Released

WOODWARD

Datasheet **36303**
(Revision F, 09/2019)

MotoHawk Control Solutions

GCM-0563-048

General Control Modules — Calibratable / Flash

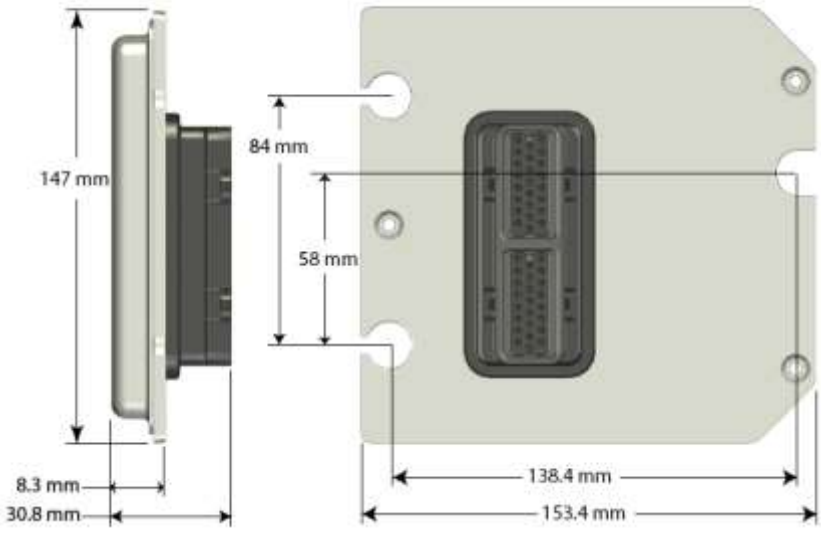
Description

Presenting the GCM-0563-048 family of general control modules from Woodward's new MotoHawk Control Solutions product line. These rugged controllers are capable of operating in harsh automotive, marine, and off-highway applications. Numerous marine applications have proven the capability of this family. Based on the Freescale MPC555 family of microprocessors, the GCM-0563-048 is capable of delivering complex control strategies. The onboard floating-point unit and high clock frequency allow software to be executed in shorter times. The CAN 2.0B datalink ensures interoperability with other vehicle systems.

The GCM-0563-048 is part of the MotoHawk Control Solutions' ControlCore® line of embedded control systems. The ControlCore operating system, MotoHawk® code generation product, and MotoHawk's suite of development tools enable rapid development of complex control systems.

Each controller is available in 'F' (Flash) or 'C' (calibratable) versions. Flash modules are typically used for production purposes. Calibratable modules are typically for prototyping/development only; they can be calibrated in real time using MotoTune®.

Physical Dimensions



- 48-pin Platform, 2 Versions
- Microprocessor: Freescale MPC563, 56 MHz
- Memory: 512K Flash, 32K RAM, 4K Serial EEPROM Flash
- Calibratable Memory: 64K Parallel EEPROM
- Operating Voltage: 8–32 Vdc
- Operating Temperature: –40 to +85 °C (in benchmark marine engine application)
- Sealed Connectors Operable to 10 ft (3 m) Submerged

Inputs:

- 11 to 18 Analog
- 2 to 8 Discrete/ Frequency
- 0 to 2 Hall Effect Frequency (cam)
- 0 or 2 Variable Reluctance Frequency (crank)
- 1 Stop

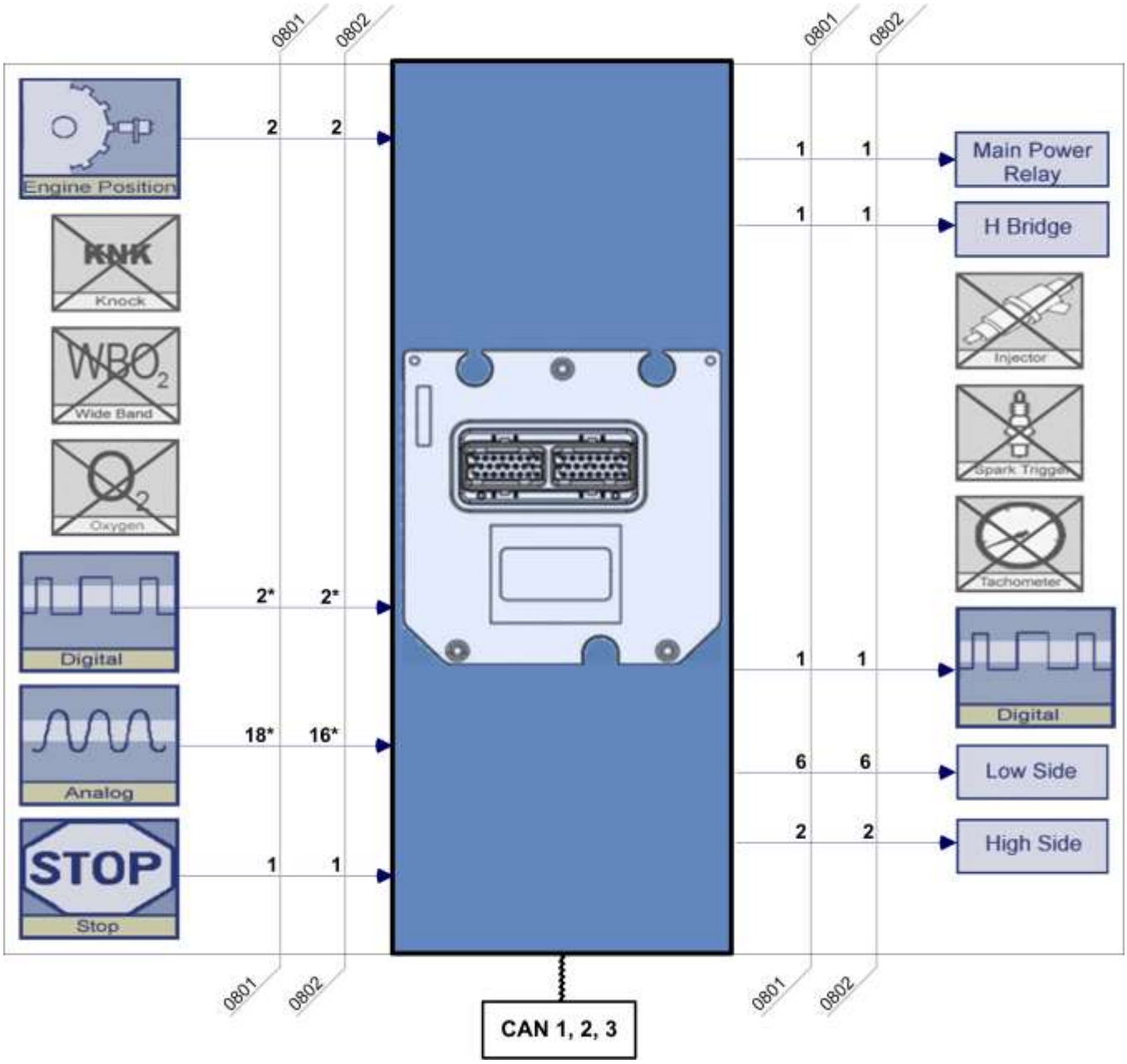
Outputs:

