Released

WOODWARD

Product Manual 35088
(Revision A, 12/2021)
Original Instructions

SECM70 Digital Control

Hardware Manual

General Precautions

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

Practice all plant and safety instructions and precautions.

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

Revisions

This publication may have been revised or updated since this copy was produced. To verify that you have the latest revision, check manual *26455*, *Customer Publication Cross Reference and Revision Status & Distribution Restrictions*, on the *publications page* of the Woodward website:

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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.

Translated Publications

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Manual 35088

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Warnings and Notices

Important Definitions

This is the safety alert symbol used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

- **DANGER** - Indicates a hazardous situation, which if not avoided, will result in death or serious injury.
- **WARNING** - Indicates a hazardous situation, which if not avoided, could result in death or serious injury.
- **CAUTION** - Indicates a hazardous situation, which if not avoided, could result in minor or moderate injury.
- **NOTICE** - Indicates a hazard that could result in property damage only (including damage to the control).
- **IMPORTANT** - Designates an operating tip or maintenance suggestion.

⚠WARNING

Overspeed / Overtemperature / Overpressure

The engine, turbine, or other type of prime mover should be equipped with an overspeed shutdown device to protect against runaway or damage to the prime mover with possible personal injury, loss of life, or property damage.

The overspeed shutdown device must be totally independent of the prime mover control system. An overtemperature or overpressure shutdown device may also be needed for safety, as appropriate.

⚠WARNING

Personal Protective Equipment

The products described in this publication may present risks that could lead to personal injury, loss of life, or property damage. Always wear the appropriate personal protective equipment (PPE) for the job at hand. Equipment that should be considered includes but is not limited to:

- **Eye Protection**
- **Hearing Protection**
- **Hard Hat**
- **Gloves**
- **Safety Boots**
- **Respirator**

Always read the proper Material Safety Data Sheet (MSDS) for any working fluid(s) and comply with recommended safety equipment.

⚠WARNING

Start-up

Be prepared to make an emergency shutdown when starting the engine, turbine, or other type of prime mover, to protect against runaway or overspeed with possible personal injury, loss of life, or property damage.

⚠WARNING

Automotive Applications

On- and off-highway Mobile Applications: Unless Woodward's control functions as the supervisory control, customer should install a system totally independent of the prime mover control system that monitors for supervisory control of engine (and takes appropriate action if supervisory control is lost) to protect against loss of engine control with possible personal injury, loss of life, or property damage.

NOTICE

Battery Charging Device

To prevent damage to a control system that uses an alternator or battery-charging device, make sure the charging device is turned off before disconnecting the battery from the system.

Electrostatic Discharge Awareness

NOTICE

Electrostatic Precautions

Electronic controls contain static-sensitive parts. Observe the following precautions to prevent damage to these parts:

- **Discharge body static before handling the control (with power to the control turned off, contact a grounded surface and maintain contact while handling the control).**
- **Avoid all plastic, vinyl, and Styrofoam (except antistatic versions) around printed circuit boards.**
- **Do not touch the components or conductors on a printed circuit board with your hands or with conductive devices.**

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

Follow these precautions when working with or near the control.

1. Avoid the build-up of static electricity on your body by not wearing clothing made of synthetic materials. Wear cotton or cotton-blend materials as much as possible because these do not store static electric charges as much as synthetics.
2. Do not remove the printed circuit board (PCB) from the control cabinet unless absolutely necessary. If you must remove the PCB from the control cabinet, follow these precautions:
   - Do not touch any part of the PCB except the edges.
   - Do not touch the electrical conductors, the connectors, or the components with conductive devices or with your hands.
   - When replacing a PCB, keep the new PCB in the plastic antistatic protective bag it comes in until you are ready to install it. Immediately after removing the old PCB from the control cabinet, place it in the antistatic protective bag.

IMPORTANT

External wiring connections for reverse-acting controls are identical to those for direct-acting controls.

Regulatory Compliance

International Compliance

UNECE	Type approval to UNECE Regulations 10 (pending)
ROHS	2011/65/EU

Chapter 1.
General Information

Introduction

This manual describes all MY17 variants (17xx models) of the Woodward 70-pin Small Engine Control Module (SECM70) hardware.

Application

The SECM70 control platform fits a variety of applications, including gasoline and natural gas engines for power generation, forklifts, lift trucks, and on-highway vehicles. The SECM70 control is programmed to meet the specific needs of the prime mover and its driven load.

At the heart of the SECM70 control is a powerful 32-bit ST SPC5642A microprocessor, and in one case an ST SPC5634M microprocessor, that runs Woodward's ControlCore operating system. Application programming is accomplished via Woodward's MotoHawk application software tool. MotoHawk is a rapid controls system development tool that allows controls engineers to quickly create controls software directly within Simulink diagrams, which run on any MotoHawk-enabled electronic control modules. Application developers work directly in the Simulink environment and with a one-step build are able to go from an application model to a file that can be programmed directly into Woodward production hardware. MotoHawk provides a high-level programming environment for users who have control systems expertise but don't necessarily have specific embedded programming skills. Once the application program has been generated and loaded into the SECM70 control via the CAN port, the user can view variables and tune the control using an appropriate service interface tool such as Woodward's ToolKit or MotoTune. Connection to other devices, such as a diagnostic tool, is accomplished by means of other CAN ports available on the control. The desired information flow is programmed into the control via MotoTune or ToolKit. Note that MotoHawk 2017b SP0 or newer is required to target the SECM70 MY17 hardware.

The SECM70 control consists of a single rigid printed circuit board attached to an aluminum housing using thermal adhesive, which is then closed and sealed with an aluminum cover. Connections to the control are made via a single 70-pin automotive-style sealed connector. The control can be mounted directly to the engine or frame using vibration isolators which are available pre-installed on the control or separately.

Control Features

Table 1-1. Control Features

Woodward P/N	With Mounting HW	HW Version	Features
1751-6767	8923-2583	1752 (PROD)	Mobile Industrial
1751-6772	8923-2584	1702 (DEV)	Mobile Industrial, on-the-fly calibratable
1751-6768	8923-2587	1753 (PROD)	Power Gen
1751-6773	8923-2588	1703 (DEV)	Power Gen, on-the-fly calibratable
1751-6769	8923-2581	1754 (PROD)	Marine
1751-6774	8923-2582	1704 (DEV)	Marine, on-the-fly calibratable
1751-6770	8923-2585	1755 (PROD)	On-Highway
1751-6776	8923-2586	1705 (DEV)	On-Highway, on-the-fly calibratable
1751-6771	8923-2579	1756 (PROD)	Hydraulic
1751-6777	8923-2580	1706 (DEV)	Hydraulic, on-the-fly calibratable
1751-6784	8923-2577	1759 (PROD)	Marine SPC5634M
1751-6785	8923-2578	1709 (DEV)	Marine SPC5634M, on-the-fly calibratable

Standard Features Common to All Models

- 2 engine speed inputs: camshaft and crankshaft speed (crank software configurable for variable reluctance [VR] magnetic pickup sensor or Hall effect proximity sensor inputs)
- 1 frequency input
- Up to 16 analog inputs
- 4 switch inputs
- Up 2 HEGO sensor inputs
- 1 UEGO sensor input (compatible with Bosch LSU4.9 or NTK sensors)
- Up to 2 knock sensor inputs
- 1 transducer power output providing +5 V (350 mA)
- Up to 6 injector drivers (3 capable of providing software configurable peak-and-hold current levels
- Up to 8 ignition coil drivers
- MPRD (Master Power Relay Driver) low-side output
- 9 low-side output drivers (up to 3 with current sense feedback)
- Up to 3 lamp drivers
- TACH low-side output
- 2 H-bridge driver outputs providing 10 A and 5 A drive capability and current-sense feedback
- Optional 3-Phase BLDC driver
- 2 CAN (Controller Area Network) communications ports
- 16-kilobyte serial EEPROM for tunable parameter storage

Model Variant Features

Table 1-2. Model Variant Features

Function	1702/1752	1703/1753	1704/1754	1709/1759	1705/1755	1706/1756
	1751-6772/6767	1751-6773/6768	1751-6774/6769	1751-6784/6785	1751-6776/6770	1751-6777/6771
AN1 (221k_PD)	x	x	x (10k_PD)	x (10k_PD)	x	x
AN2 (221k_PD)	x	x	x	x	x	x
AN3 (221k_PD)	x	x	x	x	x	x
AN4 (221k_PD)	x	x	x (2.21k_PU)	x (2.21k_PU)	x	x
AN5 (4.75k_PD)	x	x	x (2.21k_PU)	x (2.21k_PU)	x	x (221k_PD)
AN6 (4.75k_PD)	x		x (2.21k_PU)	x (2.21k_PU)		x (221k_PD)
AN7 (51.1k_PD)	x	x	x (1ms □)	x (1ms □)	x	x (221k_PD)
AN8 (4.75k_PD)	x	x	x (51.1k_PD)	x (51.1k_PD)	x	x (221k_PD)
AN9 (2.21k_PU)	x	x	x	x	x	x
AN10 (2.21k_PU)	x	x	x	x	x	x
AN11 (2.21k_PU)	x	x	x	x	x	x
AN12 (4.75k_PU)	x	x	x (221k_PD)	x (221k_PD)	x	x (51.1k_PU)
AN13 (4.75k_PU)	x	x	x (221k_PD)	x (221k_PD)	x	x (51.1k_PU)
AN14 (10k_PU)	x	x			x	
EGO1	x	x			x	x (custom circuit)
EGO2	x					x (custom circuit)
UEGO		x			x	
EK1/AN18 & AN19	x	x	x	x	x	AN18 & AN19
EK2/AN16	EK2	EK2	AN16	AN16	EK2	AN16 (221k PD)
SWG1	x	x	x	x	x	x
SWG2	x	x	x	x	x	x
SWG3	x	x	x	x	x	x
SWG4 / Bootkey	x	x	x	x	x	x
CAM_DG	x	x	x	x	x	x
CNK_DG	x	x	x	x	x	x
SPD	x					x
CNK_VR/SPD_VR	x	x	x	x	x	x
LSO1	x	x	x	x	x	x
LSO2	x	x	x	x	x	x
LSO3 (CS)	x	x	x	x	x	x

Table 1-2. Model Variant Features (cont'd.)

