Controls and Safety Features

Introduction

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

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.

Permissive Start Output

Integral to the 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).

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 TIS-910.

Auxiliary Shutdown Input

The 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 TIS-910 is primary misfire detection and monitor circuitry. The TIS-910 will measure and display the misfires per second. To see the measured value, press "M" or "H". The TIS-910 will also shut down the ignition if the user-specified misfire limit is exceeded (see Chapter 7). See Chapter 10, Primary Misfire Detection for an illustration of the Display.

Timing Sensor Fault Detection

The TIS-910 constantly scans the timing inputs for a fault. If a fault is detected, the ignition will shut down. The TIS-910 will then send the fault information on the RS-232 and CAN bus serial links. See Chapter 10 for error screens/messages.

Speed Switches

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

If the trip point is set with a positive value (0 to 5000), the contact pin will be connected to ground below the trip speed. The connection to ground will open when the rpm equals or exceeds the trip point. If the trip point is set with a negative value (-1 to -5000), the contact will **not** be connected to ground below the trip speed and close when the rpm equals or exceeds trip point. The Trip1/2 status LEDs reflect this operation. At 0 rpm, they are both on (closed circuit) if a positive trip speed is programmed. They are both off (open circuit) if a negative trip rpm is programmed.

**WARNING**

Do NOT use 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

Required Equipment

In order to program the TIS-910, the following items are needed:

- 12/24 Vdc supply
- RS-232 null-modem cable
- PC / Laptop or hand held terminal
- TIS-910 monitor program (free, contact your local distributor or factory)

NOTICE

The TIS-910 must be programmed prior to any attempt to start the engine. It is important and critical that all parameters be set correctly for the engine application.

The Appendix contains a Programming Flowchart and a Configuration Form which should be filled out and kept in a secure place for future reference.

Definitions and Programming Parameters

- **Number of Cylinders**—Actual number of cylinders, or in some applications where there are two spark plugs with an offset, the number of spark plugs used. Must be correct for the sequence number programmed.
- **Number of Teeth**—Number of teeth in the ring gear or holes in the flywheel that the trigger MPU senses per one revolution of the engine.
- **Sequence Number**—A number that is related to the firing interval of the engine. Use the engine specifications and the Timing Sequence tables in the Appendix to determine the correct sequence number. Must be correct for the number of cylinders programmed.
- **Reset Position**—The location of the reset MPU relative to TDC of cylinder 1.
- **Overspeed**—The rpm at which the ignition should shut down if exceeded.
- **Security Speed**—The speed that controls the operation of Contact A. Contact A enables or disables the primary outputs. The Security Speed determines whether the engine speed must go to zero after Contact A is closed (to ground), or if the primary outputs can be enabled during cranking. If the speed goes above the security speed with Contact A closed, it is necessary to wait for 0 rpm before the primary outputs will be enabled. If the speed stays below the security speed, and Contact A goes from closed to open, the primary outputs will be enabled and the ignition will start firing.
- **Start RPM**—The Start Energy is active if the rpm is lower than or equal to the Start RPM.
- **Start Energy**—The energy used if the rpm is lower than or equal to the Start RPM.
- **Coil Type**—Selects an optimized curve for the Auto Energy feature. See table for numbers corresponding to coil types.
- **Misfire Rate**—The number of misses per second that is permissible before the engine shuts down due to misfire rate exceeded. To disable, set misfire rate to zero.
- **CAN_ID**—Used only for CAN communication.
- **Trip 1,2**—Speed at which the Trip output is activated. Can be set to active on or active off.

- **Hysteresis 1,2**—Amount of rpm needed below the Trip RPM until the Trip output is deactivated.
- **CAN (Enable/Disable)**—Used to enable/disable CAN communications. Should be disabled if CAN communication is not used. Also determines read only or read/write for CAN Bus. If CAN is disabled, CAN communication is read only. If this is enabled, CAN is read/write mode.
- **CYL TO CYL (Enable/Disable)**—Used to enable/disable Cylinder to Cylinder timing. Must be set to enable for Cylinder to Cylinder menu to change the timing values.
- **Schedule B (Enable/Disable)**—Second timing schedule, activated with external contact (switch) to ground. This feature can be enabled or disabled during programming.
- **Speed Curve in A (Enable/Disable)**—Include/exclude the speed curve as part of Schedule A timing scheme.
- **4-20 mA Timing In A (Enable/Disable)**—Include/exclude 4–20 mA signal as part of Schedule A timing scheme.
- **0-5 Volt Timing In A (Enable/Disable)**—Include/exclude 0-5 Volt signal as part of Schedule A timing scheme.
- **Speed Curve In B (Enable/Disable)**—Include/exclude speed curve as part of Schedule B timing scheme.
- **4-20 mA Timing In B (Enable/Disable)**—Include/exclude 4–20 mA signal as part of Schedule B timing scheme.
- **0-5 Volt Timing In B (Enable/Disable)**—Include/exclude 0-5 Volt signal as part of Schedule B timing scheme.
- **Slow Speed (Enable/Disable)**—For use with a combination of <200 teeth and cranking speeds < 30 rpm. This feature is automatically disabled for >200 teeth because the cranking speed is < 30 rpm.
- **POT A CCW**—Timing relative to TDC, of Pot A when fully CCW.
- **POT A CW**—Timing relative to TDC, of Pot A when fully CW.
- **Schedule A Max. Advance**—The maximum allowable advance, independent of any timing variable (Pot A, 4–20 mA and Speed Curve).
- **Schedule A Max. Retard**—The maximum allowable retard, independent of any timing variable (Pot A, 4–20 mA and Speed Curve).
- **POT B CCW**—Timing relative to TDC, of Pot B when fully CCW.
- **POT B CW**—Timing relative to TDC, of Pot B when fully CW.
- **Schedule B Max. Advance**—The maximum allowable advance, independent of any timing variable (Pot A, 4–20 mA and Speed Curve).
- **Schedule B Max. Retard**—The maximum allowable retard, independent of any timing variable (Pot B, 4–20 mA and Speed Curve).
- **4–20mA Timing at 4mA**—Desired timing response to a 4 mA signal relative to the timing established by Pot A (Pot B).
- **4–20mA Timing at 20mA**—Desired timing response to a 20 mA signal relative to the timing established by Pot A (Pot B).
- **Dflt 4-20mA Timing**—Desired timing response if loss of signal is detected.
- **0-5 Volt Timing at 0 Volts**—Desired timing response to a 0 Volt signal relative to the timing established by Pot A (Pot B).
- **0-5 Volt Timing at 5 Volts**—Desired timing response to a 5 Volt signal relative to the timing established by Pot A (Pot B).
- **Speed Curve-Number of Breakpoints**—The number of line segments that make up the timing response to engine speed. Range: 1–5.
- **Breakpoint “n” RPM**—Engine speed of “n” breakpoint; “n”=1 to 5.
- **Breakpoint “n” Timing**—Desired timing at breakpoint “n” relative to the timing established by Pot A (Pot B).