- 6 Low Side Driver
- 2 High Side Driver
- 1 H-Bridge Driver (10 A)
- 1 Digital
- 1 Main Power Relay Driver

Datalinks:

- 3 CAN 2.0B Channels

Simple Block Diagram

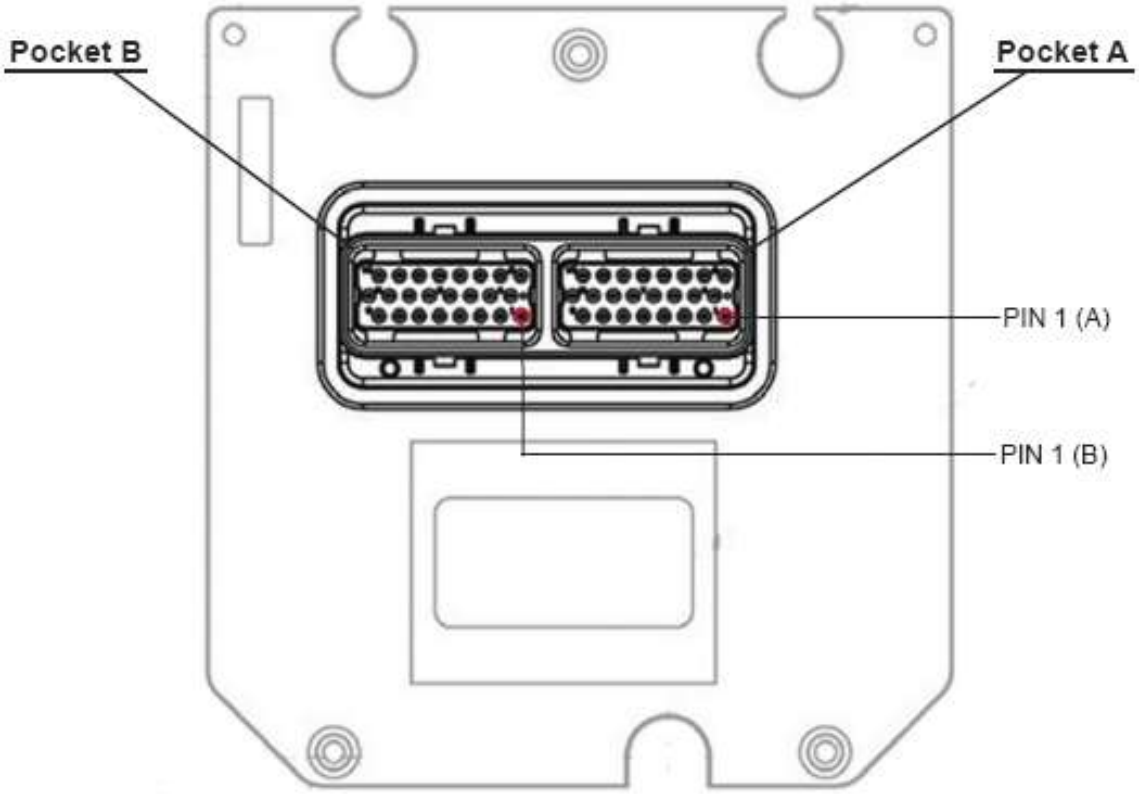


***Analog/Digital Inputs**: Some pins are configurable as either analog or digital inputs; the number of each type available depends on this configuration. See Connector Pin diagram or Block diagram for specific resource/pin information.

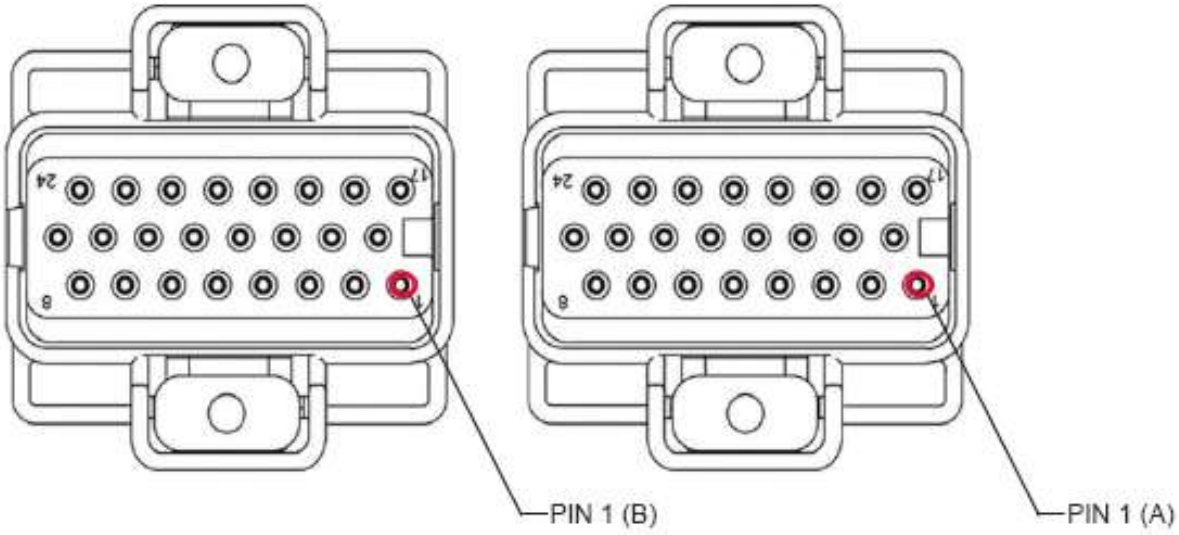
Ordering Information

Controller ID	Part No.	w/Mounting Hardware	Boot Key (P/N)	Boot Cable (P/N)	Desktop Simulator Harness (P/N)
GCM05630480801CP0	1751-6508	8923-1711	HARNINTR00801 (1635-1800)	HARNECM022 (5404-1138)	HARNINTR024C (5404-1203)
GCM05630480801F00	1751-6326	8923-1591			
GCM05630480802CP0	1751-6509	8923-1712			
GCM05630480802F00	1751-6332	8923-1593			
CP0 suffix indicates calibratable (development) version of a module.					