Function	1702/1752	1703/1753	1704/1754	1709/1759	1705/1755	1706/1756
	1751-6772/6767	1751-6773/6768	1751-6774/6769	1751-6784/6785	1751-6776/6770	1751-6777/6771
LSO4	x (no diode)	x (no diode)	x	x	x (no diode)	x
LSO5	x (no diode)	x (no diode)	x	x	x (no diode)	x
LSO6 (CS)	x (no CS, no diode)	x (no CS, no diode)	x (6.4A CS scaling)	x (6.4A CS scaling)	x (no CS, no diode)	x (830mA CS scaling)
LSO7 (CS)	x (no CS)	x (no CS)	x (6.4A CS scaling)	x (6.4A CS scaling)	x (no CS)	x (830mA CS scaling)
LSO8	x	x	x	x	x	x
LSO9	x	x	x	x	x	x
MPRD	x	x	x	x	x	x
LAMP1	x	x	Hall A	Hall A	x	x
LAMP2 (TACH)	x	x	Hall B	Hall B	x	x
LAMP3	x	x	Hall C	Hall C	x	x
INJ1 (PH)	x				x	x
INJ2 (PH)	x				x	x
INJ3 (PH)	x				x	x
INJ4 (PH)					x	
INJ4	x		x	x		x
INJ5	x		x	x		
INJ6	x		x	x		
H1	x	x			x	x
H2		x				
3P			3P	3P		
EST1	x	x			x	x
EST2	x	x			x	x
EST3	x	x			x	
EST4	x	x	x	x	x	x
EST5	x	x	x	x		x
EST6	x	x	x	x		x
EST7		x			x	x
EST8		x			x	x

Environmental Capabilities

The following is a summary list of the environmental limits used for ECM design validation.

Operating Voltage	8–32 Vdc
Minimum Cranking Voltage	5.5 V
Operating Temperature	(-40 to +105) °C (-40 to +221 °F)
Storage Temperature	(-40 to +105) °C (-40 to +221 °F)
Mechanical Vibration	RV3 (22.1 Grms)
Mechanical Shock	50 g, 11 ms, half-sine wave, 4 shocks in each direction (24 total shocks)
Ingress Protection	SAE J1455 High Pressure Spray and Steam Cleaning Tests
EMI/RFI Specification	CISPR 25 (Radiated & Conducted Emissions) ISO 7637-2 (Conducted Transient Testing) ISO 10605 (ESD) ISO 11452-4 (Conducted Immunity) ISO 11452-2 (Radiated Immunity) ISO 7637-3 (Transient Immunity)

For more detailed information on the SECM70 environmental validation specifications, please contact Woodward. Sharing of this information requires an NDA (non-disclosure agreement).

IMPORTANT

For new applications, the actual environmental data and OE specifications must be reviewed by Woodward during application development and approved prior to offering warranty coverage for the application.

SECM70 Packaging Dimensions

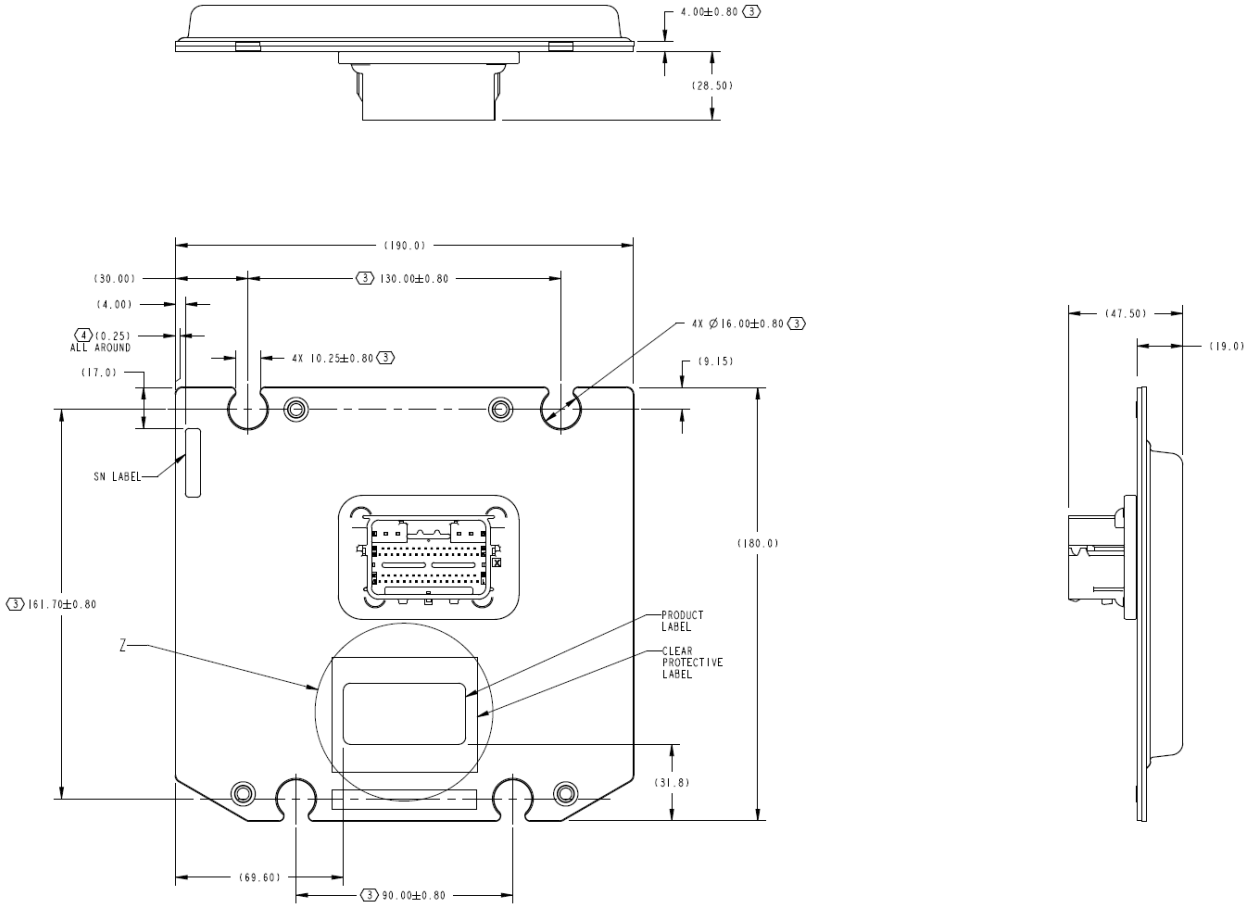

Figure 1-1. SECM70 Package Dimensions

Chapter 2.
Installation

Scope

This chapter contains general installation instructions for the SECM70 control. Power requirements, environmental precautions, and location considerations are included to help you determine the best location for the control. Additional information includes unpacking instructions, electrical connections, and installation checkout procedures.

Unpacking

Before handling the control, read the Electrostatic Discharge Awareness section (page iv). Be careful when unpacking the electronic control. Check the control for signs of damage such as bent panels, scratches, and loose or broken parts. If any damage is found, immediately notify the shipper.

Storage

Store SECM70 hardware in a location between -20 and +70 °C (-4 and +158 °F) at a maximum relative humidity of 90% non-condensing. If modules are to be stored for a long time, apply operating power to them for 2 hours at least once every 18 to 24 months. This is done to re-form the aluminum electrolytic capacitors and will prevent them from overheating upon initial power up after extended storage.

Programming Requirements

SECM70 units are shipped without application software installed. The customer is responsible for programming the microcontroller with application software. The unit will program at 250k baud on CAN 1 and 500k baud on CAN 2 from the factory and does not require bootstrap mode. If bootstrap is required due to a corrupted application, this process is covered in the CAN Port section of this manual.

CAN IDs available from the factory are noted below.

XCP CAN 2
Receive 0x188C0CF9
Broadcast Receive 0x188CFFF9
Transmit 0x188BF90C

ISO15765 CAN 1
Receive 0x18DA00F1
Functional Receive 0x18DB33F1
Transmit 0x18DAF100

ISO15765 CAN 2
Receive 0x18DA00F1
Functional Receive 0x18DB33F1
Transmit 0x18DAF100

MotoTune CAN 1
CityID 0x0B

MotoTune CAN 2
CityID 0x0C

Painting

Painting of the SECM70 is not recommended nor is it required for heat dissipation. If painting must be done, all connectors and labels must be masked prior to painting. The paint must be validated per the following requirements:

- The composition of the paint must be specified to Woodward.
- The specification for thickness of the applied paint must be supplied to Woodward.
- The customer may be asked to participate in vehicle-testing with a thermocouple-instrumented test unit that is painted and installed in the application.

Woodward will work with the customer to determine if paint can be safely applied; however, Woodward reserves the right to deny warranty if the paint is found to be detrimental to the SECM70.

Welding

Do not conduct any welding on or near the SECM70 control. At a minimum, disconnect wiring to the control if welding near the unit is being conducted.

Power Requirements

All versions of the SECM70 control require a voltage source of 8 to 32 Vdc (12 V or 24 V nominal based on system architecture and validation). The power dissipation within the control is typically less than 35 W. Standby current draw is <10 µA (nominal).

IMPORTANT

Total power consumption for both the control and the driven loads is dependent on the application. A typical application may require 0.5 kW to 0.8 kW to drive the loads under all operating conditions. The power source must be sized appropriately for the application.

If a battery is used for operating power, an alternator or other battery- charging device is necessary to maintain a stable supply voltage.

NOTICE

To prevent damage to the control, do not exceed the input voltage range.

NOTICE

To prevent damage to the control, make sure that the alternator or other battery-charging device is turned off or disconnected before disconnecting the battery from the control.

Location Considerations

Consider these requirements when selecting the mounting location:

- Adequate ventilation for cooling
- Space for servicing and repair
- Protection from direct exposure to water or to a condensation-prone environment
- Protection from road debris or material that could impact or deposit on unit and reduce thermal fin cooling

Protection from high-voltage or high-current devices, or devices which produce electromagnetic interference in excess of levels defined in Environmental Capabilities section of this manual.