All of the menus in the programming section have help menus which can be accessed by pressing "F4." The help screens are very brief descriptions of the definitions above. The Sequence Number help screen has a feature that allows the angles for the sequences to be displayed. The keys 'U' or 'D' can be used to go Up or Down in the sequence table and display the firing angles. If there are too many angles to be displayed on the screen, the last ones are cut off. Refer to the sequence table for the angles not shown.

Configuration Programming Procedure

IMPORTANT

All the menus/screens 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.

Connect your PC to the TIS-910 via the RS-232 cable.

NOTICE

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

Connect your +12/24 Vdc supply to the TIS-910. Refer to Figure 1-3. If your PC is wired correctly to the TIS-910, the following screen should appear:

Main Screen

```
RPM: 0          4-20: 0.0
SPARK: XX.XX ADV (ret)
ENERGY XX%OD   XX%EV
STATUS: READY
```

In order to enter the programming mode; press "H" on your keyboard. The following screen should appear:

"H" Screen

```
HOURS: hh.mm.ss
CHECKSUM: XX.XX
SOFTWARE REV. XX.X
MISSES/SEC: XXXX
```

The password is the whole number of hours plus 10 (hours +10). Hit the ESC key to exit the H Screen, then ESC (once from the main screen) to enter the Password screen:

Password Screen

```
ENTER PASSWORD FOR
PROGRAM MENU:
THEN ESC OR
ENTER WHEN DONE
```


Enter the password. If the password is accepted the following screen will appear:
Program Number of Cylinders Screen

```
# CYLINDERS: _____
F1: CHANGE      F2: NEXT
F3: PREVIOUS    F4: HELP
F5: SAVE
```

Programming Sequence:

1. Press F1 to change number of cylinders.
2. Enter number of cylinders (1-20), then press ENTER.
3. Press F5 to save.
4. Press F2 to program next parameter.

Program Number of Teeth Screen

```
# TEETH: _____
F1: CHANGE      F2: NEXT
F3: PREVIOUS    F4: HELP
F5: SAVE
```

Programming Sequence:

1. Press F1 to change number of teeth.
2. Enter number of teeth (60–500), then press ENTER.
3. Press F5 to save.
4. Press F2 to program next parameter.



WARNING

Always refer to the engine specification and the Timing Sequence tables in the Appendix before entering data. Failure to enter proper sequence number could cause personal injury or equipment damage.

Program Sequence Number Screen

```
SEQUENCE #: _____
F1: CHANGE      F2: NEXT
F3: PREVIOUS    F4: HELP
F5: SAVE
```

The help menu can be used to display the angles for each sequence number. Press "F4" for the help menu. Then the keys 'U' or 'D' can be used to go Up or Down in the sequence table and display the firing angles for each sequence.

Programming Sequence:

1. Press F1 to change sequence number.
2. Enter sequence number (1–168), then press ENTER.
3. Press F5 to save.
4. Press F2 to program next parameter.

Program Reset Position Screen

BTDC _____	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to change reset MPU position.
2. Enter reset position (10° to 120° Advance), then press ENTER.
3. Press F5 to save.
4. Press F2 to program next parameter.

* **NOTE**—Minimum reset position is 10 degrees + most advanced timing of the engine. It may be necessary to set the “MAX ADV A” to a smaller number and then return to this screen and set the reset position to the correct value.

Program Overspeed Trip Point Screen

OVERSPEED: _____	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to change overspeed trip point.
2. Enter overspeed trip point, then press ENTER.
3. Press F5 to save.
4. Press F2 to program next parameter.

Range: Must be \geq security speed and \leq 5000

Program Security Speed Screen

SECURITY SPEED: _____	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to change security speed.
2. Enter security speed, then press ENTER.
3. Press F5 to save.
4. Press F2 to program next parameter.

Range: Must be \leq overspeed

Program Start RPM Screen

START RPM: _____	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to change the rpm when the start energy will deactivate.
2. Enter the rpm, then press ENTER.
3. Press F5 to save.
4. Press F2 to program next parameter.

Range: 0 – 200 rpm

Program Start Energy Screen

START ENERGY: _____%	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to change the start energy.
2. Enter start energy %, then press ENTER.
3. Press F5 to save.

Range: 10 – 100%

Program Coil Type Screen

COIL TYPE: _____	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to change the coil type.
2. Enter coil type number, then press ENTER.
3. Press F5 to save.

Range: 0 – 7 (Range may increase as new coil types are added)

Program Misfire Rate Screen

MISFIRE RATE: _____	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to change misfire rate trip point.
2. Enter misfire rate trip point, then press ENTER.
3. Press F5 to save.
4. Press F2 to program next parameter.

Range: 0 – 255

Program CAN_ID Screen

CAN ID # 2	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to change CAN_ID address.
2. Enter CAN_ID address, then press ENTER.
3. Press F5 to save.
4. Press F2 to program next parameter.

Range 1 – 31

IMPORTANT

For Trip and Hysteresis screens see Speed Switches information in Chapter 6.