Connector/Pocket Definitions



Connectors viewed from wire insertion side



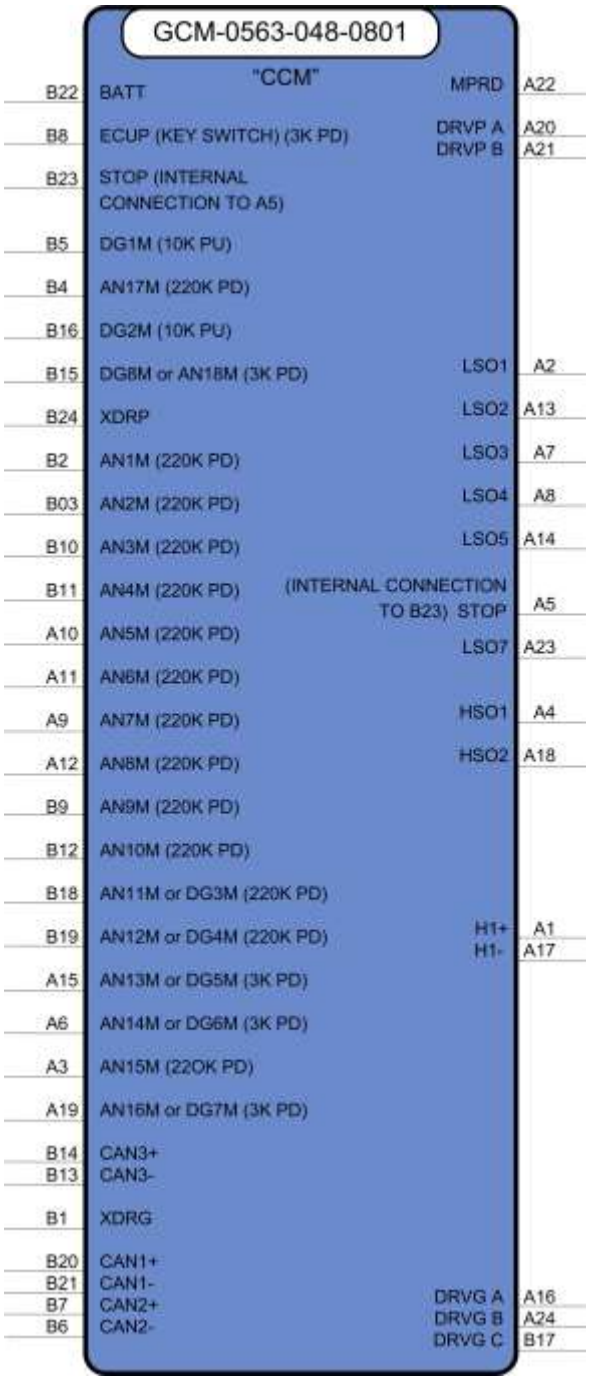
Connector B
MotoTron P/N: CON-FEML-001B
TYCO P/N: 4-1437287-6

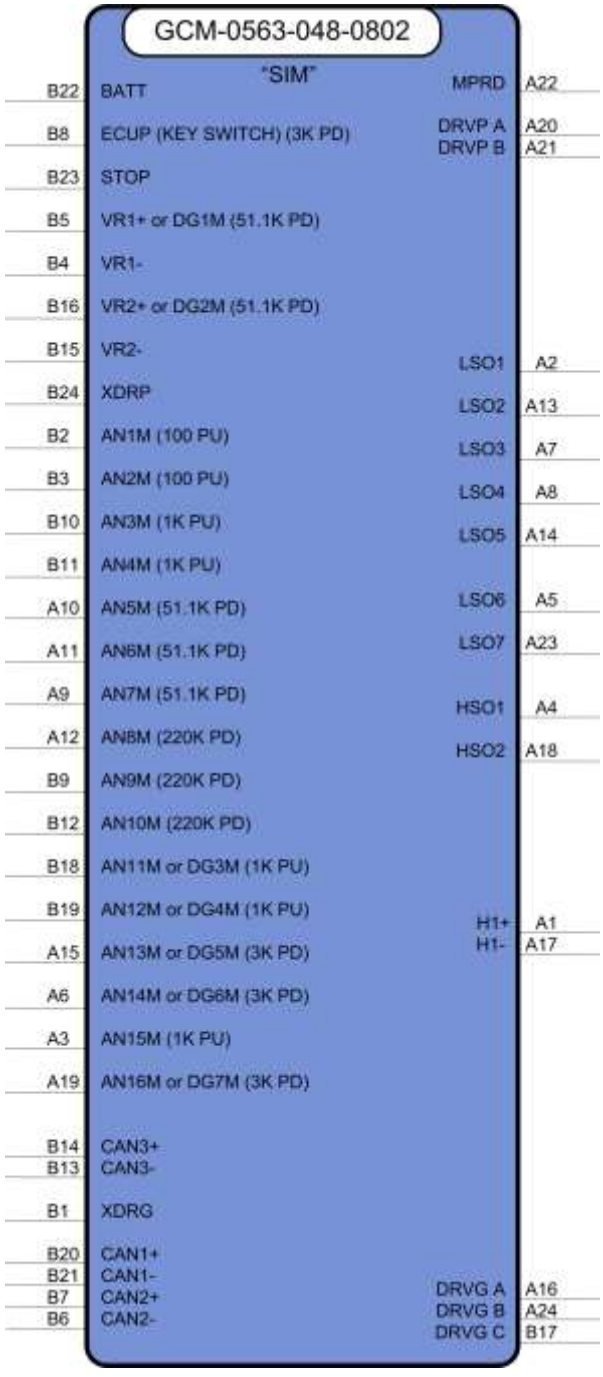
Connector A
MotoTron P/N: CON-FEML-001A
TYCO P/N: 4-1437287-5