- The SECM70 may be mounted on-engine, but this is not preferred due to the harsh vibration and thermal environment of an on-engine mount. If the control must be engine-mounted, the location must be approved by Woodward, and the customer may be required to test each application.
- The vibration isolators provided with the units must be used independent of mounting location. The isolators must be inspected for wear at least once per year. For on-engine mounting, Woodward recommends replacing the vibration isolators once a year or sooner if wear is observed.

Select a location on or near the engine that will provide an operating temperature range in accordance to the Environmental Specifications listed in this manual. Refer to manual 26784, *SECM70 Installation*, for more details on mounting location, orientation, and mating connectors.

Application Approval Process

New applications of the SECM70 module require review and approval by Woodward in order to grant production warranty coverage. This process is either via the Application Management Process (AMP) for Woodward developed systems or by submittal of I/O usage details and operational and environmental conditions to Woodward via the Account Manager. A Woodward product engineer will review and provide approval or recommendations to gain approval. Early involvement of Woodward will help assure this process goes smoothly.

Electrical Connections

⚠WARNING

The control will only meet ingress protection specifications with all mating connectors properly installed. In addition, all unused connections in the mating connectors must be plugged to ensure proper sealing of the connectors. Refer to Table 2-1 for the proper connector plug part numbers. Failure to adhere to these guidelines may result in product failure or decreased product life.

Plant wiring guidelines can be provided by Woodward for each application, and final application wiring must be jointly agreed to with OE and Woodward during the development project. No changes shall occur without approval from Woodward. Table 2-1 is the SECM70 control wiring pinout. The highlighted pins use the larger terminals. Several pins have different functions depending on model.

Table 2-1. SECM70 Control Wiring Pinout

Pin #	Pin Name	Pin #	Pin Name	Pin #	Pin Name
1	INJ3	25	SWG1	48	XDRP
2	EST_RTN	26	SWG4/BOOT	49	EGO2N/TG
3	LSO2	27	SWG2	50	EGO2P/SR
4	LSO3	28	AN1	51	H1+/3P-A
5	LSO4	29	SWG3	52	H1–/3P-C
6	EST1	30	CAM_DG	53	CAN1–
7	LSO1	31	CNK_DG	54	CAN2–
8	EST2	32	XDRG	55	MPRD
9	LSO5	33	SPEED/INCR	56	LAMP3/Motor PhaseC Vsense
10	LSO6 (w/o CS)	34	INJ1/H2+/3P-B	57	LAMP2/Motor PhaseB Vsense
11	EST3/LSO6 (w/CS)	35	INJ2/H2–	58	LAMP1/Motor PhaseA Vsense
12	INJ4	36	CAN1+	59	AN12
13	EST7/INJ5/EST5	37	CAN2+	60	AN13
14	EST8/INJ6/EST6	38	KEYSW	61	AN14
15	LSO7	39	AN9	62	EK2N
16	CNK_VR–	40	AN10	63	EK1N/AN19
17	CNK_VR+	41	AN11	64	EK1P/AN18
18	EST5/PH_INJ4	42	AN4	65	EGO1N
19	EST6	43	AN5	66	EGO1P
20	LSO8	44	AN7	67	DRVP
21	EST4	45	AN8	68	BATT
22	AN3	46	EK2P/AN16	69	DRVG_A
23	LSO9	47	AN6/SNS	70	DRVG_B
24	AN2				

Wiring Guidelines

IMPORTANT

DO NOT run signal wires next to wires carrying large currents (such as injector outputs, ignition outputs, H-bridge wiring, or power source wiring). See Woodward application note 50532, *Interference Control in Electronic Governing Systems*, for more information.

Where shielded cable is used (such as cam or crank speed signals, LSU inputs, or communications signals), cut the cable to the desired length and prepare the cable as instructed below.

Strip outer insulation from BOTH ENDS, exposing the braided or spiral wrapped shield. DO NOT CUT THE SHIELD.

- Using a sharp, pointed tool carefully spread the strands of the shield.
- Pull inner conductor(s) out of the shield. If the shield is the braided type, twist it to prevent fraying.
- Remove 6 mm (1/4 inch) of insulation from the inner conductors.
- Ground the shield at the source end and cut off the exposed shield at the receiving end.

Installations with severe electromagnetic interference (EMI) may require additional shielding precautions. Contact Woodward for more information.

The acceptable wire size range for the small 0.6 mm terminals is 0.22 – 0.75 mm^2.
The acceptable wire size range for the large 1.5 mm terminals is 0.5 – 2 mm^2.

Reference SECM70 Installation Manual 26784 for proper terminals for chosen wire size.

Unit Grounding

The SECM70 housing is intended to be mounted through non-conductive vibration isolators with ***no*** connection to engine/chassis ground.

Chapter 3.
I/O Description

IMPORTANT

All interface I/O not provided by Woodward must be reviewed by Woodward and approved prior to offering warranty coverage for the application.

Block Diagram

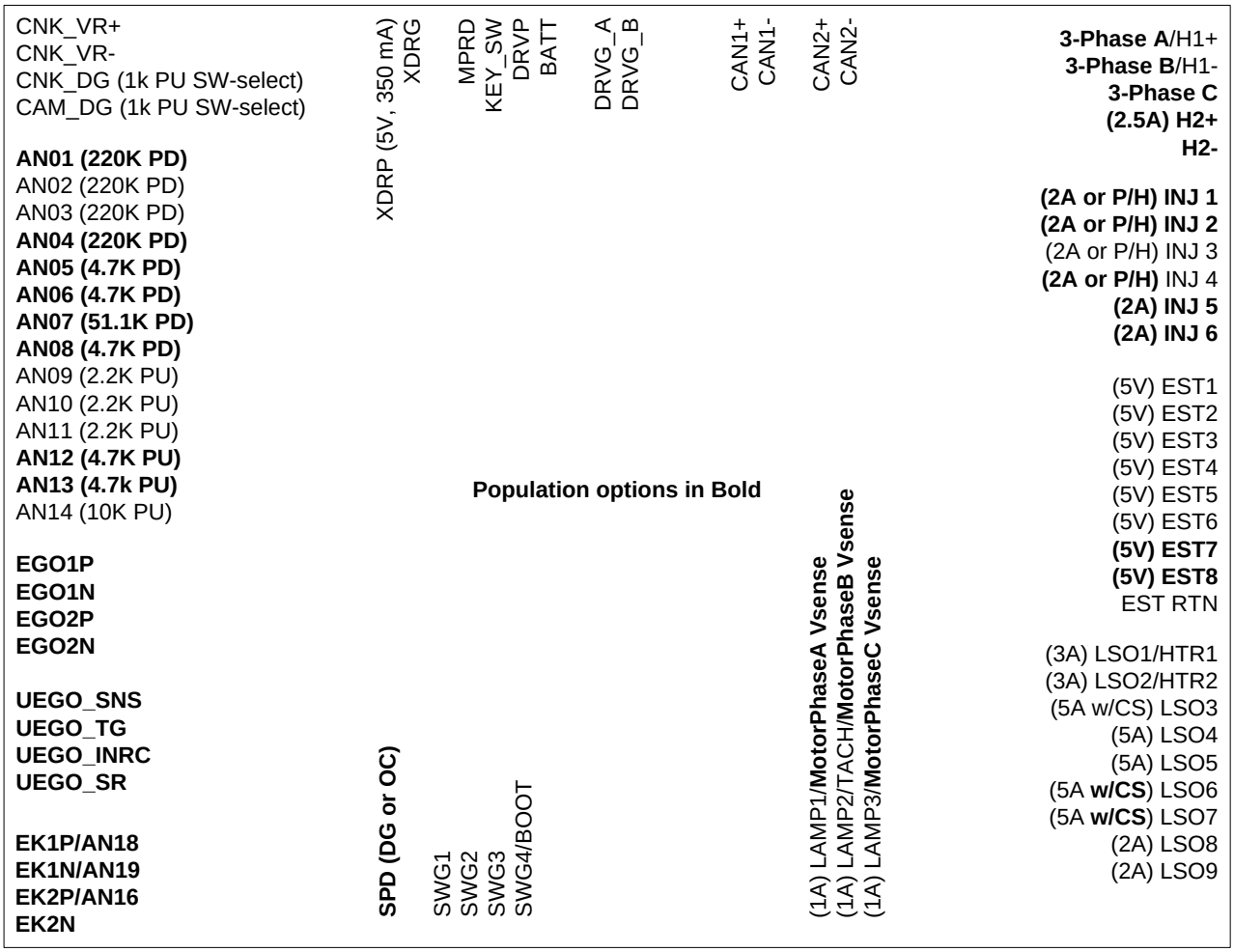

Figure 3-1. Block Diagram

Power Inputs (BATT, DRVG_A and DRVG_B)

Power supply input must be low-impedance (for example, directly from a battery). DO NOT power the control from high-voltage sources with resistors and Zener diodes in series with the control power input.

NOTICE

To prevent damage to the control, do not power a low-voltage control from high-voltage sources, do not exceed 32 V on the power inputs for more than 1 minute, and do not power any control from high-voltage sources with resistors and Zener diodes in series with the power input.

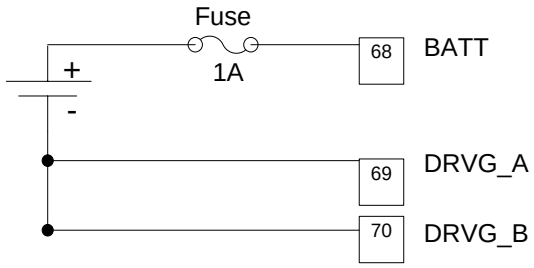

Figure 3-2. Input Power Wiring Diagram

Run the power leads directly from the power source to the control.

NOTICE

Do not power other devices with leads common to the control.

Avoid long wire lengths. Connect the battery positive (power source positive) to the BATT input and battery negative (power source common) to DRVG_A and DRVG_B (see Figure 3-2). If the power source is a battery, be sure the system includes an alternator or other battery-charging device.

If the battery is located outside the engine compartment, module grounding to battery shall be via the vehicle chassis. SECM70 MUST be locally grounded. Also, engine must be well grounded to the chassis and the chassis well-grounded to battery ground.

The BATT input is protected against damage from a -24 V reverse battery condition for up to 5 minutes.