Program Speed Trigger 1 Screen

TRIP 1: _____	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to change speed trigger 1 trip point.
2. Enter speed trigger 1 rpm, then press ENTER.
3. Press F1 for +Closed Circuit or F2 for – Open Circuit.
 Closed Circuit means the Contact is Closed if the rpm is below the speed point
 Open Circuit means the Contact is Open if the rpm is below the speed point
4. Press F5 to save.
5. Press F2 to program next parameter.
 Range 0 – 5000

Program Hysteresis 1 Screen

HYSTERESIS 1: _____	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to change speed trigger hysteresis 1 trip point.
2. Enter hysteresis 1 rpm, then press ENTER.
3. Press F5 to save.
4. Press F2 to program next parameter.
 Range 0 – 5000

Program Speed Trigger 2 Screen

TRIP 2: _____	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to change speed trigger 2 trip point.
2. Enter speed trigger 2 rpm, then press ENTER.
3. Press F1 for +Closed Circuit or F2 for – Open Circuit.
 Closed Circuit means the Contact is Closed if the rpm is below the speed point
 Open Circuit means the Contact is Open if the rpm is below the speed point
4. Press F5 to save.
5. Press F2 to program next parameter
 Range 0 – 5000

Program Hysteresis 2 Screen

HYSTERESIS 2: _____	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to change speed trigger hysteresis 2 trip point.
2. Enter hysteresis 2 rpm, then press ENTER.
3. Press F5 to save.
4. Press F2 to program next parameter.

Range 0 – 5000

Program CAN Enable Screen

CAN BUS DISABLED (enabled)	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to change, then
 2. Press F1 to Enable CAN Communication
- OR
2. Press F2 to Disable CAN Communication.
 3. Press F5 to save.
 4. Press F2 to program next parameter.

Program Cylinder to Cylinder Timing Screen

CYL TO CYL DISABLED (enable)	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to change enabled/disabled status, then
 2. Press F1 to Enable the Cylinder to Cylinder timing adjustments
- OR
2. Press F2 to Disable the Cylinder to Cylinder timing adjustments.
 3. Press F5 to save.
 4. Press F2 to program next parameter.

Program Schedule B Enable Screen

SCHEDULE A: ENABLE (disable)	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to change, then
 2. Press F1 to Enable Schedule A only.
- OR
2. Press F2 to Enable Schedule B based on contact B connection.
 3. Press F5 to save.
 4. Press F2 to program next parameter.

Program Speed Curve in Schedule A Screen

SPEED (not) IN A	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to change, then
 2. Press F1 Enable Speed curve in schedule A
- OR
2. Press F2 to Disable Speed Curve in Schedule A.
 3. Press F5 to save.
 4. Press F2 to program next parameter.

Program 4–20 mA Control in Schedule A Screen

4-20 (not) IN A	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to change, then
 2. Press F1 to enable 4–20 mA control in Schedule A
- OR
2. Press F2 to disable 4–20 mA control in Schedule A.
 3. Press F5 to save.
 4. Press F2 to program next parameter.

Program Speed Curve in Schedule B Screen

SPEED (not) IN B	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence (Schedule B Programming screens appear only if Schedule B is enabled):

1. Press F1 to change, then
 2. Press F1 to enable speed curve in Schedule B
- OR
2. Press F2 to disable speed curve in Schedule B.
 3. Press F5 to save.
 4. Press F2 to program next parameter.

Program 4–20 mA Control in Schedule B Screen

4-20 (not) IN B	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence: (Schedule B Programming screens only appear if Schedule B is enabled):

1. Press F1 to change, then
 2. Press F1 enable 4–20 mA control in Schedule B
- OR
2. Press F2 to disable 4–20 mA control in Schedule B.
 3. Press F5 to save.
 4. Press F2 to program next parameter.

Program Slow Speed Start Screen

SLOW SPEED DISABLED (enable)	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to change enabled/disabled status, then
 2. Press F1 to Enable the slow speed start operation: <200 teeth and <30 rpm cranking speed. **Automatically disabled if > 199 teeth.**
- OR
2. Press F2 to Disable the slow speed start.
 3. Press F5 to save.
 4. Press F2 to program next parameter.

Program 0–5 Volt Control in Schedule A Screen

0-5V (not) IN A	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to change, then
 2. Press F1 to enable 0–5 Volt control in Schedule A
- OR
2. Press F2 to disable 0–5 Volt control in Schedule A.
 3. Press F5 to save.
 4. Press F2 to program next parameter.

Program 0–5 Volt Control in Schedule B Screen

0-5V (not) IN B	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to change, then
 2. Press F1 to enable 0–5 Volt control in Schedule B
- OR
2. Press F2 to disable 0–5 Volt control in Schedule B.
 3. Press F5 to save.
 4. Press F2 to program next parameter.

Program Pot A CCW Screen

A CCW: _____	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to program the desired timing when Pot A is fully CCW.
2. Enter desired timing, then press ENTER.
3. Then press F1 Advance (BTDC) or F2 Retard (ATDC).
4. Press F5 to save.
5. Press F2 to program next parameter.

Range: 60.00° Ret to 60.00° Adv

Program Pot A CW Screen

A CW: _____	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to program the desired timing when Pot A is fully CW.
2. Enter desired timing then press ENTER.
3. Then press F1 Advance (BTDC) or F2 Retard (ATDC).
4. Press F5 to save.
5. Press F2 to program next parameter.

Range: 60.00° Ret to 60.00° Adv

Program Max. Advance for Schedule A Screen

MAX ADV A: _____ ADV (ret)	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

NOTICE

The MAX ADV and MAX RET need to be set for safe operation for the fuel type being used. This applies to both Schedules A and B.

Programming Sequence:

1. Press F1 to program the maximum to allow advance timing for Schedule A.
2. Enter desired timing, then press ENTER.
3. Then Press F1 Advance (BTDC) or F2 Retard (ATDC).
4. Press F5 to save.
5. Press F2 to program next parameter.

NOTE—Most advanced timing is (BTDC) -10.00° maximum span is 60.00° : ADV A – Ret A $\leq 60.00^\circ$

Program Max. Retard Schedule A Screen

MAX RET A: _____ ADV (ret)	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to program the maximum to allow retarded timing for schedule A.
2. Enter desired timing, then press ENTER.
3. Then Press F1 Advance (BTDC) or F2 Retard (ATDC).
4. Press F5 to save.
5. Press F2 to program next parameter.

Maximum span is 60.00° : ADV A – Ret A $\leq 60.00^\circ$

IMPORTANT

If Schedule B is not active, programming screens related to Schedule B are automatically skipped. See the Appendix for more information.

Program Pot B CCW Screen

B CCW: _____ ADV (ret)	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to program the desired timing when Pot B is fully CCW.
2. Enter desired timing, then press ENTER.
3. Then Press F1 Advance (BTDC) or F2 Retard (ATDC).
4. Press F5 to save.
5. Press F2 to program next parameter.

Range: 60.00° Ret to 60.00° Adv

Program Pot B CW Screen

B CW: _____	ADV (ret)
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to program the desired timing when Pot B is fully CW.
2. Enter desired timing, then press ENTER.
3. Then Press F1 Advance (BTDC) or F2 Retard (ATDC).
4. Press F5 to save.
5. Press F2 to program next parameter.

Range: 60.00° Ret to 60.00° Adv

Program Max. Advance for Schedule B Screen

MAX ADV B: _____	ADV (ret)
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

NOTICE

The MAX ADV and MAX RET need to be set for safe operation for the fuel type being used. This applies to both Schedules A and B.

Programming Sequence:

1. Press F1 to program the maximum to allow advance timing for Schedule B.
2. Enter desired timing, then press ENTER.
3. Then Press F1 Advance (BTDC) or F2 Retard (ATDC).
4. Press F5 to save.
5. Press F2 to program next parameter.

NOTE—Most advanced timing is (BTDC) -10.00° Maximum span is 60.00° : ADV
 B – Ret B $\leq 60.00^\circ$

Program Max. Retard Schedule B Screen

MAX RET B: _____	ADV (ret)
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to program the maximum to allow retarded timing for Schedule B.
2. Enter desired timing, then press ENTER.
3. Then Press F1 Advance (BTDC) or F2 Retard (ATDC).
4. Press F5 to save.
5. Press F2 to program next parameter.

Maximum span is 60.00° : ADV B – Ret B $\leq 60.00^\circ$

IMPORTANT

If 0–5 Volt control is disabled, then screens related to 0–5 Volt control are skipped.

If 4–20 mA control is disabled, then screens related to 4–20 mA control are skipped.

See the Appendix for more information.

Program Timing at 0 Volts Screen

0V TIMING: _____ADV (ret)	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to change the desired timing response at 0 Volts.
2. Enter the desired timing, then press ENTER.
3. Then Press F1 Advance (BTDC) or F2 Retard (ATDC).
4. Press F5 to save.
5. Press F2 to program next parameter.

Range: 60.00° Ret to 60.00° Adv. Max span: 0 – 5 V = 60.00°

Program Timing at 5 Volts Screen

5V TIMING: _____ADV (ret)	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to change the desired timing response at 5 Volts.
2. Enter desired timing, then press ENTER.
3. Then Press F1 Advance (BTDC) or F2 Retard (ATDC).
4. Press F5 to save.
5. Press F2 to program next parameter.

Range: 60.00° Ret to 60.00° Adv. maximum span: 0 – 5 V = 60.00°

IMPORTANT

If 4–20 mA control is disabled, then screens related to 4–20 mA control are skipped.

See the Appendix for more information.

Program Timing at 4 mA Screen

4mA TIMING: _____ADV (ret)	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to change desired timing response at 4mA.
2. Enter desired timing, then press ENTER.
3. Then Press F1 Advance (BTDC) or F2 Retard (ATDC).
4. Press F5 to save.
5. Press F2 to program next parameter.

Range: 60.00° Ret to 60.00° Adv. maximum span: 4 mA–20 mA = 60.00°

Program Timing at 20 mA Screen

20mA TIMING: _____ ADV (ret)	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to change the desired timing response at 20 mA.
2. Enter desired timing, then press ENTER.
3. Then Press F1 Advance (BTDC) or F2 Retard (ATDC).
4. Press F5 to save.
5. Press F2 to program next parameter.

Range: 60.00° Ret to 60.00° Adv. Max span: 4 mA–20 mA = 60.00°

Program Default 4–20 mA Timing Screen

DFLT 4-20: _____ ADV (ret)	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to change the desired timing response at loss of 4–20 mA signal.
2. Enter desired timing, then press ENTER.
3. Then Press F1 Advance (BTDC) or F2 Retard (ATDC).
4. Press F5 to save.
5. Press F2 to program next parameter.

Range: 60.00° Ret to 60.00° Adv

NOTICE

It is important that if “n” speed points are programmed, all “n” timing/speed points must be entered and saved.

IMPORTANT

If the speed curve is not enabled, the “# SPEED POINTS” and speed point setting screens will not be displayed. Only the screens for the number of speed points will be displayed. If the “# SPEED POINTS” is set to 1, only the 1st speed point will be displayed.

See the Appendix for more information.

Program Number of Speed Curve Breakpoints Screen

# SPEED POINTS: _____	
F1: CHANGE	F2: NEXT
F3: PREVIOUS	F4: HELP
F5: SAVE	

Programming Sequence:

1. Press F1 to change the desired number of speed curve breakpoints.
2. Enter number of breakpoints, then press ENTER. Range 0-5.
3. Press F5 to save.
4. Press F2 to program next parameter.

Program Breakpoint RPM Screen

BPn: _____ ADV (ret), _____
F1: CHANGE F2: NEXT
F3: PREVIOUS F4: HELP
F5: SAVE

Programming Sequence:

1. Press F1 program to change speed curve at point n.
2. Enter new engine speed (rpm), press enter, then
3. Enter desired timing at programmed engine speed, and press enter.
4. Then press F1 Advance (BTDC) or F2 Retard (ATDC).
5. Press F5 to save.
6. Press F2 to program next parameter.

NOTE—Speed point 1 rpm ≤ speed point 2 rpm ≤ speed point 3 etc.

Chapter 8.

Start-up Procedure

I. Before applying power to the 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 TIS-910 (fuel valve still in the off position):

1. Check and verify that the 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 TIS-910 monitor program or hand held terminal is required).
5. If the TIS-910 is measuring too high, the reset position needs to be reduced by the difference.

Example:

If the 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 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 sequence number 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 TIS-910 Configuration Form (in the Appendix) for future reference in a secure location.

Chapter 9.

CAN Bus Information

CAN Bus Interface with the D-1 Display

There are two modes for the CAN Bus: read only and read/write. The write mode is enabled with the RS-232 programming mode "CAN BUS ENABLED". If the TIS-910 is set to CAN BUS ENABLED, it will be possible to read and write values on the CAN Bus. If the TIS-910 is set to CAN BUS DISABLED, it will only be possible to read the values on the CAN Bus. The exception to this is the "energy level", "global timing point", and "spark duration." If the CAN Bus is enabled, writing of all engine parameters is allowed. With both modes, once the CAN Bus has active communication, the ESC key on the RS-232 does not work. This is to prevent conflicts with the CAN Bus writing configuration parameters and values written with the RS-232 port. This is important to remember if using the D-1 display to monitor the cylinder energy because you cannot exit the cylinder-to-cylinder adjustment or the energy screen using the ESC key.

Read/Write Mode

If the TIS-910 is set to "CAN BUS ENABLED," the CAN Bus 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 sequence number, 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 CAN Bus 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 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 TIS-910. This does not set the number of cylinders in the TIS-910, it just sets up the D-1 display so the number of cylinders match the number programmed in the TIS-910.

IMPORTANT

The D-1 display has fewer parameters than the programming menus with the RS-232 display. Since it is necessary to make sure the CAN bus is enabled or disabled with the RS-232 display, it is best to make sure all the parameters are set up with the RS-232 display initially.

CAN Bus Cable

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

Chapter 10.

Troubleshooting

Sensor Input Faults

- **TRIGGER MPU**—The TIS-910 measured the number of teeth/events between two successive reset MPU signals. If the 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 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.

The following error screen will appear while valid MPU signals are active. At 0 rpm it will not be displayed.

```
+-- IC900 Terminal --+
|PROGRAMMED # OF GEAR|
| TEETH IS INCORRECT |
|WAIT FOR 0 RPM,     |
|THEN RE-PROGRAM    |
+-----+

```

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 following screen is displayed after the ring gear pickup error occurs. The power must be cycled to clear this error.

```
+-- IC900 Terminal --+
|      0: GEAR COUNT  |
|RING GEAR MPU ERROR |
|                     |
+-----+

```

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 TIS-910 measured the number of events between two successive reset cam signals. If the TIS-910 detects that the number of events does not match the expected number of events, an error will be detected.

The following screen is displayed after the reset error occurs. The power must be cycled to clear this error.

```
+-- IC900 Terminal  --+
|                       |
|  RESET MPU ERROR     |
|  RESET MPU ERROR     |
|                       |
+-----+-----+

```

- **CAM MPU (4 cycle only)**—The TIS-910 measured the number of events between three successive reset MPU signals. If the TIS-910 detects that the number of events does not match the expected number of events, an error will be detected.

The following screen is displayed after the reset error occurs. The power must be cycled to clear this error.

```
+-- IC900 Terminal  --+
|                       |
|  CAM MPU ERROR       |
|  CAM MPU ERROR       |
|                       |
+-----+-----+

```

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 following 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. If “F5” was not pressed after changing one of these, that could be the problem. If “F5” was pushed and the error still occurs, recheck the sequence table and number of cylinders. Pressing “F4” in the Sequence number screen will display the firing angles for the sequence.

```

+-- IC900 Terminal --+
|#CYL WRONG FOR SEQ |
|ERROR:              |
|PRESS F1            |
|OR ESC TO CHANGE   |
+-----+

```

The following screen is a result of the “MAX ADV B” parameter greater than “RESET BTDC” –10.00. Pressing “F1” here will bring the display to the “MAX ADV B” screen so this parameter can be changed.

```

+-- IC900 Terminal --+
|ADV/RET/RESET TIMING|
|IN SCHED B ERROR:  |
|PRESS F1            |
|OR ESC TO CHANGE   |
+-----+

```

Ignition Coil Faults

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

- Primary Misfire Detection
- Self-Test Feature

Primary Misfire Detection

The TIS-910 continuously monitors the primary discharge of the energy storage capacitor. The status screen to monitor the misfire detection is obtained by pressing “M” from the main screen.

Misfire Monitor Screen

ABCDEFGHIJKLM	MISS/
111101111111	SEC =
ABCDEFGHIJKLM	0
11111101111	UNDER

Line 2 of the display shows the odd cylinder bank, and line 4 shows the even cylinder bank. A “0” indicates that a misfire is being detected on the cylinder as indicated by the letter. A “1” indicated that a misfire has not been detected.

If a “0” appears, inspect the wiring to and the coil of the specified cylinder. Verify continuity of the wiring and of the coil.

Self-Test Feature

 WARNING

In using the self-test feature of the 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.

The self-test feature of the TIS-910 allows the operator/mechanic to conduct performance checks on the 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 TIS-910 will “fire” a cylinder every 0.1 second. The energy delivered to each coil is determined by the manual energy level setting.

The self-test feature can be started by pressing “S” (upper case) from the main screen. This screen also needs the password of hours +10 to be enabled.

While in self-test, proper performance of each cylinder can be checked using standard troubleshooting tools (timing light, voltmeter, etc.).

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

Coil Types

Coil type	Description
0	S1 type coils
1	Altronic Blue
2	Altronic Red
3	Woodward Red shielded
4	Black shielded
5	Black shielded low gain
6	Black shielded high filter
7	Black shielded high-filter low gain

Table A-1. Coil Types

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.

Timing Sequence Tables

IMPORTANT

Sequences 162–168 were intended for two spark plugs per cylinder. They appear in the 2 Cycle table, but if used with 2 plugs per cylinder, the number of cylinders is half the value in the table. By enabling the Cylinder-to-Cylinder feature in the programming menu and then advancing the even cylinders by 1 or 2 degrees, the coils will fire together.

Example: sequence 167: 1° –59° firing. Fires 12 outputs every 360° if 2 coils per cylinder, then it is a 2 cycle, 6 cylinder application.

WARNING

Any firing sequence with 24 cylinders or outputs must have a 24 cylinder power board. This is designated with a special part number that is different from the standard 20 output TIS-910.

Timing Sequence Tables

2-Cycle

No. of Cylinders (2 CYCLE)	Sequence Number	Firing Interval
1	11	360 – 360
2	10	180 - 180
3	1	120 - 120
4	2	90 - 90
4	25	60 - 120
4	26	120 - 60
4	61	45 - 135
4	62	135 - 45
4	67	63 - 117
4	68	117 - 63
4	137	10 - 170
4	138	170 - 10
5	3	72 - 72
6	4	60 - 60
6	15	30 - 90
6	16	90 - 30
6	19	45 - 75
6	20	75 - 45
6	21	50 - 70
6	22	70 - 50
6	27	48 - 72
6	28	72 - 48
6	31	55 - 65
6	32	65 - 55
6	33	54 - 66
6	34	66 - 54
6	41	57 - 63
6	42	63 - 57

6	43	36 - 84
6	44	84 - 36
6	49	40 - 80
6	50	80 - 40
6	99	4 - 116
6	100	116 - 4
6	139	6 - 114
7	111	51.43 - 51.43
8	5	45 - 45
8	13	30 - 60
8	14	60 - 30
8	17	40 - 50
8	18	50 - 40
8	23	20 - 70
8	24	70 - 20
8	39	42 - 48
8	40	48 - 42
8	45	36 - 54
8	46	54 - 36
8	57	22.5 - 67.5
8	58	67.5 - 22.5
8	59	27 - 63
8	60	63 - 27
8	112	6 - 41 - 6 - 127
8	113	6 - 127 - 6 - 41
8	131	4 - 86
8	132	86 - 4
8	144	43 - 47
8	145	47 - 43
10	7	36 - 36
10	63	12 - 60
10	64	60 - 12
10	65	9 - 63
10	66	63 - 9
10	90	22 - 50
10	91	50 - 22
10	118	30 - 6 - 30 - 84 - 30 - 6 - 30 - 54 - 36 - 54
10	147	2 - 70
10	148	70 - 2
10	150	2.2 - 69.8
10	151	69.8 - 2.2
12	6	30 - 30
12	35	15 - 45
12	36	45 - 15
12	47	24 - 36
12	48	36 - 24
12	71	20 - 40
12	72	40 - 20
12	119	4 - 32 - 4 - 80
12	120	4 - 80 - 4 - 32
12	121	8 - 55 - 2 - 55

12	124	50 - 10
12	125	10 - 50
12	126	9 - 27 - 40.5 - 36 - 40.5 - 27
12	127	36 - 18 - 36 - 27 - 36 - 27
12	152	3 - 57
12	153	3 - 42 - 3 - 72
12	155	6 - 41 - 6 - 67
12	167*	1 - 59
16	162*	1 - 66.5 - 1 - 21.5
16	164*	2 - 58 - 2 - 28
16	165*	2 - 43
16	166*	1 - 44
20	168*	1 - 35
24	163*	1 - 29

Table A-2. 2-Cycle Sequence

4-Cycle

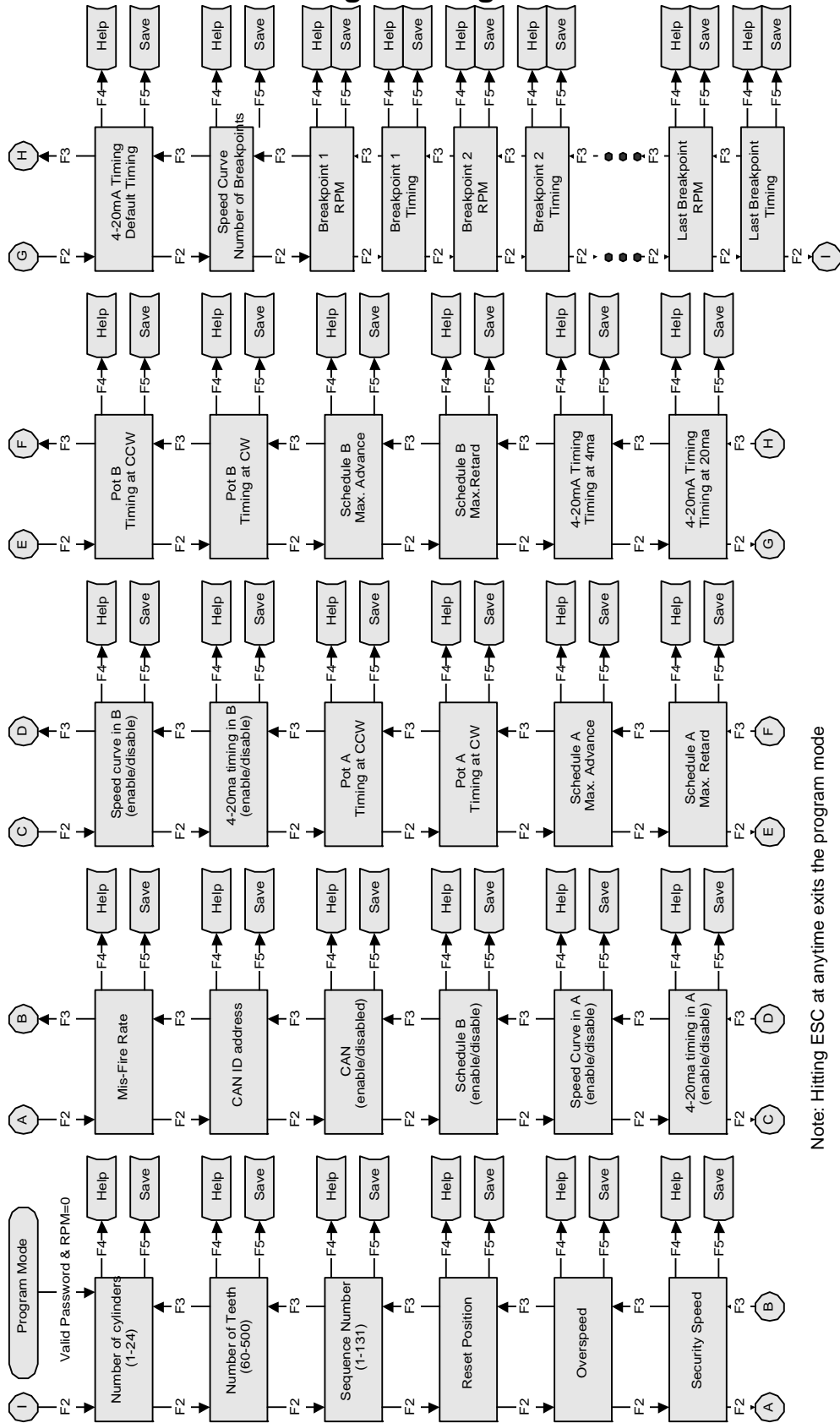
No. of Cylinders (4-CYCLE)	Sequence Number	Firing Interval
2	11	360 - 360
2	97	180 - 540
2	98	540 - 180
3	96	240 - 240
4	10	180 - 180
4	81	180 - 240 - 180 - 120
4	82	180 - 90 - 180 - 270
5	8	144 - 144
6	1	120 - 120
6	37	90 - 150
6	38	150 - 90
6	51	60 - 180
6	52	180 - 60
6	53	75 - 165
6	54	165 - 75
6	55	55 - 185
6	56	185 - 55
6	85	60 - 180 - 120 - 60 - 120 - 180
7	12	102.86 - 102.86
8	2	90 - 90
8	25	60 - 120
8	26	120 - 60
8	61	45 - 135
8	62	135 - 45
8	67	63 - 117
8	68	117 - 63
8	86	90 - 90 - 90 - 60 - 90 - 90 - 90 - 120
8	87	90 - 90 - 90 - 135 - 90 - 90 - 90 - 45
8	88	90 - 90 - 90 - 65 - 90 - 90 - 90 - 115
8	89	90 - 135 - 45 - 135 - 90 - 45 - 135 - 45
8	137	10 - 170
8	138	170 - 10
8	143	47 - 133 - 47 - 139 - 47 - 133 - 47 - 127
9	9	80 - 80
10	3	72 - 72
10	69	27 - 117
10	70	117 - 27
10	73	12 - 132
10	74	132 - 12
10	77	54 - 90
10	78	90 - 54
10	115	60 - 84
10	116	84 - 60
10	133	137 - 7
10	134	7 - 137
12	4	60 - 60
12	15	30 - 90

No. of Cylinders (4-CYCLE)	Sequence Number	Firing Interval
12	16	90 - 30
12	19	45 - 75
12	20	75 - 45
12	21	50 - 70
12	22	70 - 50
12	27	48 - 72
12	28	72 - 48
12	31	55 - 65
12	32	65 - 55
12	33	54 - 66
12	34	66 - 54
12	41	57 - 63
12	42	63 - 57
12	43	36 - 84
12	44	84 - 36
12	49	40 - 80
12	50	80 - 40
12	99	4 - 116
12	100	116 - 4
12	139	6 - 114
12	142	47 - 73 - 47 - 73 - 47 - 79 - 47 - 73 - 47 - 73 - 47 - 67
12	146	114 - 6
14	101	45 - 57.86
14	102	57.86 - 45
14	111	51.43 - 51.43
14	157	60 - 42.5 - 60 - 42.5 - 60 - 45
16	5	45 - 45
16	13	30 - 60
16	14	60 - 30
16	17	40 - 50
16	18	50 - 40
16	23	20 - 70
16	24	70 - 20
16	39	42 - 48
16	40	48 - 42
16	45	36 - 54
16	46	54 - 36
16	57	22.5 - 67.5
16	58	67.5 - 22.5
16	59	27 - 63
16	60	63 - 27
16	112	6 - 41 - 6 - 127
16	113	6 - 127 - 6 - 41
16	131	4 - 86
16	132	86 - 4
16	140	6 - 41 - 6 - 127 - 6 - 41 - 6 - 133 - 6 - 41 - 6 - 127 - 6 - 41 - 6 - 121
16	144	43 - 47
16	145	47 - 43

No. of Cylinders (4-CYCLE)	Sequence Number	Firing Interval
16	154	30 - 60 - 30 - 60 - 30 - 60 - 30 - 60 - 30 - 60 - 30 - 60 - 30 - 58 - 30 - 62
18	103	45 - 35
18	104	35 - 45
18	105	50 - 30
18	106	30 - 50
18	114	40 - 40
18	156	60 - 20
18	158	19 - 60 - 19 - 60 - 22 - 60
18	159	10 - 70
18	160	70 - 10
20	7	36 - 36
20	63	12 - 60
20	64	60 - 12
20	65	9 - 63
20	66	63 - 9
20	90	22 - 50
20	91	50 - 22
20	118	30 - 6 - 30 - 84 - 30 - 6 - 30 - 54 - 36 - 54
20	147	2 - 70
20	148	70 - 2
20	150	2.2 - 69.8
20	151	69.8 - 2.2
20	161	3 - 114 - 3 - 24
24	6	30 - 30
24	35	15 - 45
24	36	45 - 15
24	47	24 - 36
24	48	36 - 24
24	71	20 - 40
24	72	40 - 20
24	119	4 - 32 - 4 - 80
24	120	4 - 80 - 4 - 32
24	121	8 - 55 - 2 - 55
24	124	50 - 10
24	125	10 - 50
24	126	9 - 27 - 40.5 - 36 - 40.5 - 27
24	127	36 - 18 - 36 - 27 - 36 - 27
24	141	6 - 41 - 6 - 67 - 6 - 41 - 6 - 67 - 6 - 41 - 6 - 73 - 6 - 41 - 6 - 67 - 6 - 41 - 6 - 67 - 6 - 41 - 6 - 61
24	152	3 - 57
24	153	3 - 42 - 3 - 72
24	155	6 - 41 - 6 - 67
24	167	1 - 59

Table A-3. 4-Cycle Sequence

TIS-910 Programming Flowchart



Note: Hitting ESC at anytime exits the program mode

TIS-910 Configuration Form

Customer			
Engine Type/Model			
Engine Serial Number			
Ignition Timing Point			
(1) Number of Cylinders:	(2) Number of Teeth:		(3) Sequence Number:
(4) Reset Position:	Nominal:		Actual:
(5) Overspeed:	rpm		
(6) Security Speed:	rpm		
(7) Start RPM:	rpm		
(8) Start Energy:	%		
(9) Coil Type:			
(10) Misfire Rate:			
(11) CAN ID:			
(12) Trip 1 (Speed Trigger 1):	rpm		
(13) Hysteresis 1:	rpm		
(14) Trip 2 (Speed Trigger 2):	rpm		
(15) Hysteresis 2:	rpm		
(16) CAN Bus:	<input type="checkbox"/> Enabled	<input type="checkbox"/> Disabled	
(17) Cyl-to-Cyl Timing:	<input type="checkbox"/> Enabled	<input type="checkbox"/> Disabled	
(18) Schedule A or B:	<input type="checkbox"/> Only Schedule A	<input type="checkbox"/> Schedule A or B	
(19) Speed Curve in A:	<input type="checkbox"/> Enabled	<input type="checkbox"/> Disabled	
(20) 4–20 mA in A:	<input type="checkbox"/> Enabled	<input type="checkbox"/> Disabled	
(21) Speed Curve in B:	<input type="checkbox"/> Enabled	<input type="checkbox"/> Disabled	
(22) 4–20 mA in B:	<input type="checkbox"/> Enabled	<input type="checkbox"/> Disabled	
(23) Slow Speed Operation:	<input type="checkbox"/> Enabled	<input type="checkbox"/> Disabled	
(24) 0–5 Volt in A:	<input type="checkbox"/> Enabled	<input type="checkbox"/> Disabled	
(25) 0–5 Volt in B:	<input type="checkbox"/> Enabled	<input type="checkbox"/> Disabled	
(26) Pot A Max CCW:	<input type="checkbox"/> ADV (BTDC)	<input type="checkbox"/> RET (ATDC)	
(27) Pot A Max CW	<input type="checkbox"/> ADV (BTDC)	<input type="checkbox"/> RET (ATDC)	
(28) Max Advance for A:	<input type="checkbox"/> ADV (BTDC)	<input type="checkbox"/> RET (ATDC)	
(29) Max Retard for A:	<input type="checkbox"/> ADV (BTDC)	<input type="checkbox"/> RET (ATDC)	
(30) Pot B Max CCW:	<input type="checkbox"/> ADV (BTDC)	<input type="checkbox"/> RET (ATDC)	
(31) Pot B Max CW:	<input type="checkbox"/> ADV (BTDC)	<input type="checkbox"/> RET (ATDC)	
(32) Max Advance for B:	<input type="checkbox"/> ADV (BTDC)	<input type="checkbox"/> RET (ATDC)	
(33) Max Retard for B:	<input type="checkbox"/> ADV (BTDC)	<input type="checkbox"/> RET (ATDC)	
(34) 0 Volt Timing:	<input type="checkbox"/> ADV (BTDC)	<input type="checkbox"/> RET (ATDC)	
(35) 5 Volt Timing:	<input type="checkbox"/> ADV (BTDC)	<input type="checkbox"/> RET (ATDC)	
(36) 4 mA Timing:	<input type="checkbox"/> ADV (BTDC)	<input type="checkbox"/> RET (ATDC)	
(37) 20 mA Timing:	<input type="checkbox"/> ADV (BTDC)	<input type="checkbox"/> RET (ATDC)	
(38) Default 4–20 mA Timing:	<input type="checkbox"/> ADV (BTDC)	<input type="checkbox"/> RET (ATDC)	
(39) No. of Speed Points:			
(40) Speed Curve Data:			
(a) BP1 Timing	<input type="checkbox"/> ADV	<input type="checkbox"/> RET	
Speed	rpm		
(b) BP2 Timing	<input type="checkbox"/> ADV	<input type="checkbox"/> RET	
Speed	rpm		
(c) BP3 Timing	<input type="checkbox"/> ADV	<input type="checkbox"/> RET	
Speed	rpm		
(d) BP4 Timing	<input type="checkbox"/> ADV	<input type="checkbox"/> RET	
Speed	rpm		
(e) BP5 Timing	<input type="checkbox"/> ADV	<input type="checkbox"/> RET	
Speed	rpm		

Energy Control Menu

Even Energy	% _____	
Odd Energy	% _____	
Auto Energy	<input type="checkbox"/> Enable	<input type="checkbox"/> Disable
Spark Duration SP	_____	

Cylinder-to-Cylinder Menu

Cylinder 1	<input type="checkbox"/> ADV	<input type="checkbox"/> RET	Cylinder 13	<input type="checkbox"/> ADV	<input type="checkbox"/> RET
Cylinder 2	<input type="checkbox"/> ADV	<input type="checkbox"/> RET	Cylinder 14	<input type="checkbox"/> ADV	<input type="checkbox"/> RET
Cylinder 3	<input type="checkbox"/> ADV	<input type="checkbox"/> RET	Cylinder 15	<input type="checkbox"/> ADV	<input type="checkbox"/> RET
Cylinder 4	<input type="checkbox"/> ADV	<input type="checkbox"/> RET	Cylinder 16	<input type="checkbox"/> ADV	<input type="checkbox"/> RET
Cylinder 5	<input type="checkbox"/> ADV	<input type="checkbox"/> RET	Cylinder 17	<input type="checkbox"/> ADV	<input type="checkbox"/> RET
Cylinder 6	<input type="checkbox"/> ADV	<input type="checkbox"/> RET	Cylinder 18	<input type="checkbox"/> ADV	<input type="checkbox"/> RET
Cylinder 7	<input type="checkbox"/> ADV	<input type="checkbox"/> RET	Cylinder 19	<input type="checkbox"/> ADV	<input type="checkbox"/> RET
Cylinder 8	<input type="checkbox"/> ADV	<input type="checkbox"/> RET	Cylinder 20	<input type="checkbox"/> ADV	<input type="checkbox"/> RET
Cylinder 9	<input type="checkbox"/> ADV	<input type="checkbox"/> RET	Cylinder 21	<input type="checkbox"/> ADV	<input type="checkbox"/> RET
Cylinder 10	<input type="checkbox"/> ADV	<input type="checkbox"/> RET	Cylinder 22	<input type="checkbox"/> ADV	<input type="checkbox"/> RET
Cylinder 11	<input type="checkbox"/> ADV	<input type="checkbox"/> RET	Cylinder 23	<input type="checkbox"/> ADV	<input type="checkbox"/> RET
Cylinder 12	<input type="checkbox"/> ADV	<input type="checkbox"/> RET	Cylinder 24	<input type="checkbox"/> ADV	<input type="checkbox"/> RET

Run-Time Controls

Cylinder-to-Cylinder	Command:	Upper Case "C" is a toggle; displays Cyl-Cyl or Main Screen
Energy Control	Command:	Upper Case "E" is a toggle; displays Energy or Main Screen
Hour Meter	Command:	Upper Case "H" is a toggle; displays Hours or Main Screen
Misfire Rate	Command:	Upper Case "M" is a toggle; displays Misfire or Main Screen
	Command:	ESC clears the above screens if CAN Com is off

TIS-910 Control Specifications

Woodward Part Number	8408-701
Power Consumption	12 V operation: 10–14 Vdc (5.1 A max.) 24 V operation: 18–30 Vdc (3.6 A max.)
	Notes:
	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 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 **26139B**.



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