Woodward P/N: 1635-1727

Woodward P/N: 1635-1726

Block Diagrams





Signal Conditioning

Input Signal Conditioning	Notes (see Resource by Connector Pin table and/or block diagram for pull up/pull down resistor levels)
IMPORTANT **The ECM has been validated in an application using typical loads. Maximum loading is based on datasheet values. Actual capability is somewhere between typical (validated) and maximum (datasheet) and is dependent on ambient temperature, system voltage, and the state of all other inputs and outputs. In most cases it will not be possible for an application to use the maximum values. Please contact Woodward sales for more information.**	
Power and Ground **BATT, ECUP (KEY SWITCH), DRVP A, DRVP B, DRVG A, DRVG B, DRVG C, XDRP, XDRG, MPRD**	**(Note: See Figure 1 in "Typical Circuit Schematics" section for Power and Ground Block Diagram)**
BATT (B22)	V_{BATT} (min) = 6.7 V (crank transient) and 6.7 V (continuous) V (nom) = 13.8 V I_{BATT} (key off, max) = 1 mA (Battery drain when module is off)
ECUP (KEY SWITCH) (B8)	V_{IL} (max) = 2.0 V V_{IH} (min) = 5.6 V ADC Counts = 0.118 V_{ECUP} (1023/5) or V_{ADC} = 0.118 V_{ECUP} τ = 2 ms
DRVP (A20, A21)	V_{BATT} (max) = 36 V (jump start) V_{BATT} (nom) = 8–32 V V_{ADC} = 0.118 V_{DRVP} (10-bit resolution) τ =1.8 ms
DRVG A (A16), DRVG B (A24), DRVG C (B17)	These pins are the single point ground for the module.
XDRP (B24), XRDG (B1) 5 V supply for analog sensors.	V_{OUT} = 4.9 to 5.1 V I_{OUT} (max) = 300 mA
MPRD (A22) This output energizes the Main Power Relay. Short-circuit protection, open-circuit and short-circuit detection.	I_{SINK} (max) = 1 A

Input Signal Conditioning	Notes (see Resource by Connector Pin table and/or block diagram for pull up/pull down resistor levels)
STOP (B23) See Figure 4 in "Typical Circuit Schematics" section.	V_{IL} (max) = 1.1 V V_{IH} (min) = 3.5 V V_{HYST} = 0.4 V τ = 112 µs
Analog Inputs See Figure 2 in "Typical Circuit Schematics" section.	V_{IN} = 0–5 V V_{ADC} = V_{IN} x (1023/5) τ = 1 ms Resolution= 10-bit

Input Signal Conditioning (cont.)	
Analog / Digital Inputs Some pins can work as either Analog or Digital inputs. See Figure 2 or Figure 3, in “Typical Circuit Schematics” section, depending on resource type selected.	V_{IN} = 0–5 V $V_{ADC} = V_{IN}$ x (1023/5) τ = 5.1 µs Resolution= 10-bit
Digital Inputs See Figure 3 in “Typical Circuit Schematics” section.	V_{IN} = 0–5 V $V_{ADC} = V_{IN}$ x (1023/5) V_{IL} (max) = 1.1 V V_{IH} (min) = 3.5 V V_{HYST} = 0.4 V τ = 5.1 µs Resolution= 10-bit

Output Signal Conditioning	Notes
See Figure 5, 6, or 7 in “Typical Circuit Schematics” section depending on output type.	Outputs are protected from shorts to battery and ground. Outputs have open circuit and short circuit detection.
LSO1 (A2), LSO2 (A13), LSO3 (A7), LSO4 (A8) Recirculation diode.	I_{SINK} (max) = 3 A V_{CLAMP} = 55 V
LSO5 (A14) No diode.	I_{SINK} (max) = 3 A V_{CLAMP}(min) = 55 V
LSO6 (A5) **In GCM-0563-048-0801 only:** Pin A5 internally connected to B23. See Figure 4 in “Typical Circuit Schematics” section.	I_{SINK} (max)= 1 A V_{CLAMP} (min) = 55 V
LSO7 (A23) Pull-up to 5 V via diode.	I_{SINK} (max) = 1 A V_{CLAMP}(min) = 55 V
HSO1 (A4), HSO2 (A18) High-side drivers.	I_O (max) = 2 A
H1+ (A1), H1– (A17) 32 V H-bridge.	I_O (max) = 10 A F_O (max) = 25 kHz

Communications	
CAN1+ (B20), CAN1– (B21), CAN2+ (B7), CAN2– (B6), CAN3+ (B14), CAN3– (B13)	High-speed CAN 2.0B buses.

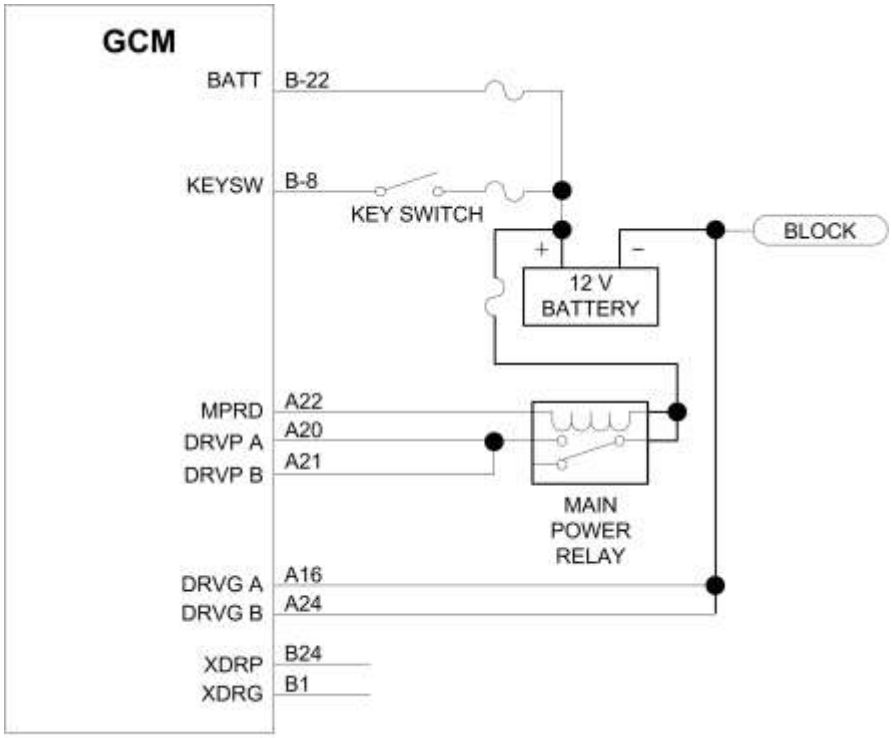
Memory	
FLASH	512K of FLASH memory, on chip.
RAM	32K of RAM, on chip (4K overlayable).
EEPROM	16K serial EEPROM.