DRVP Input

DRVP provides the primary power for the internal H-bridges and output recirculation diodes. These inputs must not be directly connected to the power source. They must be connected to the power source via the Master Power Relay Driver (see Figure 3-3) to protect the drivers during a reverse-battery condition. The Master Power Relay is energized by the MPRD output, which is under application program control. DRVP voltage monitor is available (see the Analog Inputs section below). Note that the DRVP monitor will typically read up to 3 V when MPRD is off due to internal leakage paths.

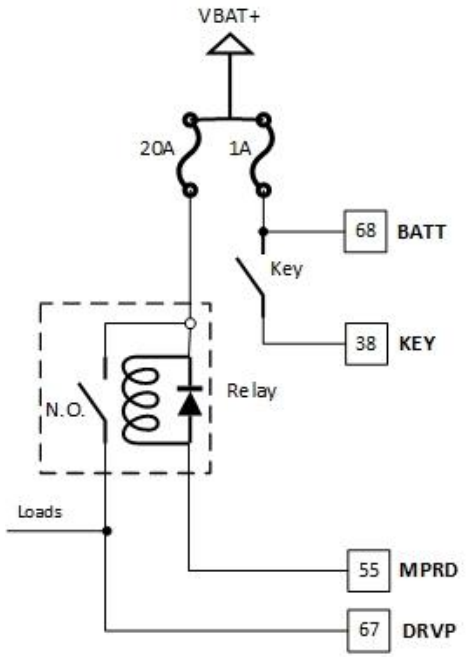

Figure 3-3. Driver Power Wiring Diagram

NOTICE

Proper fusing of the control is highly recommended to prevent damage to the control in case of shorts that may occur in the field wiring. Fuses should be wired in series with all the power inputs to the control.

KEYSW Input

The KEYSW discrete input provides a power-on wake-up command signal to the SECM70 control's internal power supply. Once activated, the control's internal power supply will remain active until commanded to shut down by the application program. A normally-open switch is connected between battery positive and the KEYSW input, thus connecting battery voltage to the control when the switch is closed (see Figure 3-4). The VBAT+ supply must be from a fused source. KEYSW voltage monitor is available (see the Analog Inputs section below).

Figure 3-4. Keyswitch Wiring Diagram

IMPORTANT

The control will not power up until the KEYSW input is activated. Once activated, the KEYSW input may be opened, but the control's power supply will remain activated until commanded to shut down by the application program. Typically, the application will monitor the KEYSW input voltage level, and command the control to shutdown whenever the KEYSW input voltage drops below a specified minimum level. The application program may include shutdown delays to allow time for tunable settings to be stored in non-volatile memory before shutting down.

The KEYSW input is protected against damage from a -24 V reverse battery condition for up to 5 minutes.

MPRD Output

The MPRD (Main Power Relay Driver) Output is used in conjunction with the KEYSW input to control the switching of power to the external loads that are connected to the module. For example, the power to the injectors, ignition coils, wastegate control valve, etc., can be disabled until the relay(s) that are connected to the MPRD output are energized. The power to the injectors should come through a set of normally-open contacts on the relay(s) (see Figure 3-5). It is assumed that the architecture for any system that employs the SECM70 will use the MPRD output to switch power through the master power relay(s). The MPRD output is protected against reverse battery connection by utilizing a blocking diode. The maximum sinking current for the MPRD output is 1 A.

NOTICE

Failure to use the MPR power distribution architecture will leave the output drivers and actuators unprotected from a reverse battery condition and will void warranty for this failure mode.

The driver is thermally self-protected and will provide shutdown fault detection. Open-load detection must be based on DRVP diagnostics.

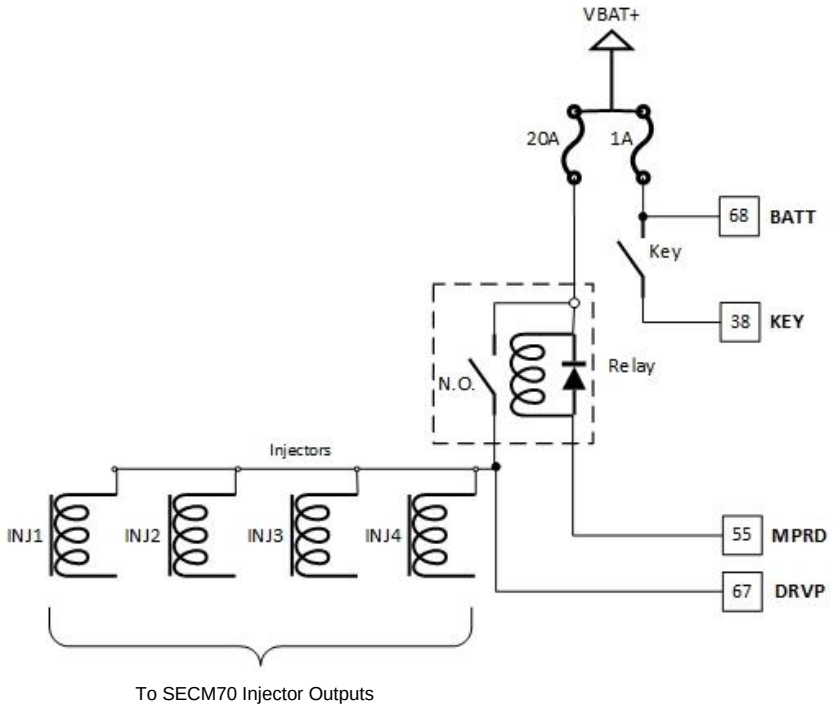

Figure 3-5. MPRD Wiring Diagram

CNK_VR±, CNK_DG & CAM_DG Inputs

The Cam and Crank (CNK) inputs are used to detect engine speed and angular position relative to TDC. The CNK input can be connected to either a variable reluctance magnetic pick-up sensor (VR-MPU) as shown in Figure 3-6, or to a Hall-effect proximity switch as shown in Figure 3-7; however, each type of input has dedicated connector pins. CNK input type is configured by software. Usage of shielded wire for the speed sensor inputs is recommended but not absolutely necessary. Make sure the shield has continuity the entire distance to the speed sensor, and make sure the shield is insulated from all other conducting surfaces. If shielded wire is not used, then twisted wire pairs would be the next best alternative.

Both the CNK_DG and CAM_DG offer software-selectable 1 kΩ pull-ups for use with open collector Hall sensor types.

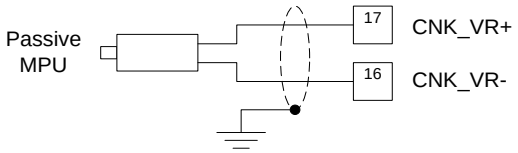

Figure 3-6. MPU Input Wiring Diagram

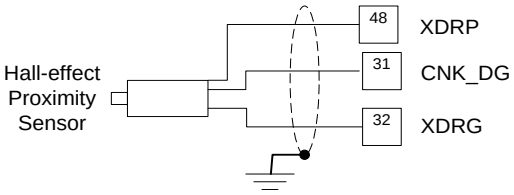

Figure 3-7. Hall-Effect Input Wiring Diagram

WARNING

The CAM or CNK gear tooth pattern is used by the control to convert pulses from the speed sensing device to engine rpm, and to obtain engine angular position information (TDC and phasing). To prevent possible serious injury from an over speeding engine or improper cylinder firing, make sure the control is properly programmed with the correct gear pattern. Refer to the software manual for information on gear-tooth pattern selection. Improper pattern selection could cause engine damage.

The application software allows the programmer to select either VR mode or Hall-effect mode for speed sensing. If VR mode is selected, the SECM70 control utilizes an adaptive variable reluctance sensor amplifier that operates with a positive-going threshold, which is derived by peak-detecting the input signal. If Hall mode is selected, the application software allows the programmer to select to either enable or disable a 1 kΩ pull-up resistor which can be used for open collector type sensors.

Tables 3-1 and 3-2 list the input circuit specifications.

Table 3-1. VR Input Specifications

Parameter	Specification
VR polarity	VR signal connected to SECM70 shall be configured so that the + and – at SECM70 input results in a waveform with falling edge and fast zero crossing.
Minimum signal amplitude (@ 24 Hz)	0.5 V peak
Tooth center-to-center tolerance	Cam less than ±1 crank angle degree. Crank less than ±0.1 crank angle degree.
Tooth-to-tooth pulse peak amplitude variation	Between 0.7 and 1.3
Amplitude maximum (overspeed condition with minimum sensor gap)	90 V peak (180 V peak-to-peak)
Amplitude minimum (slow cranking condition with maximum sensor gap)	0.75 V peak (1.5 V peak-to-peak)

IMPORTANT

The VR+/- are differential inputs with an offset of 2.5 V. The VR- should not be grounded in the application or via test measurement equipment.

Table 3-2. Digital Input Specifications

Parameter	Specification
Input Voltage Thresholds	Vil(min) = 1.6 V Vih(max) = 3.7 V
Hysteresis	VHYST (min) = 0.5 Vdc
Input impedance	1 kΩ ± 1 % pull-up to VCC (software controlled)
Anti-aliasing filter	1 pole at 20 μs

Transducer Power Outputs (XDRP)

The SECM70 control provides a +5 Vdc transducer power source for powering external transducers. The transducer power output is protected against over-voltage, over-temperature, short circuits, and reverse power. Figure 3-8 shows a typical connection of the transducer output powering a transducer, with the transducer signal feeding back to an analog input on the SECM70 control.

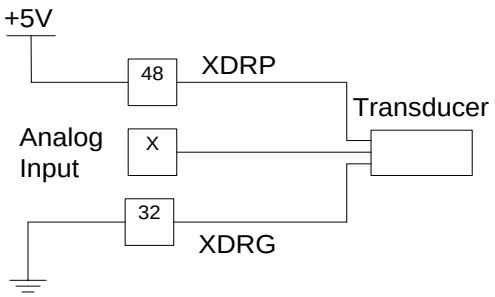

Figure 3-8. Transducer Output Power Wiring Diagram

Table 3-3. Transducer Output Specifications

Output	Voltage	Current Limit
XDRP	5 V ± 2 %	350 mA

Analog Inputs (AN1—AN14)

There are 14 analog inputs on the SECM70. The analog inputs have either a pull-up resistor as shown in Figure 3-9, or a pull-down resistor as shown in Figure 3-10. All the analog inputs have a single-pole filter with a 1 ms time constant except for AN7, which is reserved for a MAP (Manifold Absolute Pressure) sensor and has a 0.24 ms time constant. Table 3-4 provides the pin-out and configuration information for each of the analog inputs. Analog inputs are protected for shorts up to 32 V.