Signal Conditioning

Typical Circuit Schematics

Power and Ground

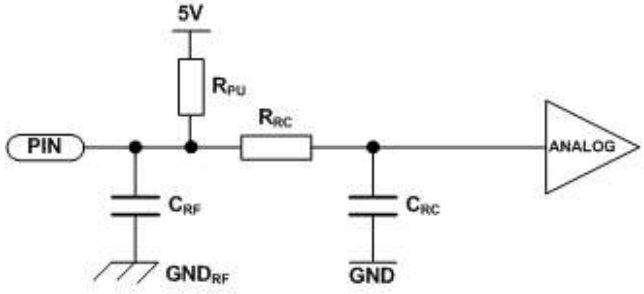
Figure 1:



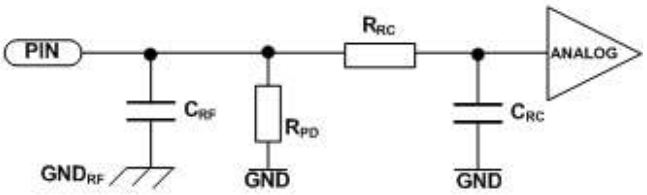
Analog Inputs

Figure 2:

Resistor Pull-up



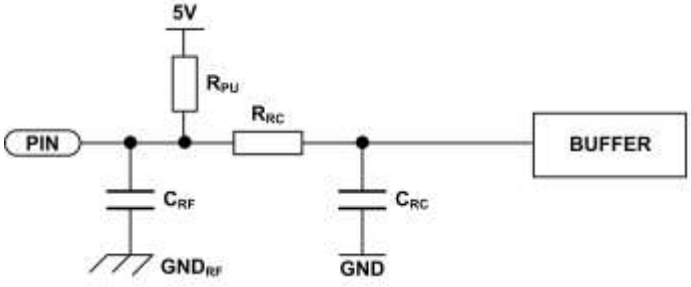
Resistor Pull-down



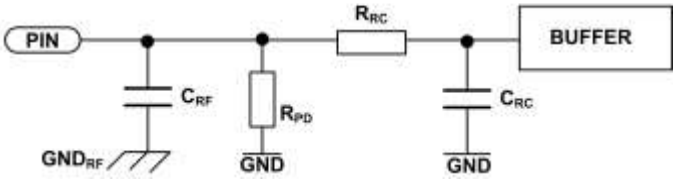
Digital Inputs

Figure 3:

Resistor Pull-up

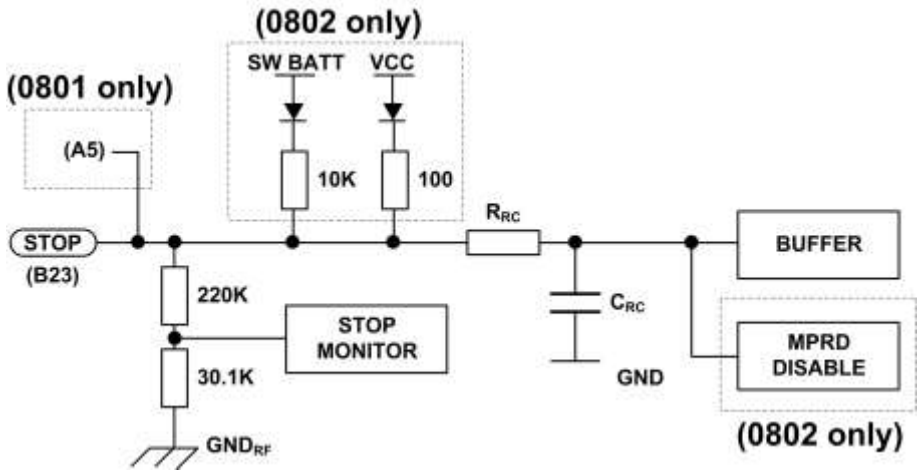


Resistor Pull-down

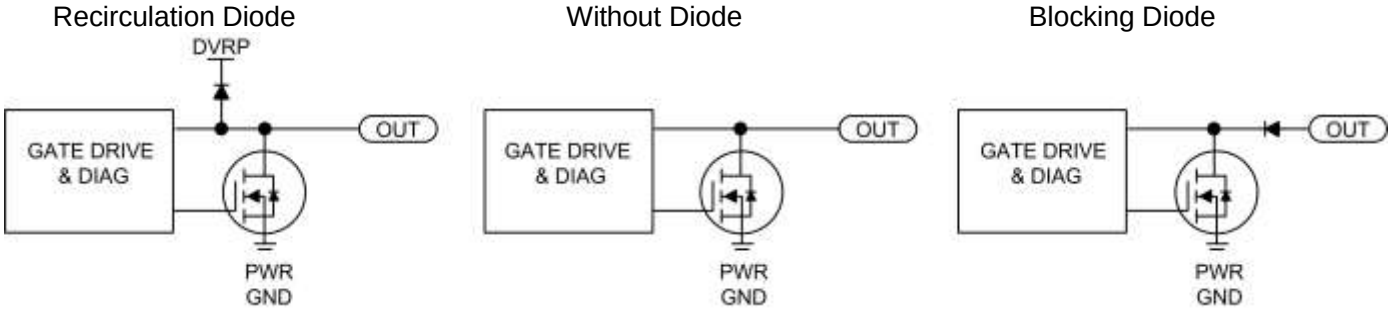


Typical Circuit Schematics

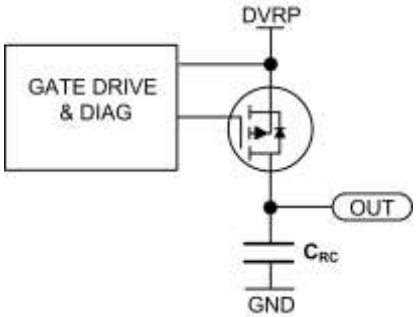
Stop Input **Figure 4:**



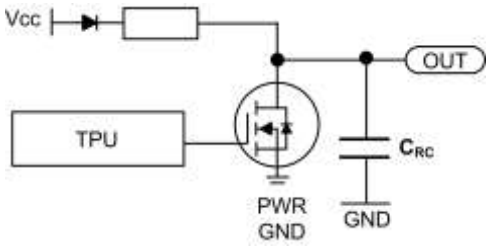
Low Side Outputs **Figure 5:**



High Side Output **Figure 6:**



Digital Output **Figure 7:**

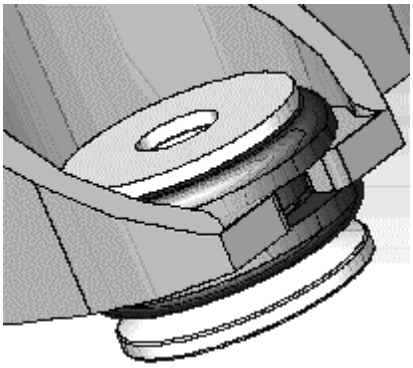


Connector Pinouts

RESOURCE BY CONNECTOR PIN					
Pin#	**0801 "CCM"**	**0802 "SIM"**	Pin#	**0801 "CCM"**	**0802 "SIM"**
A1	**H1+**	**H1+**	B1	**XDRG**	**XDRG**
	H-Bridge Output 1	H-Bridge Output 1		Transducer Ground	Transducer Ground
	10 A maximum	10 A maximum		Analog ground reference	Analog ground reference
A2	**LSO1**	**LSO1**	B2	**AN2M**	**AN1M**
	Low Side Output 1	Low Side Output 1		Analog Input 1	Analog Input 1
	Recirc. diode, current sense 3 A	Recirc. diode, current sense 3 A		Rpulldown= 220K	Rpullup= 100
A3	**AN15M**	**AN15M**	B3	**AN2M**	**AN2M**
	Analog Input 15	Analog Input 15		Analog Input 2	Analog Input 2
	Rpulldown= 220K	Rpullup= 1 K		Rpulldown= 220K	Rpullup= 100
A4	**HSO1**	**HSO1**	B4	**AN17M**	**VR1–**
	High Side Output 1	High Side Output 1		Analog Input 1	VR Input Return
	High Side Driver	High Side Driver		Rpulldown= 220K	VR use only
A5	**STOP**	**LSO6**	B5	**DGM1**	**VR1+ or DG1M**
	Low Side Output with Monitor	Low Side Output 6		Digital Input 1	VR1 or Digital 1 Input
	Internal connection to B23	No diode, 1 A		Discrete, Rpullup= 10K	VR / Hall, Rpulldown= 51.1K
A6	**AN14M or DG6M**	**AN14M or DG6M**	B6	**CAN2–**	**CAN2–**
	Analog 14 or Digital 6 Input	Analog 14 or Digital 6 Input		CAN Lo signal	CAN Lo signal
	Rpulldown= 3K, 42 V full-scale	Rpulldown= 3K, 42 V full-scale		CAN 2.0B	CAN 2.0B
A7	**LSO3**	**LSO3**	B7	**CAN2+**	**CAN2+**
	Low Side Output 3	Low Side Output 3		CAN Hi signal	CAN Hi signal
	Recirculation diode, 3 A	Recirculation diode, 3 A		CAN 2.0B	CAN 2.0B
A8	**LSO4**	**LSO4**	B8	**ECUP**	**ECUP**
	Low Side Output 4	Low Side Output 4		Key Switch	Key Switch
	Recirculation diode, 3 A	Recirculation diode, 3 A		Module "wake up" signal	Module "wake up" signal
A9	**AN7M**	**AN7M**	B9	**AN9M**	**AN9M**
	Analog Input 7	Analog Input 7		Analog Input 9	Analog Input 9
	Rpulldown= 220K	Rpulldown= 51.1K		Rpulldown= 220K	Rpulldown= 220K
A10	**AN5M**	**AN5M**	B10	**AN3M**	**AN3M**
	Analog Input 5	Analog Input 5		Analog Input 3	Analog Input 3
	Rpulldown= 220K	Rpulldown= 51.1K		Rpulldown= 220K	Recirc. diode, Rpullup= 1K
A11	**AN6M**	**AN6M**	B11	**AN4M**	**AN4M**
	Analog Input 6	Analog Input 6		Analog Input 4	Analog Input 4
	Rpulldown= 220K	Rpulldown= 220K		Rpullup= 1K	Rpullup= 1K
A12	**AN8M**	**AN8M**	B12	**AN10M**	**AN10M**
	Analog Input 8	Analog Input 8		Analog Input 10	Analog Input 10
	Rpulldown= 220K	Rpulldown= 220K		Rpulldown= 220K	Rpulldown= 220K

RESOURCE BY CONNECTOR PIN					
A13	**LSO2**	**LSO2**	B13	**CAN3–**	**CAN3–**
	Low Side Output 2	Low Side Output 2		CAN Lo signal	CAN Lo signal
	Recirc. diode, current sense 3 A	Recirc. diode, current sense 3 A		CAN 2.0B	CAN 2.0B
A14	**LSO5**	**LSO5**	B14	**CAN3+**	**CAN3+**
	Low Side Output 5	Low Side Output 5		CAN Hi signal	CAN Hi signal
	No diode, 3 A	No diode, 3 A		CAN 2.0B	CAN 2.0B
A15	**AN13M or DG5M**	**AN13M or DG5M**	B15	**AN18M or DG8M**	**VR2–**
	Analog 13 or Digital 5 Input	Analog 13 or Digital 5 Input		Analog 18 or Digital 8 Input	VR Input Return
	Rpulldown= 3K, 42 V full-scale	Rpulldown= 3K, 42 V full-scale		Rpulldown= 3K, 42 V full-scale	VR use only
A16	**DRVG A**	**DRVG A**	B16	**DG2M**	**VR2+ or DG2M**
	Driver Ground	Driver Ground		Digital Input 2	VR1 or Digital 1 Input
				Rpullup= 10K	VR / Hall, Rpulldown= 51.1K
A17	**H1–**	**H1–**	B17	**DRVG C**	**DRVG C**
	H-Bridge Output 1	H-Bridge Output 1		Driver Ground	Driver Ground
	10 A maximum	10 A maximum			
A18	**HSO2**	**HSO2**	B18	**AN11M or DG3M**	**AN11M or DG3M**
	High Side Output 2	High Side Output 2		Analog 11 or Digital 3 Input	Analog 11 or Digital 3 Input
	High Side Driver	High Side Driver		Rpulldown= 220K	Recirc. diode, Rpullup= 1K
A19	**AN16M or DG7M**	**AN16M or DG7M**	B19	**AN12M or DG4M**	**AN12M or DG4M**
	Analog 16 or Digital 7 Input	Analog 16 or Digital 7 Input		Analog 12 or Digital 4 Input	Analog 12 or Digital 4 Input
	Rpulldown= 3K, 42 V full-scale	Rpulldown= 3K, 42 V full-scale		Rpulldown= 220K	Recirc. diode, Rpullup= 1K
A20	**DRVP A**	**DRVP A**	B20	**CAN1+**	**CAN1+**
	Driver Power	Driver Power		CAN Hi signal	CAN Hi signal
				CAN 2.0B	CAN 2.0B
A21	**DRVP B**	**DRVP B**	B21	**CAN1–**	**CAN1–**
	Driver Power	Driver Power		CAN Lo signal	CAN Lo signal
				CAN 2.0B	CAN 2.0B
A22	**MPRD**	**MPRD**	B22	**BATT**	**BATT**
	Main Power Relay Driver	Main Power Relay Driver		Battery Connection	Battery Connection
	Reverse battery diode, 1 A	Reverse battery diode, 1 A		8–32 V	8–32 V
A23	**LSO7**	**LSO7**	B23	**STOP**	**STOP**
	Low Side Output 7	Low Side Output 7		Low Side Output with Monitor	Emergency Stop Input
	5 V digital, Rpullup= 200	5 V digital, Rpullup= 200		Internal connection to A5	With monitor, disables MPRD
A24	**DRVG B**	**DRVG B**	B24	**XDRP**	**XDRP**
	Driver Ground	Driver Ground		Transducer Power	Transducer Power
				5 V for Analog Sensors	5 V for Analog Sensors

Environmental Ratings

Environmental Ratings	Notes
The ECM is designed for automotive, under hood and marine industry environmental requirements. Validation tests include extreme operating temperatures, thermal shock, humidity, salt spray, salt fog, immersion, fluid resistance, mechanical shock, vibration, and EMC. The customer must contact Woodward and provide the intended environmental conditions in the application for verification of performance capability.	
Storage Temperature	–50 to +105 °C
Operating Temperature	–40 to +85 °C
Thermal Shock	–40 to +125 °C, air-to-air, 500 cycles
Fluid Resistance	Two-stroke motor oil, four-stroke motor oil, unleaded gasoline, ASTM Reference 'C' fuel
Humidity Resistance	85% humidity at 85 °C for 1000 hours
Salt Fog Resistance	500 hours. 5% salt fog, 35 °C
Immersion	Immersed in 8% salt water to 10 ft (3 m) depth
Mechanical Shock	50 g's, 11 ms, 1/2 sine wave, 4 times each axis (plus and minus)
Drop Test	Drop test on concrete from 1 meter, six surfaces
Vibration This ECM family has been successfully deployed in engine mounted applications ranging from common small displacement engines to large racing engines with extreme vibrations. Electrical and mechanical isolation is achieved via Woodward mounting hardware (consisting of grommet, bushing, and washer) shown to the right. IMPORTANT **For prior verification of performance capability, contact Woodward and provide the vibration profile of the intended application.**	

Programming Information

Using a Boot Key/Cable

Errors in configuration, logic and/or other programming made during program development for this module (via .srz file), can cause a persistent loss of CAN communications with the module under development.

If this happens, apply the boot key (or cable, depending on the model) to force the module into reboot mode, reloading the module with functional program code (a known, valid .srz file) in order to allow resumption of module communication. Follow the steps listed in this section. Refer to diagram below for connections.

Refer to “Ordering Information” on p. 2 for related boot key/cable part numbers.

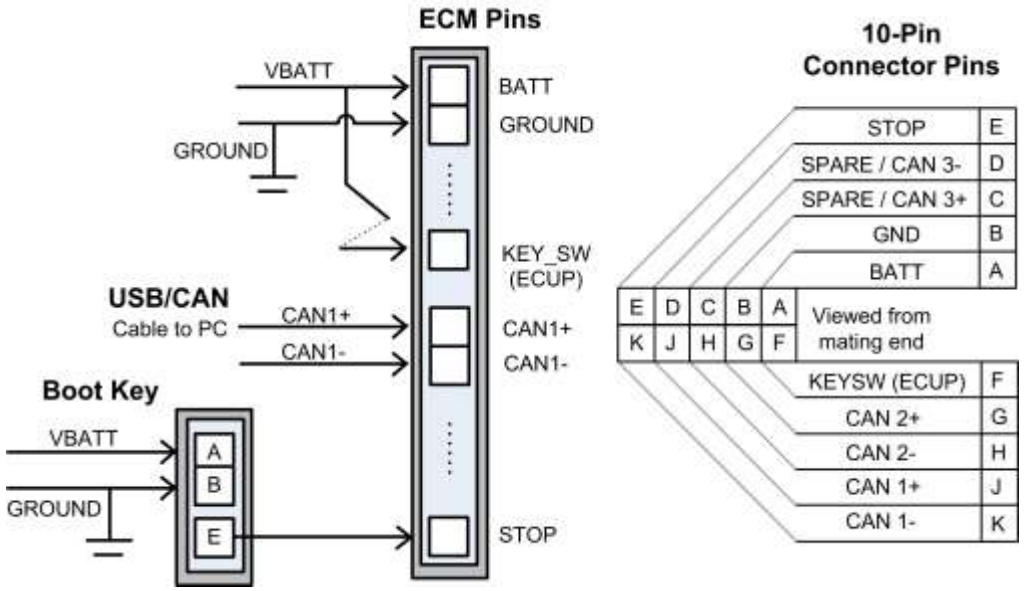
WARNING **Remove the ECU from direct control connections before performing the reboot procedure, as outputs are set to defaults or undefined states, with unpredictable and possibly hazardous results if applied.**