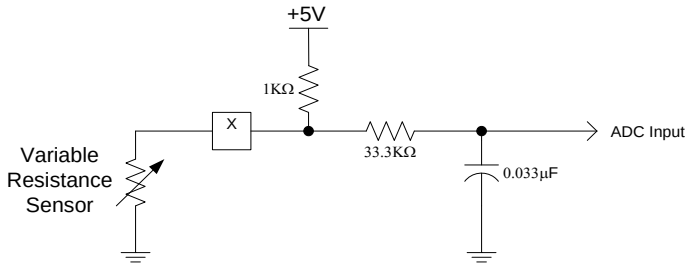

Figure 3-9. Analog Input (with internal pull-up resistor) Wiring Diagram

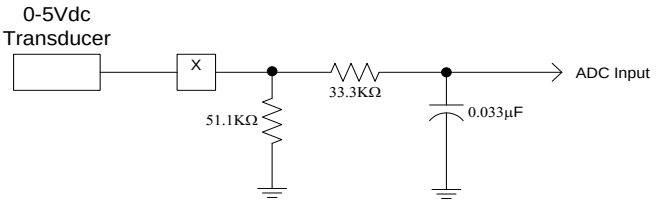

Figure 3-10. Analog Input (with internal pull-down resistor) Wiring Diagram

Table 3-4. Analog Input Configuration

Channel Number	Connector Pinout	τ_{RC} (ms)	Base Configuration	Notes
AN1	28	1	221 kΩ pull-down	10.0 kΩ pull-down for 1704/1754/1709/1759
AN2	24	1	221 kΩ pull-down	
AN3	22	1	221 kΩ pull-down	
AN4	42	1	221 kΩ pull-down	2.21 kΩ pull-up for 1704/1754/1709/1759
AN5	43	1	4.75 kΩ pull-down	2.21 kΩ pull-up for 1704/1754/1709/1759, 221kΩ pull-down for 1706/1756
AN6	47	1	4.75 kΩ pull-down	Not populated for 1703/1753; 2.21 kΩ pull-up for 1509/1754; 221kΩ pull-down for 1516/1756
AN7	44	0.240	51.1 kΩ pull-down	1ms TC for 1704/1754/1709/1759; 221kΩ pull-down for 1706/1756
AN8	45	1	4.75 kΩ pull-down	51.1 kΩ pull-down for 1704/1754/1709/1759; 221kΩ pull-down for 1706/1756
AN9	39	1	2.21 kΩ pull-up	
AN10	40	1	2.21 kΩ pull-up	
AN11	41	1	2.21 kΩ pull-up	
AN12	59	1	4.75 kΩ pull-up	221 kΩ pull-down for 1704/1754/1709/1759; 51.1kΩ pull-up for 1706/1756
AN13	60	1	4.75 kΩ pull-up	221 kΩ pull-down for 1704/1754/1709/1759; 51.1kΩ pull-up for 1706/1756
AN14	61	1	10 kΩ pull-up	Not populated for 1704/1754/1709/1759 or 1706/1756
AN16	46	1	221 kΩ pull-down	Only populated for 1706/1756 models
AN18	64	1	No pull-up or pull-down	Only populated for 1706/1756 models
AN19	63	1	No pull-up or pull-down	Only populated for 1706/1756 models
XDRP	Internal	0.33	Raw A/D reads 0.5x voltage	Tracks to 0.5% of VCC (micro ADC reference)
KEYSW	Internal	1.8	Raw A/D reads 0.116x voltage	
DRVP	internal	1.7	Raw A/D reads 0.108x voltage	

Switch Inputs (SWG1—SWG4)

The switch inputs on the SECM70 can be used to monitor the state of a ground referenced contact switch. Figure 3-11 shows how the discrete inputs are connected when using a ground-referenced contact switch. The contacts may be either normally open or normally closed. Table 3-5 shows the switch input capabilities and characteristics. SW4 is also the BOOT input pin which is used to force the unit into boot mode during start-up.

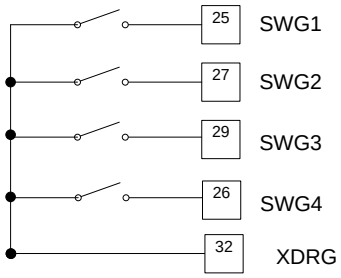

Figure 3-11. Digital Input Wiring Diagram

Table 3-5. Switch Input Characteristics and Capabilities

Channel Number	Connector Pinout	Type	τ_{RC} (ms)	Thresholds	Configuration
SWG1	25	Boolean	1.1	Vil(max) = 2.4 V Vih(min) = 2.6 V Vhyst(min) = 0.5 Vdc	1 kΩ pull-up to VCC (w/blocking diode)
SWG2	27	Boolean	1.1		1 kΩ pull-up to VCC (w/blocking diode)
SWG3	29	Boolean	1.1		1 kΩ pull-up to VCC (w/blocking diode)
SWG4/BOOT	26	Boolean	0.225		1 kΩ pull-up to VCC (w/blocking diode)

Digital Input (SPD)

The SPD on the SECM70 can be used to monitor the state of a ground-referenced contact switch, measure the duty cycle of a PWM signal, or measure the frequency of a Hall-effect proximity switch. Figure 3-12 shows how the discrete inputs are connected when using a ground-referenced contact switch. The contacts may be either normally open or normally closed. Note that the SPD input function is not available on all models.

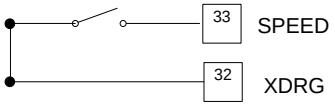

Figure 3-12. Digital Input Wiring Diagram

Table 3-6. Digital Input Characteristics and Capabilities

Channel Number	Connector Pinout	Max Frequency	τ_{RC} (ms)	Thresholds	Configuration
SPD	33	0–10 kHz	0.016	Vil(min) = 2.4 V Vih(max) = 2.6 V Vhyst(min) = 0.8 Vdc	1 kΩ ± 1 % pull-up to VCC (SW-controlled)

HEGO Sensor Inputs

The SECM70 control has two HEGO (Heated Exhaust Gas Oxygen) inputs which are single-ended. Table 3-7 shows the voltage transfer function for both HEGO inputs, and Table 3-8 shows the fault diagnostic voltage states. LSO1 & LSO2 are reserved for heater control.

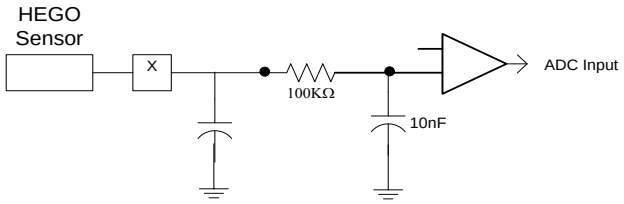

Figure 3-13. HEGO Sensor Wiring Diagram

Table 3-7. HEGO Transfer Function

VHEGO	VADC
0	0.365
0.2	0.728
0.4	1.092
0.6	1.456
0.8	1.819
1	2.182
1.2	2.545

VADC = VHEGO * 1.817 + 0.365

Table 3-8. HEGO Fault Diagnostic States

Diagnostics	VADC
Short to GND	0.5
Open circuit	4.0
Short to Vbatt	5.0

For the 1706/1756 models, the HEGO inputs have the following custom circuit population for specific level and temperature sensors.

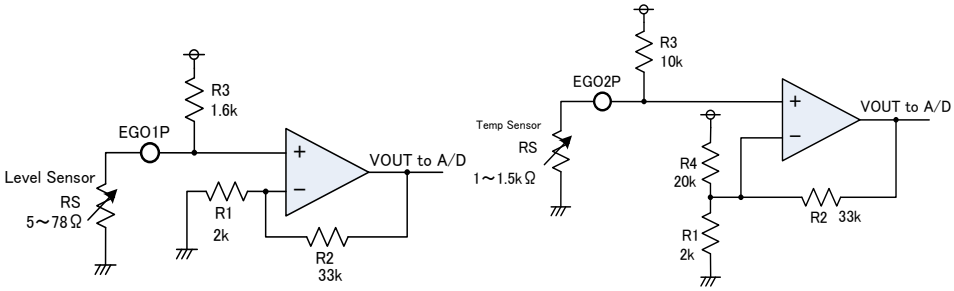

Figure 3-14. Model 1706 and 1756 HEGO Sensor Circuits

Lambda Sensor Unit (UEGO) Inputs

The SECM70 control has one LSU (Lambda Sensor Unit), also known as UEGO (Universal Exhaust Gas Oxygen) input, which will interface with either the Bosch LSU4.9 or NTK wide range λ-sensors (Lambda sensors). The λ-sensor(s) work in conjunction with the on-board ST L9780 ASIC to provide continuous regulation of λ for a sensor in the range of λ = 0.65...∞ (air). The LSU inputs allow the SECM70 to continuously regulate the engine air-to-fuel ratio, thus controlling the percentage of exhaust pollutants during the combustion process. Figure 3-15 shows the wiring diagram for the LSU mating connector to the SECM70 control.

IMPORTANT **It is highly recommended that the wires from the UEGO sensor(s) to the SECM70 control be shielded to reduce the levels of EMI.**

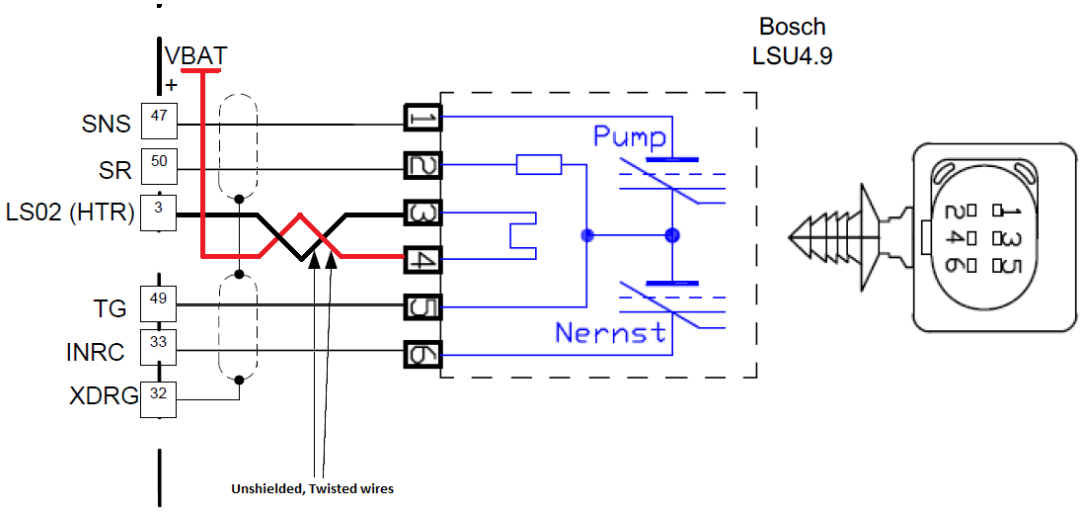

Figure 3-15. Lambda Sensor Unit Wiring Diagram

The application of the LSU sensor is complex. The sensor installation, heater control, and reading of outputs need to follow the sensor manufacturer guidelines to ensure accurate A/F ratio reading and protection of the sensor from shortened life. Covering the detail requirements of the application of the LSU sensor is outside the scope of this manual.

Knock Sensor Inputs

The SECM70 supports two Knock Sensor inputs. These differential inputs are amplified prior to ADC sampling and then processed by the microcontrollers DSP capabilities. Up to a 4th order IIR filter can be supported using the SPC5642A/SPC5634M decimation filter silicon for a minimal CPU bandwidth knock solution. The SPC5642A/SPC5634M also supports DSP capability that will allow a software-based solution. This would allow a very feature-rich knock solution to be authored, but at the expense of needing to consume more of the available CPU bandwidth. Figure 3-16 shows the wiring for the knock inputs.

IMPORTANT **The knock inputs are differential inputs with an offset of 2.5 V. The inputs should not be grounded in the application or via test measurement equipment.**

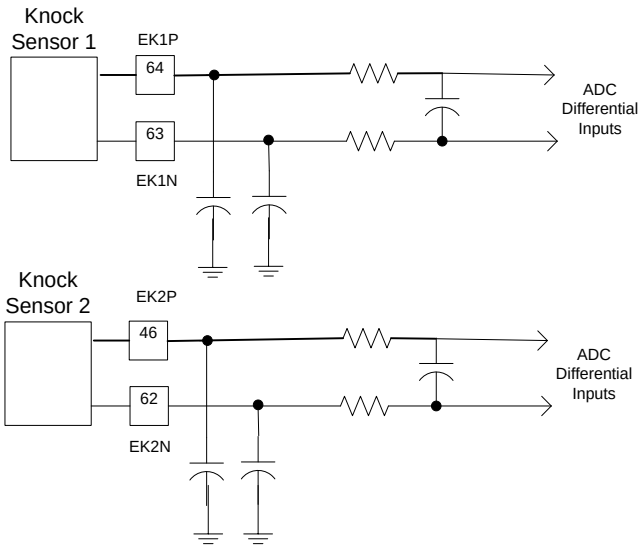

Figure 3-16. Knock Sensor Wiring Diagram

Low-Side Outputs (LSO1-LSO9)

The SECM70 control has 9 low-side outputs (LSOx) that can be used as Boolean outputs for driving relays, or some as PWM outputs to drive solenoids. LSO1 and LSO2 are also designed to drive the heater coil on a HEGO or UEGO sensor. Some low-side outputs are provided with freewheeling diodes (internal to the SECM70 through DRVP) to suppress the back EMF caused by inductive loads. Others have internal flyback clamping, however LSO1 has limited inductive load capability and is limited to 51 mJ for single pulse avalanche energy. LSO1 and LSO2 should be used with resistive loads only when PWM is used and small inductive loads when discrete behaviors (on/off) are used. The MotoHawk software provides diagnostics for open and short detection of the LSO loads (refer to the SW manual or MotoHawk help files for specifics on the diagnostic capabilities). Figures 3-17 and 3-18 show typical applications of the various outputs to drive a load. Table 3-9 shows the low-side output capabilities, characteristics and diagnostics. Note that models with current sense on LSO6 utilize an alternate connector pin.

IMPORTANT

LSO1 and LSO2 should not be operated above 100 Hz when driving the heater coil of a Lambda Sensor Unit (LSU). Exceeding 100 Hz will affect the accuracy of the LSU readings.

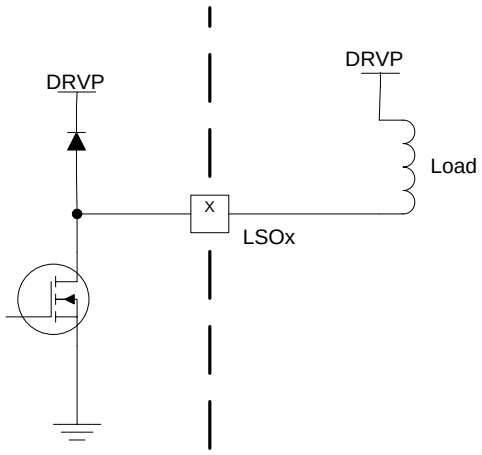

Figure 3-17. LSO3-LSO9 Output Wiring Diagram

IMPORTANT **LSOs that have a recirculation diode to DRVP must be used with a load powered from DRVP.**

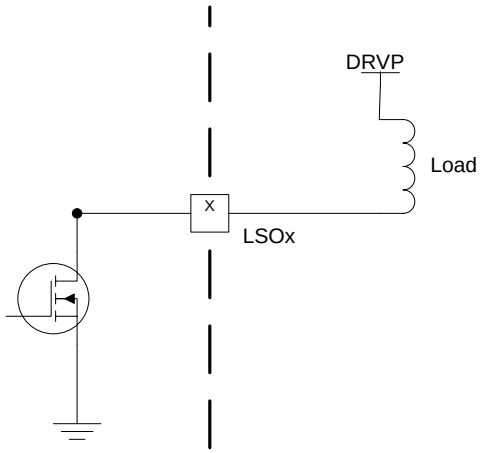

Figure 3-18. LSO1 & LSO2 Output Wiring Diagram

Table 3-9. LSO Characteristics & Capabilities

Function	Pin	Drive Capability	Max Current	Diode Type	Current Sense	Open Load Fault Diagnostic (Driver Off)	Shorted Load Fault Diagnostic (Driver On)
LSO1	7	Boolean or PWM	6 A peak, 3 A continuous	None	No	63k – 350k load (VBAT dependent)	3.0 – 15.5 A
LSO2	3	Boolean or PWM (inductive load limited)	6 A peak, 3 A continuous	None	No	63k – 350k load (VBAT dependent)	8.7 – 24.4 A
LSO3	4	Boolean or PWM	10 A peak, 5 A continuous	To DRVP	Low-side current scaled to 5 A	63k – 350k load (VBAT dependent)	6.4 – 14.4 A
LSO4	5	Boolean or PWM (with diode)	10 A peak 5 A continuous (50mJ flyback energy max)	To DRVP (on 1704/1754/ 1709/1759 models only)	No	63k – 350k load (VBAT dependent)	8.7 – 24.4 A
LSO5	9	Boolean or PWM (with diode)	10 A peak 5 A continuous (50mJ max flyback energy)	To DRVP (on 1704/1754/ 1709/1759 models only)	No	63k – 350k load (VBAT dependent)	8.7 – 24.4 A
LSO6	10 (11 for 1509/1559 and 1515/1565)	Boolean or PWM (with diode)	10 A peak 3.55 A continuous (50mJ max flyback energy)	To DRVP (on 1704/1754/ 1709/1759 models only)	Load current scaled to 6.4 A (1704/1754/ 1709/1759 model) 830mA scaling for 1516/1566 model)	63k – 350k load (VBAT dependent)	8.7 – 24.4 A
LSO7	15	Boolean or PWM	10 A peak 3.5 A continuous	To DRVP	Load current scaled to 6.4 A (1704/1754/ 1709/1759 model) 830mA scaling for 1706/1756 model)	63k – 350k load (VBAT dependent)	8.7 – 24.4 A
LSO8	20	Boolean or PWM	2 A continuous	To DRVP	No	63k – 350k load (VBAT dependent)	3.0 – 15.5 A
LSO9	23	Boolean or PWM	2 A continuous	To DRVP	No	63k – 350k load (VBAT dependent)	3.0 – 15.5 A

Lamp Outputs (LAMP1-3) / MotorPhaseA/B/C Vsense

The SECM70 control has 3 lamp outputs that can be used as Boolean outputs for driving resistive lamps or relays, or some as PWM outputs for inductive loads such as solenoids. Only LAMP2/TACH and LAMP3 have PWM drive capability. When the 3-Phase BLDC driver is populated, these Lamp drivers are configured as Hall analog inputs with 15k pull-ups for motor position feedback (MotorPhaseA/B/C Vsense).

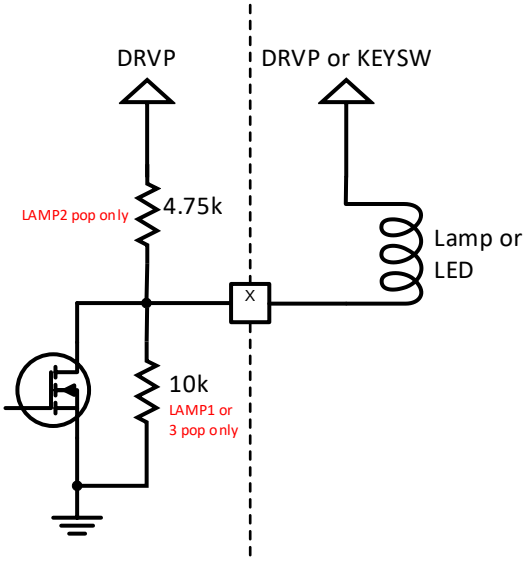

Figure 3-19. LAMP Output Wiring Diagram

Table 3-10. LAMP Characteristics and Capabilities

Function	Pin	Drive Capability	Max Current	Impedance	Current Sense	Open Load Fault Diagnostic (driver off)	Shorted Load Fault Diagnostic (driver on)
LAMP1/ MotorPhaseC Vsense	58	Boolean	1 A	10k PD to GND	No	Dependent on analog threshold calibration	1.7-3.5 A
LAMP2/TACH/ MotorPhaseB Vsense	57	Boolean or PWM	1 A	4.75k to DRVP	No	None, due to pull-up	1.7-3.5 A
LAMP3/ MotorPhaseC Vsense	56	Boolean (Boolean or PWM for 1703/1753)	1 A	10k PD to GND	No	Dependent on analog threshold calibration	1.7-3.5 A

Injector Outputs

The SECM70 control has 6 injector outputs with up to 4 capable of driving either low or high impedance injectors. Each injector output can be used as a Boolean output, a PWM output, or as a synchronous or periodic peak-and-hold injector output. When configured as injector outputs, the SECM70 hardware is capable of producing a peak-and-hold current waveform similar to that shown in Figure 3-20.

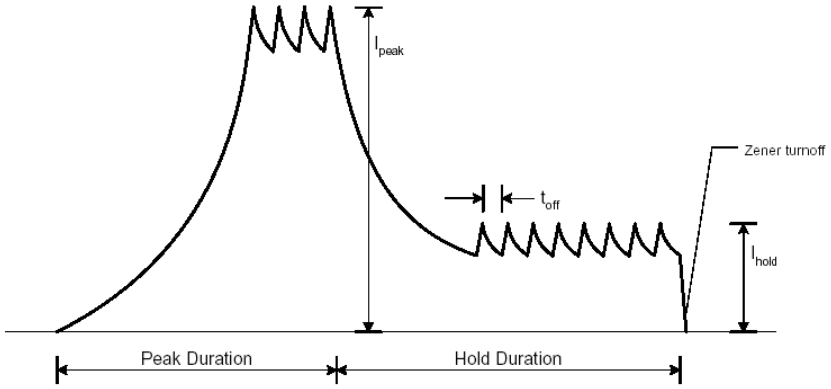

Figure 3-20. Injector Current Waveform

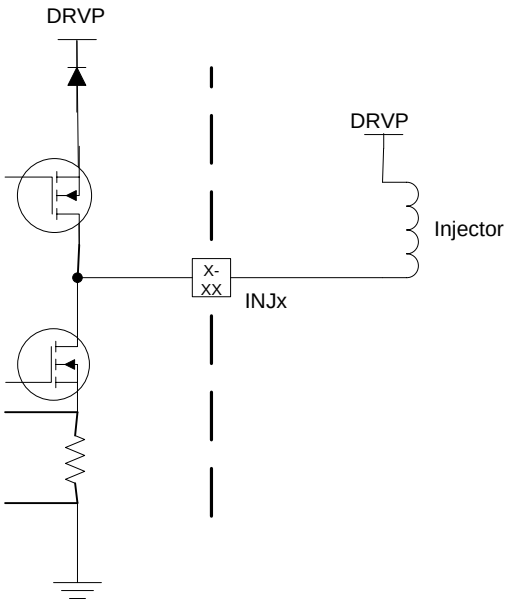

Figure 3-21. Injector Wiring Diagram

The peak-and-hold current levels are globally software configurable up to a maximum of 7 A. The peak-hold injector current levels must be configured by the application through the MotoHawk Peak/Hold Current Definition and Set blocks before the injector drivers can be used in a peak/hold manner. See the MotoHawk help files for specifics on these blocks.

The hardware in the SECM70 employs a switched mode architecture that controls the actual sensed current against a target level. The Zener turnoff is used at the end of injection to ensure rapid solenoid closure. Table 3-11 shows the Injector output capabilities, characteristics, and diagnostics. The MotoHawk software provides diagnostics for open or short detection of the injector loads. Refer to the MotoHawk help files for specifics on diagnostic capabilities.

INJ4 hardware capability varies with model. The 1706/1756 model has four peak/hold capable injector drivers.

Table 3-11. Injector Driver Characteristics and Capabilities

Function	Pin	Drive Capability	Injection Type	Open Load Fault Diagnostic (driver off)	Shorted Load Fault Diagnostic (driver on)
INJ1 INJ2 INJ3 INJ4 (PH)	34 35 1 18	Boolean or PWM	Peak/hold (7 A peak max)	Based on maximum time to reach peak threshold (calibratable time)	Based on minimum time to reach peak threshold (calibratable time)
INJ4 INJ5 INJ6	12 13 14	Boolean or PWM	Saturated drive (1.4 A max)	63k – 350k load (VBAT dependent)	3.0 – 15.5 A

EST Outputs

The SECM70 has up to 8 Electronic Spark Trigger (EST) push/pull logic-level outputs which are driven low when in an off state. Diagnostics are provided via analog feedback during a software-initiated high impedance condition during the off state. Diagnostic pull-up is a 33k to 5.6–6.2 V.

Table 3-12. EST Driver Characteristics and Capabilities

Function	Pin	Drive Capability	Max Current	Open Load Fault Diagnostic (driver operating)	Shorted Load (to GND) Fault Diagnostic (driver operating)
EST1 EST2 EST3 EST4 EST5 EST6 EST7 EST8	6 8 11 21 18/13* 19/14* 13 14	Boolean or PWM 0.75 V to 4.5 V (at 5 mA)	5 mA	Based on EST analog feedback diagnostic threshold (calibratable) Default is 64 counts (1.344 V)	Based on EST analog feedback diagnostic threshold (calibratable) Default is 275 counts (0.312 V)

(*) The MI-1751-6675/1751-6683 models use pins 13 and 14 as EST5 and EST6 respectively to keep the channels labeled sequentially.

H-Bridge Outputs

The SECM70 control has up to two H-bridge outputs that can be used to drive electric motors such as butterfly throttle valves. Both H-bridges provide unsigned load current feedback. Table 3-13 shows the H-bridge output capabilities, characteristics and diagnostics.

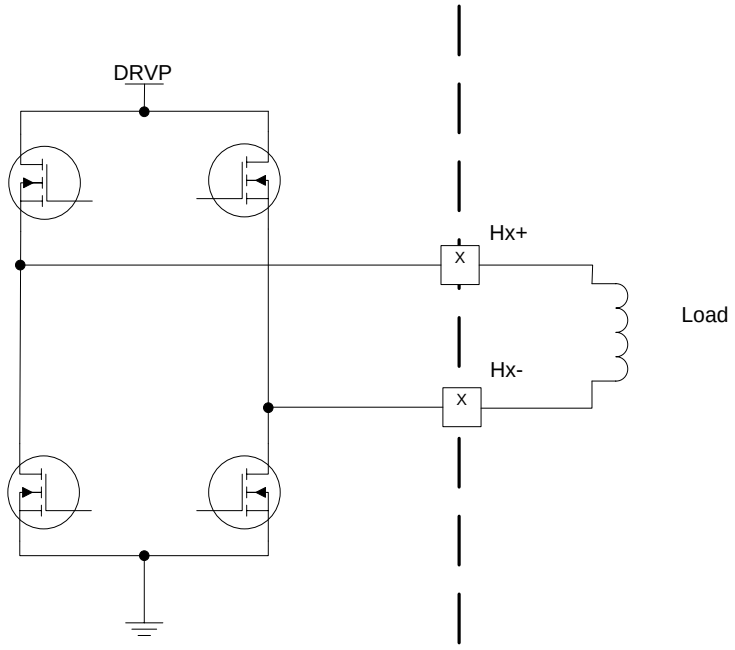

Figure 3-22. H-Bridge Wiring Diagram

Table 3-13. H-Bridge Characteristics and Capabilities

Function	Pin	Drive Capability	Max Current	Current Sense	Open Load Fault Diagnostic (driver on)	Shorted Load Fault Diagnostic (driver on)
H1+ H1-	51 52	Boolean or PWM	8 A peak, 4 A average	Scaled for 10 A max (unsigned)	Application may diagnose based on current sense feedback	8.5 – 38 A
H2+ H2-	34 35	Boolean or PWM	5 A peak, 2.5 A average	Scaled for 6 A max (unsigned)	Application may diagnose based on current sense feedback	5.4 – 7 A (low-side short to VBAT) 16 – 30 A (high-side short to GND)

3-Phase BLDC Output

The SECM70 control can be populated with a 3-phase driver capable of driving a brushless DC (BLDC) motor. This output is only available on the 1704/1754/1709/1759 models.

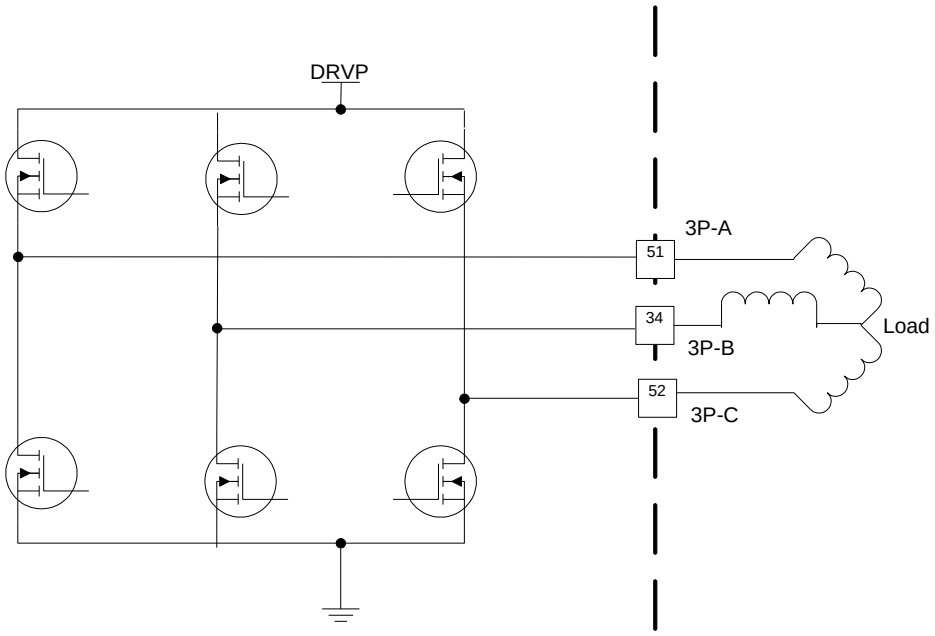

Figure 3-23. 3-Phase Wiring Diagram

Table 3-14. 3-Phase Characteristics and Capabilities

Function	Pin	Drive Capability	Max Current	Current Sense	Open Load Fault Diagnostic (driver on)	Shorted Load Fault Diagnostic (driver on)
3P-A 3P-B 3P-C	51 34 52	PWM	3 A average	Phase A & Phase B legs, scaled for 10 A max, (unsigned)	Application may diagnose based on current sense feedback	13 – 59 A

When the 3-phase BLDC driver is populated, LAMP1/2/3 become MotorPhaseA/B/C Vsense respectively as Hall motor position feedback channels.

CAN Communications Ports (CAN1+/–, CAN2+/–)

The SECM70 has two CAN ports for distributed I/O, distributed control, and HMI (Human Machine Interface) purposes. Each port operates independently. Communications are controlled via MotoHawk. Take care in the choice of devices used on each network. HMI devices should generally not be put on distributed control networks with real-time control requirements. The CAN port assignments are provided in the application documentation.

The CAN ports on the SECM70 are not isolated from each other or from any of the other circuitry on the SECM70 control, as they share a common ground. As such, neither port should be used for communication off the engine. They are designed for on-engine distributed control. The CAN network must be limited to 30 m or less wiring length between the two devices at the physical ends of the network. This limit is further reduced to 25 m if 1000 kbps baud rate is used.

The SECM70 supports MotoTune, xCP, ISO15765, CANOpen, and SAE J1939 protocols for transmitting data over the CAN lines. The physical wiring of the CAN ports must conform to ISO 11898-2 (see Figure 3-24 for the CANbus topology). Units come from the factory with CAN 1 port set to 250k baud or CAN 2 port set to 500 k baud and MotoTune, xCP, and ISO15765 protocols enabled.

Table 3-15. CAN Specification

Transceiver type	CAN 2.0B
Internal ECM termination	None
Isolation voltage	None
Baud rates supported	125, 250, 500, and 1000 kbps
Protocols supported	Multiple including xCP, ISO15765, SAE J1939, CANOpen

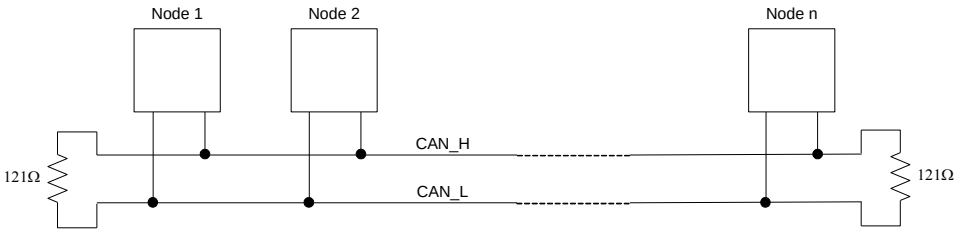

Figure 3-24. CANbus Topology

Per ISO 11898-2, the two-wire CANbus must meet the following criteria:

- A maximum length of 25 m for 1 Mbit/s data rate, 40 m for 250 kbits/s (limited to 30 m for SECM70)
- A recommended maximum drop line length of 0 m for 1 Mbit/s data rate, 1 m at 250 kbits/s
- Characteristic line impedance of 121Ω
- Nominal line resistance of 70 mΩ/m
- Nominal specific propagation delay of 5 ns/m

Termination

It is necessary to terminate the network to prevent interference caused by signal reflections. Depending on network length, many CAN networks will not operate without proper termination.

As a rule, no matter how many units are on a network, there should never be more than two network terminations installed. Termination resistors must be installed only for the two units that are at the physical ends of the network. Terminating more than two units can overload the network and stop all communications.

Termination is a simple 121Ω, 0.25 W, 1 % metal film resistor placed between CAN high and CAN low terminals at the two end units, a differential termination. Do not connect the termination resistor to anything besides the CAN high and CAN low wires.

Shielding

Shielded CAN cable is not required between the SECM70 and any other device(s), but it is highly recommended. Unshielded or improperly shielded cables are likely to cause communication problems and unreliable control operation. Improper shield termination to ground can also cause communication problems and unreliable control operation.

If shielding is used with the SECM70 CAN wiring, the shield should be tied only at the SECM70 control transducer ground pin (XDRG on pin 32). If the shield is grounded at the other end, it should be through a high-frequency AC ground (via a 0.01 µF capacitor to chassis-body ground).

Bootstrapping

If software becomes corrupted or is resetting, the unit can be re-programmed by bootstrapping the microcontroller. The micro can be bootstrapped via two different methods: with a boot key or by the analog method. The boot key provides a 555 Hz square wave to the SW4/BOOT, or an arbitrary waveform generator with a 0–5 V signal can be used. To bootstrap, connect the boot key and initiate programming at 250k on CAN1 with ID 0xB (PCM-1 on MotoTune) before key-on. Alternatively, set AN1, AN2, & AN3 to 5 V and AN9, AN10, & AN11 to GND before key-on.

Power Shutdown

⚠WARNING **Follow power shutdown procedure to safely turn off the power to the SECM70 module.**

Power Shutdown Procedure

1. Command all individual drivers to cut off power from loads.
2. Wait duration required for energy to be dissipated from inductive loads (normally >10 milli-seconds).
3. Remove the DRVP connection.
4. If removing SECM70 from the system, remove battery connection and wait >3 minutes.
5. SECM70 can be safely disconnected from the wiring harness for any maintenance.

Chapter 4.
Product Support and Service Options

Product Support Options

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

1. Consult the troubleshooting guide in the manual.
2. Contact the **OE Manufacturer or Packager** of your system.
3. Contact the **Woodward Business Partner** serving your area.
4. Contact Woodward technical assistance via email (mailto:**MCSSupport@Woodward.com**) with detailed information on the product, application, and symptoms. Your email will be forwarded to an appropriate expert on the product and application to respond by telephone or return email.
5. If the issue cannot be resolved, you can select a further course of action to pursue based on the available services listed in this chapter.

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

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

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

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

Product Service Options

Depending on the type of product, the following options for servicing Woodward products may be available through your local Full-Service Distributor or the OEM or Packager of the equipment system.

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

Replacement/Exchange: Replacement/Exchange is a premium program designed for the user who is in need of immediate service. It allows you to request and receive a like-new replacement unit in minimum time (usually within 24 hours of the request), providing a suitable unit is available at the time of the request, thereby minimizing costly downtime.

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

Flat Rate Repair: Flat Rate Repair is available for many of the standard mechanical products and some of the electronic products in the field. This program offers you repair service for your products with the advantage of knowing in advance what the cost will be.

Flat Rate Remanufacture: Flat Rate Remanufacture is very similar to the Flat Rate Repair option, with the exception that the unit will be returned to you in “like-new” condition. This option is applicable to mechanical products only.

Returning Equipment for Repair

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

When shipping the item(s), attach a tag with the following information:
- return number;
- name and location where the control is installed;
- name and phone number of contact person;
- complete Woodward part number(s) and serial number(s);
- description of the problem;
- instructions describing the desired type of repair.

Packing a Control

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

NOTICE

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

Replacement Parts

When ordering replacement parts for controls, include the following information:
- the part number(s) (XXXX-XXXX) that is on the enclosure nameplate;
- the unit serial number, which is also on the nameplate.

Engineering Services

Woodward's Full-Service Distributors offer various Engineering Services for our products. For these services, you can contact the Distributor by telephone or by email.

- Technical Support
- Product Training
- Field Service

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

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

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

For information on these services, please contact one of the Full-Service Distributors listed at **www.woodward.com/directory**.

Contacting Woodward's Support Organization

For the name of your nearest Woodward Full-Service Distributor or service facility, please consult our worldwide directory at **www.woodward.com/directory**, which also contains the most current product support and contact information.

You can also contact the Woodward Customer Service Department at one of the following Woodward facilities to obtain the address and phone number of the nearest facility at which you can obtain information and service.

Products Used in Electrical Power Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany:	
Kempen	+49 (0) 21 52 14 51
Stuttgart	+49 (711) 78954-510
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Products Used in Engine Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
Germany	+49 (711) 78954-510
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
United States	+1 (970) 482-5811

Products Used in Industrial Turbomachinery Systems

Facility	Phone Number
Brazil	+55 (19) 3708 4800
China	+86 (512) 6762 6727
India	+91 (124) 4399500
Japan	+81 (43) 213-2191
Korea	+82 (51) 636-7080
The Netherlands	+31 (23) 5661111
Poland	+48 12 295 13 00
United States	+1 (970) 482-5811

Technical Assistance

If you need to contact technical assistance, you will need to provide the following information. Please write it down here before contacting the Engine OEM, the Packager, a Woodward Business Partner, or the Woodward factory:

General

Your Name _____

Site Location _____

Phone Number _____

Fax Number _____

Prime Mover Information

Manufacturer _____

Engine Model Number _____

Number of Cylinders _____

Type of Fuel (gas, gaseous, diesel, dual-fuel, etc.) _____

Power Output Rating _____

Application (power generation, marine, etc.) _____

Control/Governor Information

Control/Governor #1

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number _____

Control/Governor #2

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number _____

Control/Governor #3

Woodward Part Number & Rev. Letter _____

Control Description or Governor Type _____

Serial Number _____

Symptoms

Description _____

_____

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

Revision History

Changes to Revision A—

Chapter 1

- Updated the manual to include marine application models and Monaco processor configuration

Chapter 2

- Added Storage section; updated Programming Requirements section to include CAN IDs available from factory

Chapter 3

- Changed reference of 1716/1766 models to 1706/1756 models
- Revised Figure 3-14 caption to describe figure as relevant to Model 1706 and 1756 HEGO sensor circuits instead of Model 1516 and 1566
- Revised Figures 3-15 and 3-19
- Updated Tables 3-4, 3-9, and 3-10

Released

We appreciate your comments about the content of our publications.

Send comments to: icinfo@woodward.com

Please reference publication 35088.

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PO Box 1519, Fort Collins CO 80522-1519, USA
1041 Woodward Way, Fort Collins CO 80524, USA
Phone +1 (970) 482-5811

Email and Website—www.woodward.com

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