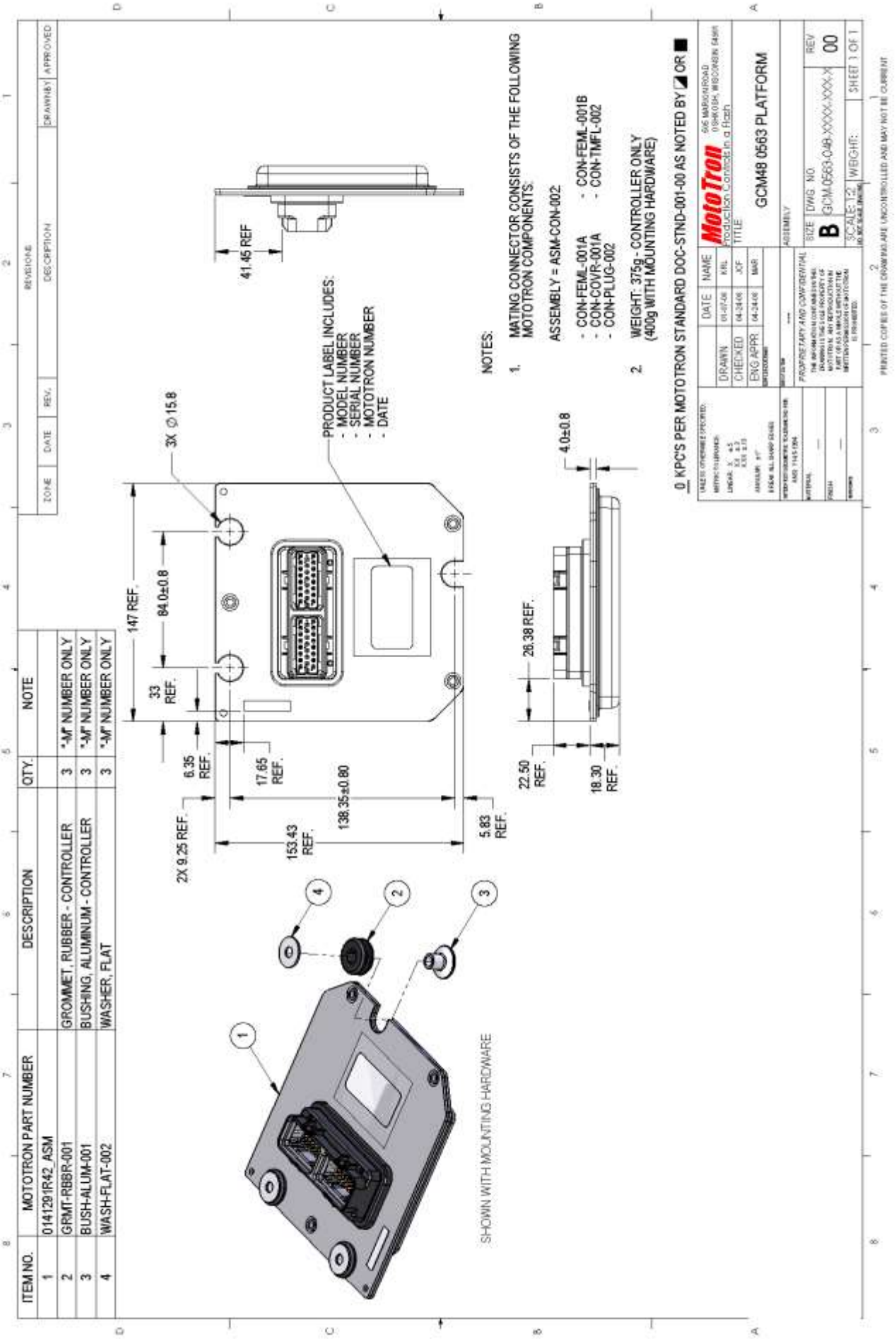
NOTICE **Remove other ECUs from CANbus for this procedure.**

1. Connect the module for programming via necessary cables, CAN converter, etc.
2. Select a known, valid .srz file for programming.
3. With key off, disconnect battery power from module. With module power off, initiate programming of the module using MotoTune.
4. When the “Looking for an ECU” prompt appears in the dialog, reconnect Battery, and then turn key on, to power up and “wake-up” ECU.

The module must “wake-up” – KEYSW (or ECUP) on – with the boot key or cable connections applied as described in order to initiate a reboot and to absorb the selected program.

Note: A boot key provides a 555 Hz, 50% duty cycle, $V=V_{batt}$, square wave signal to the STOP pin, which may be duplicated by applying this signal from a signal generator to that pin.




ZONE | DATE | REV. | DESCRIPTION | DRAWN BY | APPROVED
REVISIONS
ITEM NO. | MOTOTRON PART NUMBER | DESCRIPTION | QTY. | NOTE
1 | 0141291R42_ASM | | | *-M* NUMBER ONLY
2 | GRMT-RB8R-001 | GROMMET, RUBBER - CONTROLLER | 3 | *-M* NUMBER ONLY
3 | BUSH-ALUM-001 | BUSHING, ALUMINUM - CONTROLLER | 3 | *-M* NUMBER ONLY
4 | WASH-FLAT-002 | WASHER, FLAT | 3 | *-M* NUMBER ONLY
SHOWN WITH MOUNTING HARDWARE
NOTES:
1. MATING CONNECTOR CONSISTS OF THE FOLLOWING MOTOTRON COMPONENTS:
ASSEMBLY = ASM-CON-002
- CON-FEML-001A - CON-FEML-001B
- CON-COVR-001A - CON-TMFL-002
- CON-PLUG-002
2. WEIGHT: 375g - CONTROLLER ONLY (400g WITH MOUNTING HARDWARE)
0 KPC'S PER MOTOTRON STANDARD DOC-STND-001-00 AS NOTED BY ◪ OR ■
PRODUCT LABEL INCLUDES:
- MODEL NUMBER
- SERIAL NUMBER
- MOTOTRON NUMBER
- DATE
3X Ø 15.8
147 REF.
84.0±0.8
33 REF.
6.35 REF.
17.65 REF.
2X 9.25 REF.
153.43 REF.
138.35±0.80
5.83 REF.
41.45 REF
4.0±0.8
26.38 REF.
22.50 REF.
18.30 REF.
DRAWN | DATE | NAME
CHECKED | 04-24-06 | JOF
ENG APPR. | 04-24-06 | MAR
MOTOTRON 606 MARKHORAD DYNKIRK, WISCONSIN 54304
Production Controller in a Horn
TITLE
GCM48 0563 PLATFORM
ASSEMBLY
PROPRIETARY AND CONFIDENTIAL
SIZE | DWG. NO. | REV
B | GCM-0563-048-XXXX-XXX-X | 00
SCALE: 1:2 | WEIGHT: | SHEET 1 OF 1
PRINTED COPIES OF THE DRAWING ARE UNCONTROLLED AND MAY NOT BE CURRENT

PO Box 1519, Fort Collins CO, USA 80522-1519
1041 Woodward Way, Fort Collins CO 80524, USA
Phone: +1 (970) 482-5811
Email and Website—www.woodward.com

Woodward has company-owned plants, subsidiaries, and branches, as well as authorized distributors and other authorized service and sales facilities throughout the world. Complete address / phone / fax / email information for all locations is available on our website.

For more information contact: