



## MotoHawk Control Solutions

# ECM-0565-128-0701-C

## Engine Control Module (Part No. 8237-1238)

### Description

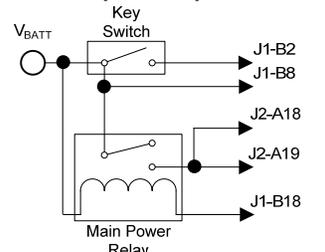
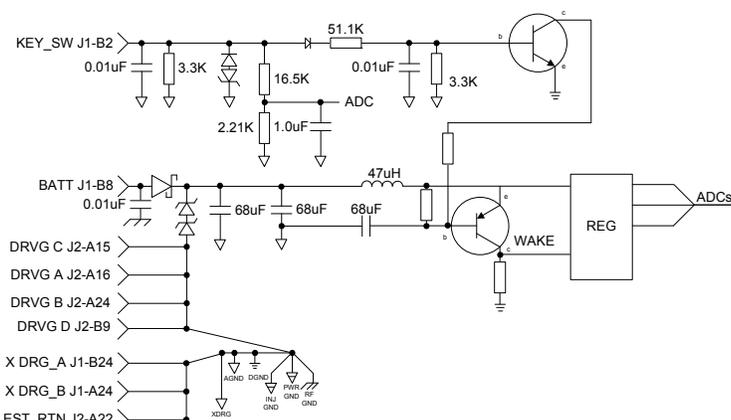
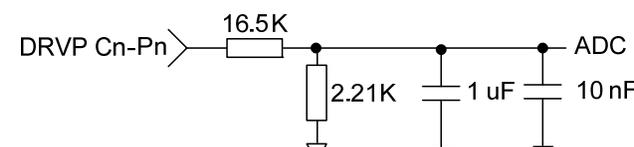
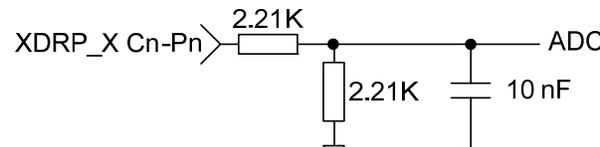
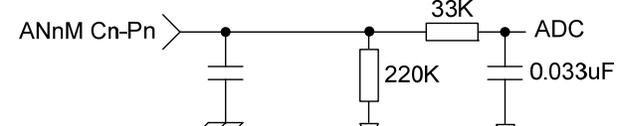
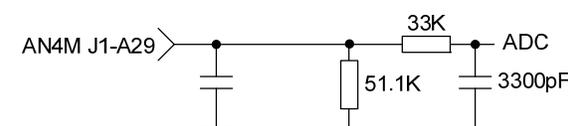
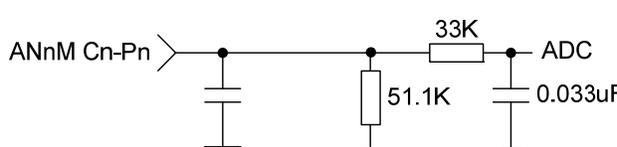
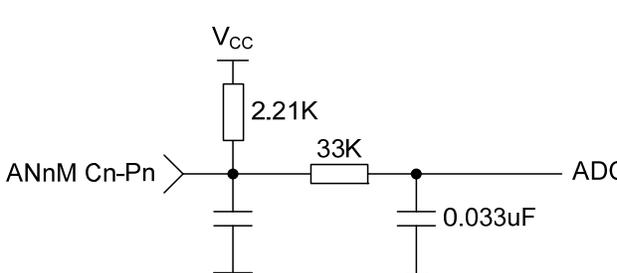
Presenting the ECM-0565-128-0701-C engine control module from Woodward's new MotoHawk Control Solutions product line. This rugged embedded controller is capable of operating in harsh automotive, marine, and off-highway applications. Numerous marine applications have proven the capability of this module. Based on the Freescale MPC565 family of microprocessors, the ECM-0565-128-0701-C modules are 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.

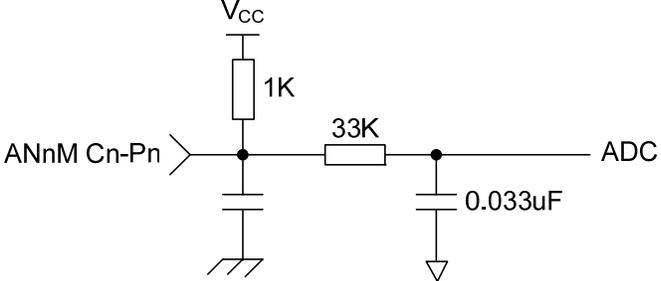
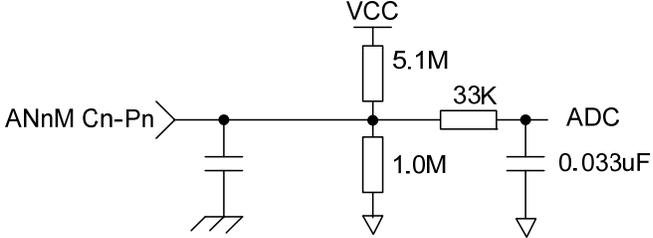
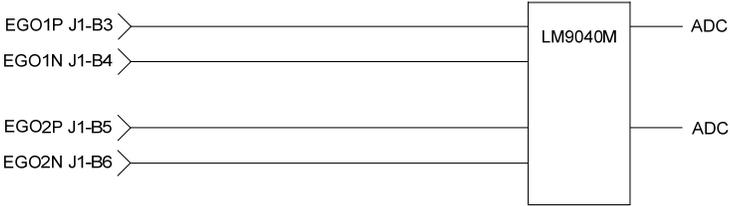
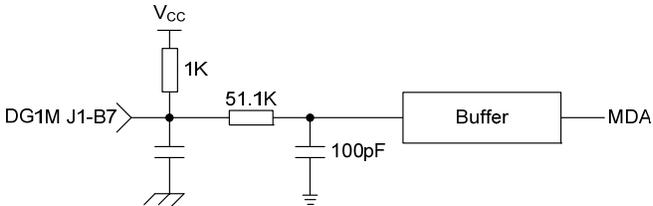
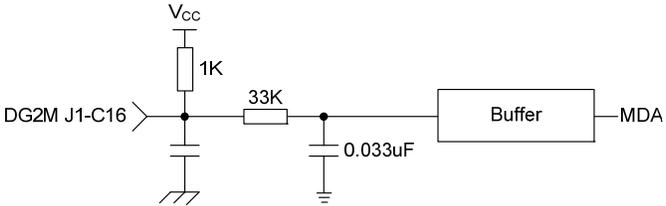
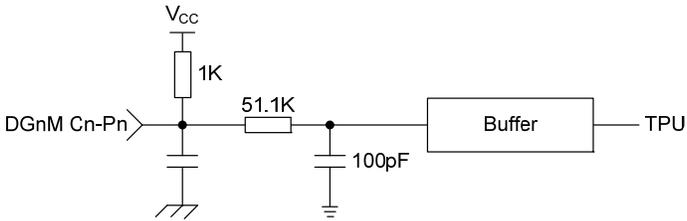
The ECM-0565-128-0701-C module is part of the ControlCore<sup>®</sup> family of embedded control systems. MotoHawk Control Solutions' ControlCore operating system, MotoHawk<sup>®</sup> code-generation product, and MotoHawk's suite of development tools enable rapid development of complex control systems.

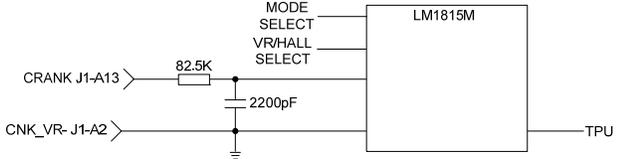
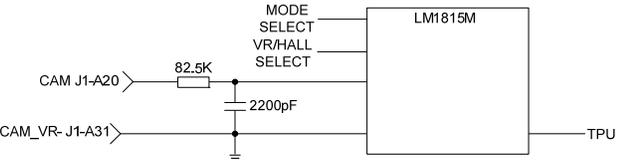
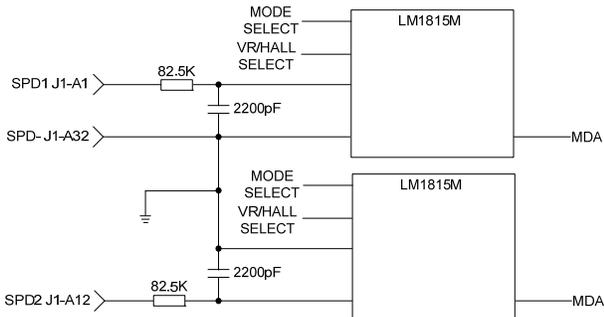
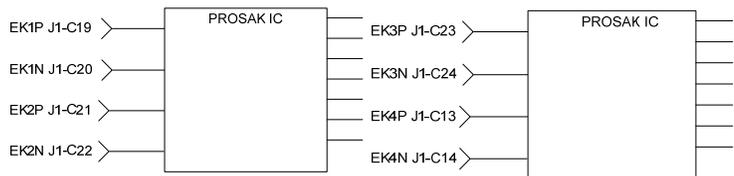
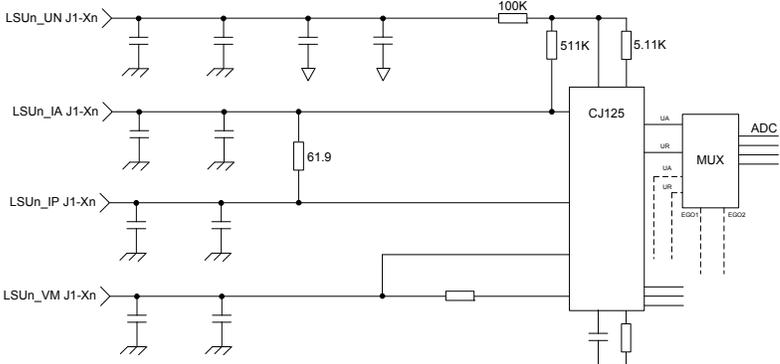
### **IMPORTANT**

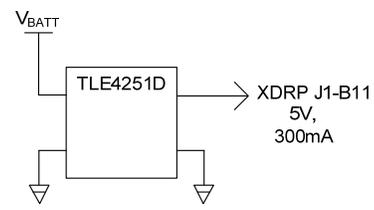
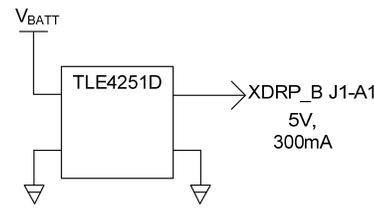
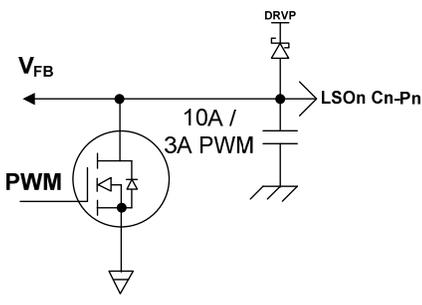
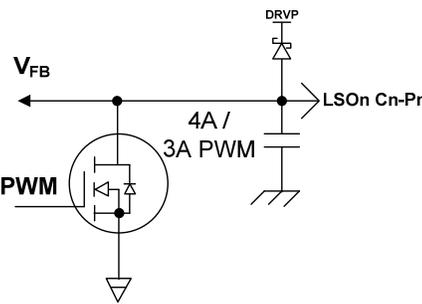
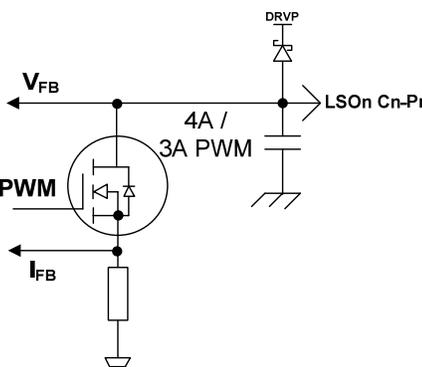
Woodward does not warranty this ECM based on information supplied in this datasheet, but only with an express and specific production supply agreement based on customer's operating mode. Information in this datasheet is subject to change without prior notice. Please contact MotoHawk Control Solutions sales for more information.

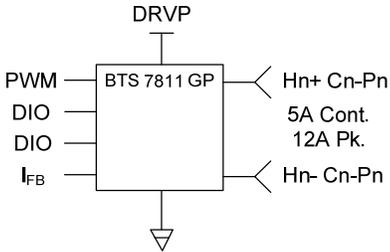
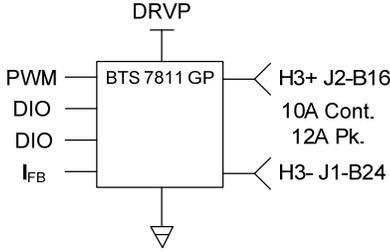
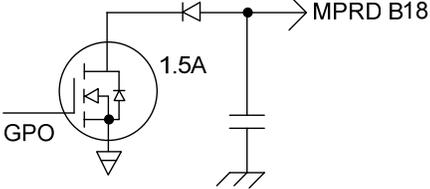
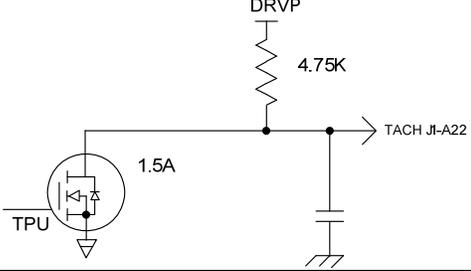
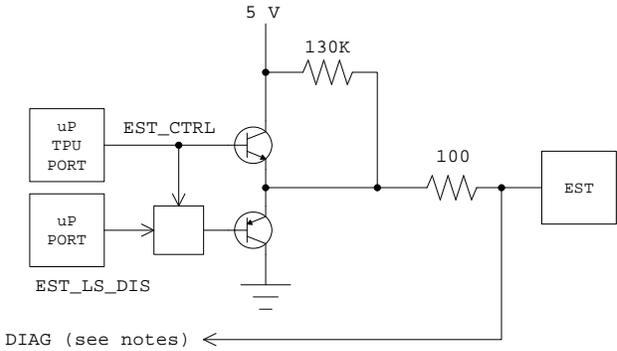
- **Microprocessor:**  
Freescale MPC565,  
56 MHz
- **Memory:** 1M Flash,  
548K RAM, 8K Serial  
EEPROM, 64Kx8  
Parallel EEPROM
- **Operating Voltage:**  
9–32 Vdc
- **Operating  
Temperature:** –40 to  
+105 °C
- Sealed connectors  
operable to 10 ft (3 m)  
submerged
- **Inputs:**  
30 Analog  
4 Low Frequency Digital  
4 VR Frequency  
2 Wide Range O<sub>2</sub> (I)  
Sensor Inputs  
(Bosch LSU4.2)  
Dual Lambda Sensor  
Interface (switch  
type)  
4 Dual Sensor Wide  
Band Knock Detector  
Input
- **Outputs:**  
6x 3 A Peak/1 A Hold  
Injector Drivers  
6x 7 A/3 A or 3 A/1 A  
Peak/Hold Inj.  
Drivers  
16x TTL Level Ignition  
System  
10x 3 A Low Side PWMs  
1x 1.5 A Tachometer  
Output  
2x 5 A H-Bridge PWMs  
1x 10 A H-Bridge PWM  
1x Relay Driver (Main  
Power)
- **Datalinks:**  
2 CAN 2.0B Channels  
1 ISO 9141 Channel  
(KWP2000/  
HWP2000,  
10.4 kbps)  
1 RS-485 Channel

| 1-Input Signal Conditioning  | See Freescale MPC565 Datasheet for description of processor resources.               |
|--|--|
| <p><b>1.1 KEY_SW (J1-B2), BATT (J1-B8), DRVG A (J2-A16), DRVG B (J2-A24), DRVG C (J2-A15), DRVG D (J2-B9), XDRG_A (J1-B24), XDRG_B (J1-A24), EST_RTN (J2-A22)</b></p>  <p>DRVG is connected to Battery Ground, XDRG is the transducer return.</p> |    |
| <p><b>1.2 DRVP (J2-A18, J2-A19)</b></p> <p>This is the source for the H-Bridges (via the Main Power Relay). The DRVP monitor is scaled for 42.5 V 12 V = 290 counts.</p>   |    |
| <p><b>1.3 XDRP_A, XDRP_B (J1-B11, J1-A11)</b></p> <p>The XDRP monitors are scaled for 10 V 5 V = 512 counts.</p>   |   |
| <p><b>1.4 AN1M, AN2M, AN3M (J1-A14, J1-A18, J1-A8)</b></p> <p>These inputs are 10-bit 0–5 V ADCs, <math>\tau = 1</math> ms<br/>They are intended for potentiometers</p>  |  |
| <p><b>1.5 AN4M (J1-A2)</b></p> <p>This input is a 10-bit 0–5 V ADCs, <math>\tau = 100</math> <math>\mu</math>s.<br/>It is intended for a MAP sensor.</p>   |  |
| <p><b>1.6 AN5M...AN12M (J1-A30, J1-A6, J1-A21, J1-A17, J1-A25, J1-A16, J1-A26, J1-A15)</b></p> <p>These inputs are 10-bit 0–5 V ADCs, <math>\tau = 1</math> ms.<br/>They are intended for pressure sensors.</p>  |  |
| <p><b>1.7 AN13M, AN26M...AN28M (J1-A10, J1-C12, J1-C15, J1-C7)</b></p> <p>These inputs are 10-bit 0–5 V ADCs, <math>\tau = 1</math> ms.<br/>They are intended for variable-resistance sensors such as thermistors.</p>   |  |

| 1-Input Signal Conditioning   | (continued)  |
|---|--|
| <p><b>1.8 AN14M...AN25M</b><br/>(J1-A28, J1-A5, J1-A27, J1-A7, J1-C10, J1-C11, J1-C9, J1-C2, J1-C4, J1-C5, J1-C1, J1-C3)</p> <p>These input are 10-bit 0–5 V ADCs, <math>\tau = 1</math> ms.<br/>They are intended for variable-resistance sensors such as thermistors.</p> |    |
| <p><b>1.9 AN29M, AN30M</b><br/>(J1-C6, J1-C8)</p> <p>These inputs are 10-bit 0–5 V ADCs, <math>\tau = 1</math> ms.<br/>They are intended for switch type Oxygen sensors.</p>  |    |
| <p><b>1.10 EGO1P, EGO1N, EGO2P, EGO2N</b><br/>(J1-B3, J1-B4, J1-B5, J1-B6)</p>  |    |
| <p><b>1.10.1 DG1M</b><br/>(J1-B7)</p> <p>Digital switch input; <math>V_{IL}=2.0</math> V max., <math>V_{IH}=2.5</math> V min.,<br/><math>\tau = 5.1</math> <math>\mu</math>s.</p>   |  |
| <p><b>1.11 DG2M</b><br/>(J1-C16)</p> <p>Digital switch input; <math>V_{IL}=2.0</math> V max., <math>V_{IH}=2.5</math> V min.,<br/><math>\tau = 1</math> ms.</p>   |  |
| <p><b>1.12 DG3M, DG4M</b><br/>(J1-A19, J1-A9)</p> <p>Digital switch inputs; <math>V_{IL}=2.0</math> V max., <math>V_{IH}=2.5</math> V min., <math>\tau = 5.1</math> <math>\mu</math>s.<br/>They may be used for high speed MAF sensors.</p>                                 |  |

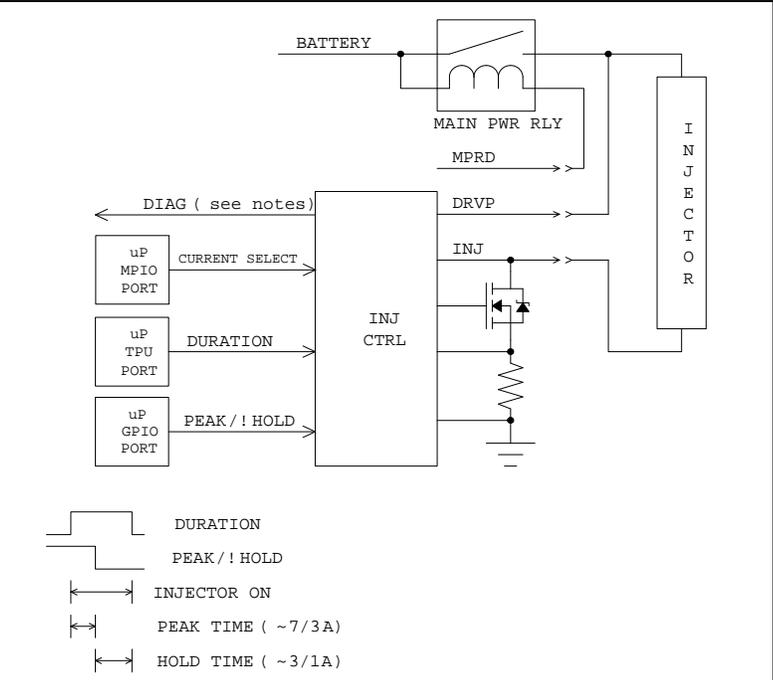
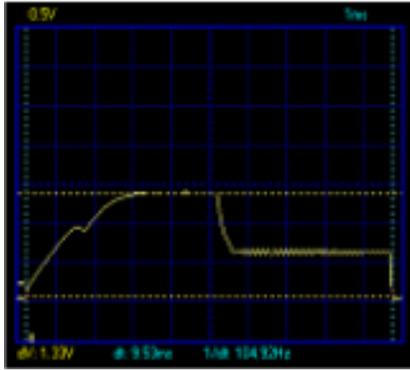
| 1-Input Signal Conditioning   | (continued)  |
|---|--|
| <p><b>1.13 CRANK, CNK_VR-</b><br/><b>(J1-A13, J1-A2)</b><br/>CRANK input may be used with a Hall-Effect or Variable Reluctance sensor.</p>  |    |
| <p><b>1.14 CAM, CAM_VR-</b><br/><b>(J1-A20, J1-A31)</b><br/>CAM input may be used with a Hall-Effect or Variable Reluctance sensor</p>  |    |
| <p><b>1.15 SPD1, SPD2, SPD-</b><br/><b>(J1-A1, J1-A12, J1-A32)</b><br/>Speed inputs may be used with a Hall-Effect or Variable Reluctance sensor.</p>   |    |
| <p><b>1.16 EK1P, EK1N, EK2P, EK2N, EK3P, EK3N, EK4P, EK4N</b><br/><b>(J1-C19, J1-C20, J1-C21, J1-C22, J1-C23, J1-C24, J1-C13, J1-C14)</b><br/>These inputs are intended for wide-band piezoelectric knock sensors.</p>            |   |
| <p><b>1.17 LSU1_UN, LSU1_IA, LSU1_IP, LSU1_VM, LSU2_UN, LSU2_IA, LSU2_IP, LSU2_VM</b><br/><b>(J1-B21, J1-B15, J1-B14, J1-B1, J1-B12, J1-B16, J1-B17, J1-B13)</b><br/>This circuit is compatible with the Bosch LSU4.2 sensor.</p> |  |

| 2-Output Signal Conditioning   |  |
|--|--|
| <p><b>2.1 XDRP_A<br/>(J1-B11)</b><br/>Independent 5 V, 300 mA transducer power.</p>  |    |
| <p><b>2.2 XDRP_B<br/>(J1-A11)</b><br/>Independent 5 V, 300 mA transducer power.</p>  |    |
| <p><b>2.3 LSO1/LSUH1, LSO2/LSUH2<br/>(J1-B20, J1-B19)</b><br/>These are low side drivers intended to drive heaters for the Lambda Sensing Units (1.17), 10 A continuous, 3 A PWM. LSO1 and 2 each use one leg of a 6 A dual diode part so average PWM current between the two can not exceed 6 A. The corresponding average load current allowed depends on the duty cycle. The higher the duty cycle, the less current will flow through the diode.</p> |    |
| <p><b>2.4 LSO 5... LSO 10<br/>(J2-B12, J2-B15, J2-B17, J2-B19, J2-B18, J2-B20)</b><br/>These are low side drivers intended to drive inductive loads, 4 A continuous, 3 A PWM.</p>  |  |
| <p><b>2.5 LSO 3, LSO4<br/>(J1-A23, J2-B21)</b><br/>These are low side drivers with current feedback, 4 A continuous, 3 A PWM.</p>  |  |

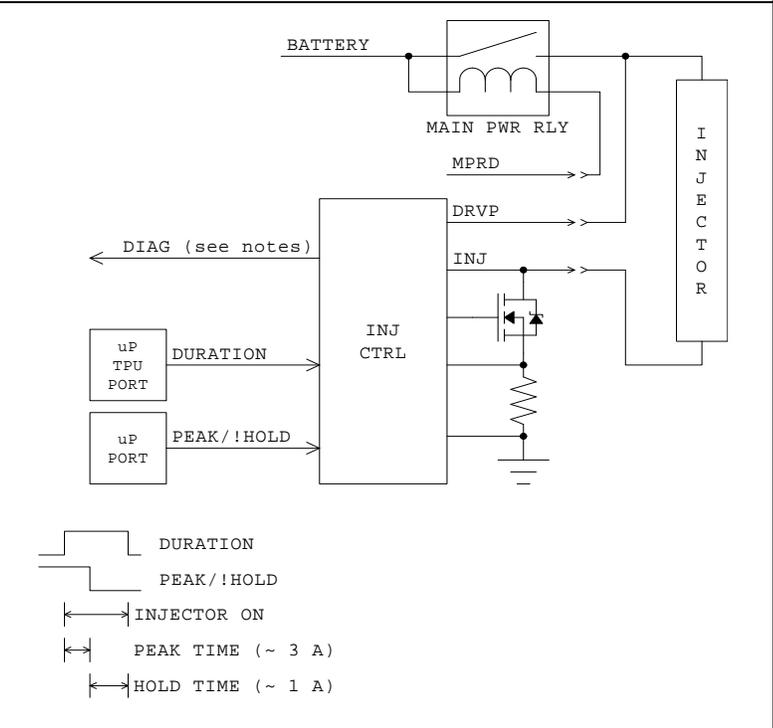
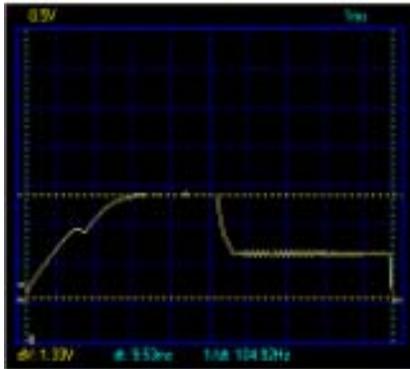
| 2-Output Signal Conditioning  | (continued)  |
|---|--|
| <p><b>2.6 H1+, H1-, H2+, H2-</b><br/>(J2-A9, J2-A17, J2-B22, J2-B23)</p> <p>These outputs are high current drivers intended for loads that may be operated in either polarity such as DC motors.</p>  |    |
| <p><b>2.7 H3+, H3-</b><br/>(J2-B16, J2-B24)</p> <p>These outputs are high current drivers intended for loads that may be operated in either polarity such as DC motors.</p>   |    |
| <p><b>2.8 MPRD</b><br/>(J1-B18)</p> <p>This is a 1.5 A low side driver intended to drive a relay coil (1.1) that supplies DRVP used by the loads and H-Bridges (see above).</p>   |    |
| <p><b>2.9 TACH</b><br/>(J1-A22)</p> <p>This is a 1.5 A low side driver intended to drive a tachometer.</p>  |   |
| <p><b>2.10 EST1...EST12, EST13/LAMP1...EST16/LAMP4</b><br/>(J2-A12, J2-A13, J2-A14, J2-A20, J2-A10, J2-A11, J2-A21, J2-A23, J2-B14, J2-B13, J2-B11, J2-B10, J2-B6, J2-B5, J2-B7, J2-B8)</p> <p>These are TTL level outputs intended for intelligent coil modules.</p> <p><b>Notes:</b> Short circuit protection, open circuit and short circuit detection.</p> <p>Since EST_RTN (not shown) is a direct path to the ECM ground care must be taken not to introduce ground loops. EST_RTN is not designed to carry any significant current; it is a reference only. It should be open circuit unless the smart coil electronics provides an isolated logic ground reference. Care must also be taken not to introduce noise on EST_RTN. Electrical transients on EST_RTN can cause module upsets.</p> <p>EST13/LAMP1...EST16/Lamp4 may be used to drive resistive loads requiring up to 1.5 A.</p> |  <p>DIAG (see notes) ←</p> <p>↑ EST_CTRL<br/>↑ EST<br/>↑ DWELL<br/>↑ SPARK TRIGGER</p> |

**2-Output Signal Conditioning (continued)**

**2.11 INJ04, INJ05, INJ07...INJ09, INJ12 (J2-A6, J2-A8, J2-A2, J2-A4, J2-B3, J2-B1)**  
**Notes:** When the injector output is on (duration) the current is regulated to either the peak or hold level, which is determined by the Current Select signal. Current regulation is implemented via a chopper drive and the recirculation path is via DRVP. If the output is off there is no leakage path to DRVP and flyback energy is dissipated via low-side avalanche.



**2.11.1 INJ01, ...INJ03, INJ06, INJ10, INJ11 (J2-A1, J2-A3, J2-A7, J2-A5, J2-B2, J2-B4)**  
**Notes:** When the injector output is on (duration) the current is regulated to either the peak or hold level. Current regulation is implemented via a chopper drive and the recirculation path is via DRVP. If the output is off there is no leakage path to DRVP and flyback energy is dissipated via low-side avalanche.



**3-Communications**

|  |   |
|--|---|
| <p><b>3.1 CAN1+, CAN1-, CAN2+, CAN2- (J1-B9, J1-B10, J1-C17, J1-C18)</b></p> | <p>CAN 2.0B, Standard or Extended ID, up to 1 MBd.</p>                                |
| <p><b>3.2 RS-485+, RS-485- (J1-B22, J1-B23)</b></p>                          | <p>RS-485, programmable baud rate 1200 - 57600.<br/>8 Bits, No Parity, 1 Stop Bit</p> |
| <p><b>3.3 ISO 9141-K, ISO 9141-L (J1-A3, J1-A4)</b></p>                      | <p>KWP2000/HWP2000, 10.4 kBd</p>  |

| 4-Connector Pinouts |                              |                            |                         |                  |           |
|---------------------|------------------------------|----------------------------|-------------------------|------------------|-----------|
| Pin #<br>ECM        | ControlCore<br>Resource Name | Function                   | Notes                   | Wire<br>Color    | Wire<br># |
| J1-A1               | SPD1                         | Auxiliary Speed Input      | VR or HALL Effect       | purple/white     | 1         |
| J1-A2               | CNK_VR-                      | Return for CRANK VR sensor |                         | white/yellow     | 2         |
| J1-A3               | ISO_9141_K                   | Serial Data Link           | ISO 9141 Compliant      | yellow           | 3         |
| J1-A4               | ISO_9141_L                   |                            |                         | blue/black       | 4         |
| J1-A5               | AN15M                        | Variable Resistance Input  | 1K Pull Up              | white/orange     | 5         |
| J1-A6               | AN6M                         | Pressure Input             | 51K Pull Down           | light blue/white | 6         |
| J1-A7               | AN17M                        | Variable Resistance Input  | 1K Pull Up              | white/yellow     | 7         |
| J1-A8               | AN3M                         | Pressure Input             | 220K Pull Down          | brown/white      | 8         |
| J1-A9               | DG4                          | Discrete Switch, Frequency | 1K Pull Up              | yellow/pink      | 9         |
| J1-A10              | AN13M                        | Potentiometer Input        | 2.2K Pull Up            | red/pink         | 10        |
| J1-A11              | XDRP_B                       | Transducer Power B (5 V)   | Transducer Power        | white            | 11        |
| J1-A12              | SPD2                         | Auxiliary Speed Input      | VR or HALL Effect       | white/red        | 12        |
| J1-A13              | CNK                          | Crank Position Signal      | VR or HALL Effect       | tan/orange       | 13        |
| J1-A14              | AN1M                         | Pressure Input             | 220K Pull Down          | tan              | 14        |
| J1-A15              | AN12M                        | Pressure Input             | 51K Pull Down           | tan/green        | 15        |
| J1-A16              | AN10M                        | Pressure Input             | 51K Pull Down           | green            | 16        |
| J1-A17              | AN8M                         | Pressure Input             | 51K Pull Down           | brown            | 17        |
| J1-A18              | AN2M                         | Pressure Input             | 220K Pull Down          | white/dark blue  | 18        |
| J1-A19              | DG3                          | Discrete Switch, Frequency | 1K Pull Up              | black/red        | 19        |
| J1-A20              | CAM                          | Cam Position Signal        | VR or HALL Effect       | yellow/orange    | 20        |
| J1-A21              | AN7M                         | Pressure Input             | 51K Pull Down           | dark blue        | 21        |
| J1-A22              | TACH                         | Tachometer Output          | 4.75K Pull Up           | black/orange     | 22        |
| J1-A23              | LSO3                         | PWM with current feedback  | 4 A continuous, 3 A PWM | purple/yellow    | 23        |
| J1-A24              | XDRG                         | Transducer Ground          | Return for Transducers  | red/purple       | 24        |
| J1-A25              | AN9M                         | Pressure Input             | 51K Pull Down           | light blue/black | 25        |
| J1-A26              | AN11M                        | Pressure Input             | 51K Pull Down           | pink/black       | 26        |
| J1-A27              | AN16M                        | Variable Resistance Input  | 1K Pull Up              | orange/pink      | 27        |
| J1-A28              | AN14M                        | Variable Resistance Input  | 1K Pull Up              | dark blue/white  | 28        |
| J1-A29              | AN4M                         | Pressure Input             | 51K Pull Down           | white/light blue | 29        |
| J1-A30              | AN5M                         | Pressure Input             | 51K Pull Down           | white/black      | 30        |
| J1-A31              | CAM_VR-                      | Return for CAM VR sensor   |                         | yellow           | 31        |
| J1-A32              | SPD-                         | Return for SPD VR sensors  |                         | brown            | 32        |

| 4-Connector Pinouts (continued) |                              |                                 |  |                  |           |
|---------------------------------|------------------------------|---------------------------------|--|------------------|-----------|
| Pin #<br>ECM                    | ControlCore<br>Resource Name | Function                        | Notes  | Wire<br>Color    | Wire<br># |
| J1-B1                           | LSU1_VM                      | Lambda Sensing Unit             | See datasheet for Bosch LSU4.x<br>and CJ125. | black/green      | 33        |
| J1-B2                           | KEY_SW                       | ECM Wake                        | Wake Up Module                               | green/black      | 34        |
| J1-B3                           | EGO1P                        | LM9040 EGO                      |  | gray/dark blue   | 35        |
| J1-B4                           | EGO1N                        |                                 |  | yellow/purple    | 36        |
| J1-B5                           | EGO2P                        |                                 |  | white            | 37        |
| J1-B6                           | EGO2N                        |                                 |  | white/purple     | 38        |
| J1-B7                           | DG1                          | Discrete Switch, Frequency, IRQ | 1K Pull Up                                   | light blue/black | 39        |
| J1-B8                           | BATT                         | Battery Connection              |  | yellow/black     | 40        |
| J1-B9                           | CAN1+                        | Serial Communications           | Terminating Resistance<br>Required           | green/purple     | 41        |
| J1-B10                          | CAN1-                        |                                 |  | green/brown      | 42        |
| J1-B11                          | XDRP_A                       | Transducer Power A (5 V)        | 300 mA Source for Transducers                | orange           | 43        |
| J1-B12                          | LSU2_UN                      | Lambda Sensing Unit2            |  | gray             | 44        |
| J1-B13                          | LSU2_VM                      |                                 |  | red              | 45        |
| J1-B14                          | LSU1_IP                      | Lambda Sensing Unit1            | See datasheet for Bosch<br>LSU4.x and CJ125. | white/brown      | 46        |
| J1-B15                          | LSU1_IA                      |                                 |  | black/blue       | 47        |
| J1-B16                          | LSU2_IA                      | Lambda Sensing Unit2            |  | orange/black     | 48        |
| J1-B17                          | LSU2_IP                      |                                 |  | red/blue         | 49        |
| J1-B18                          | MPRD                         | Main Power Relay Driver         | Wire to Coil of Main Power<br>Relay          | red/blue         | 50        |
| J1-B19                          | LSO2/LSUH2                   | PWM Output/ LSU Heater          | 10 A continuous, 3 A PWM                     | yellow/white     | 51        |
| J1-B20                          | LSO1/LSUH1                   |                                 |  | pink/light blue  | 52        |
| J1-B21                          | LSU1_UN                      | Lambda Sensing Unit1            | See datasheet for Bosch LSU4.x<br>and CJ125. | orange/white     | 53        |
| J1-B22                          | SCL+                         | RS-485 HI                       |  | pink/dark blue   | 54        |
| J1-B23                          | SCL-                         | RS-485 LO                       |  | black/yellow     | 55        |
| J1-B24                          | XDRG                         | Transducer Ground               | Return for Transducers                       | purple/pink      | 56        |

| 4-Connector Pinouts (continued) |                              |  |   |                  |           |
|---------------------------------|------------------------------|--|---|------------------|-----------|
| Pin #<br>ECM                    | ControlCore<br>Resource Name | Function                                 | Notes                                     | Wire<br>Color    | Wire<br># |
| J1-C1                           | AN24M                        | Variable Resistance Input                | 1K Pull Up                                | yellow/orange    | 57        |
| J1-C2                           | AN21M                        | Variable Resistance Input                | 1K Pull Up                                | brown/white      | 58        |
| J1-C3                           | AN25M                        | Variable Resistance Input                | 1K Pull Up                                | red/white        | 59        |
| J1-C4                           | AN22M                        | Variable Resistance Input                | 1K Pull Up                                | brown/yellow     | 60        |
| J1-C5                           | AN23M                        | Variable Resistance Input                | 1K Pull Up                                | brown/white      | 61        |
| J1-C6                           | AN29M                        | High Impedance Input                     | 5.1M Pull Up, 1M Pull Down                | pink/black       | 62        |
| J1-C7                           | AN28M                        | Potentiometer Input                      | 2.2K Pull Up                              | green/orange     | 63        |
| J1-C8                           | AN30M                        | High Impedance Input                     | 5.1M Pull Up, 1M Pull Down                | green/blue       | 64        |
| J1-C9                           | AN20M                        | Variable Resistance Input                | 1K Pull Up                                | yellow/red       | 65        |
| J1-C10                          | AN18M                        | Variable Resistance Input                | 1K Pull Up                                | yellow/white     | 66        |
| J1-C11                          | AN19M                        | Variable Resistance Input                | 1K Pull Up                                | pink/brown       | 67        |
| J1-C12                          | AN26M                        | Potentiometer Input                      | 2.2K Pull Up                              | green/red        | 68        |
| J1-C13                          | EK4P/DG7                     | Knock Sensor Positive                    | Compatible with the<br>Motorola PROSAK IC | green/white      | 69        |
| J1-C14                          | EK4N/DG8                     | Knock Sensor Negative                    |   | green/yellow     | 70        |
| J1-C15                          | AN27M                        | Potentiometer Input                      | 2.2K Pull Up                              | black            | 71        |
| J1-C16                          | DG2                          | Discrete Switch, Frequency, IRQ          | 1K Pull Up                                | black            | 72        |
| J1-C17                          | CAN2+                        | Serial Communications                    | Terminating Resistance<br>Required        | gray/white       | 73        |
| J1-C18                          | CAN2-                        |  |   | gray/red         | 74        |
| J1-C19                          | EK1P                         | Knock Sensor Positive                    | Compatible with the<br>Motorola PROSAK IC | yellow/pink      | 75        |
| J1-C20                          | EK1N                         | Knock Sensor Negative                    |   | green/white      | 76        |
| J1-C21                          | EK2P                         | Knock Sensor Positive                    |   | pink/purple      | 77        |
| J1-C22                          | EK2N                         | Knock Sensor Negative                    |   | light blue/white | 78        |
| J1-C23                          | EK3P/DG5                     | Knock Sensor Positive/<br>Discrete Input |   | pink/orange      | 79        |
| J1-C24                          | EK3N/DG6                     | Knock Sensor Negative/<br>Discrete Input |   | black            | 80        |

| 4-Connector Pinouts (continued) |                              |                         |                              |                      |                           |
|---------------------------------|------------------------------|-------------------------|------------------------------|----------------------|---------------------------|
| Pin #<br>ECM                    | ControlCore<br>Resource Name | Function                | Notes                        | Wire<br>Color        | Wire<br>#                 |
| J2-A1                           | INJ01                        | Injector 1 Driver       | 3 A/1 A peak/hold            | pink/light blue      | 81                        |
| J2-A2                           | INJ07                        | Injector 7 Driver       | 7 A/3 A or 3 A/1 A peak/hold | pink/orange          | 82                        |
| J2-A3                           | INJ02                        | Injector 2 Driver       | 3 A/1 A peak/hold            | yellow/black         | 83                        |
| J2-A4                           | INJ08                        | Injector 8 Driver       | 7 A/3 A or 3 A/1 A peak/hold | white                | 84                        |
| J2-A5                           | INJ06                        | Injector 6 Driver       | 3 A/1 A peak/hold            | white/<br>dark blue  | 85                        |
| J2-A6                           | INJ04                        | Injector 4 Driver       | 7 A/3 A or 3 A/1 A peak/hold | black/red            | 86                        |
| J2-A7                           | INJ03                        | Injector 3 Driver       | 3 A/1 A peak/hold            | yellow/orange        | 87                        |
| J2-A8                           | INJ05                        | Injector 5 Driver       | 7 A/3 A or 3 A/1 A peak/hold | light blue           | 88                        |
| J2-A9                           | H1+                          | H-Bridge Output         | High Current (5 A)           | tan/light blue       | 89                        |
| J2-A10                          | EST5                         | Electronic Spark Timing | TTL                          | gray                 | 90                        |
| J2-A11                          | EST6                         |                         |                              | dark blue            | 91                        |
| J2-A12                          | EST1                         |                         |                              | dark blue/white      | 92                        |
| J2-A13                          | EST2                         |                         |                              | white/<br>light blue | 93                        |
| J2-A14                          | EST3                         |                         |                              | white/black          | 94                        |
| J2-A15                          | DVRG                         |                         |                              | Driver Ground        | Connect to Battery Ground |
| J2-A16                          | DVRG                         | black/white             | 96                           |                      |                           |
| J2-A17                          | H1-                          | H-Bridge Output         | High Current (5 A)           | pink/purple          | 97                        |
| J2-A18                          | DRVP                         | Driver Power (VBATT)    | Power to H-Bridges and Loads | pink/brown           | 98                        |
| J2-A19                          | DRVP                         |                         |                              | orange               | 99                        |
| J2-A20                          | EST4                         | Electronic Spark Timing | TTL                          | orange/white         | 100                       |
| J2-A21                          | EST7                         |                         |                              | black/blue           | 101                       |
| J2-A22                          | EST_RTN                      | Low Current Return      |                              | yellow/purple        | 102                       |
| J2-A23                          | EST8                         | Electronic Spark Timing | TTL                          | red/blue             | 103                       |
| J2-A24                          | DVRG                         | Driver Ground           | Connect to Battery Ground    | black/white          | 104                       |

| 4-Connector Pinouts (continued) |                              |  |                              |                  |           |
|---------------------------------|------------------------------|--|------------------------------|------------------|-----------|
| Pin #<br>ECM                    | ControlCore<br>Resource Name | Function   | Notes                        | Wire<br>Color    | Wire<br># |
| J2-B1                           | INJ12                        | Injector 12 Driver                               | 7 A/3 A or 3 A/1 A peak/hold | black/orange     | 105       |
| J2-B2                           | INJ10                        | Injector 10 Driver                               | 3 A/1 A peak/hold            | tan              | 106       |
| J2-B3                           | INJ09                        | Injector 9 Driver                                | 7 A/3 A or 3 A/1 A peak/hold | yellow           | 107       |
| J2-B4                           | INJ11                        | Injector 11 Driver                               | 3 A/1 A peak/hold            | dark blue/pink   | 108       |
| J2-B5                           | EST14/LAMP2                  | Electronic Spark Timing/<br>Low Side Lamp Driver | High Current (1 A)           | red/pink         | 109       |
| J2-B6                           | EST13/LAMP1                  |  |                              | white            | 110       |
| J2-B7                           | EST15/LAMP3                  | Electronic Spark Timing/<br>Low Side Lamp Driver | High Current (1 A)           | white/green      | 111       |
| J2-B8                           | EST16/LAMP4                  |  |                              | brown/white      | 112       |
| J2-B9                           | DVRG                         | Driver Ground                                    | Connect to<br>Battery Ground | gray/red         | 113       |
| J2-B10                          | EST12                        | Electronic Spark Timing                          | TTL                          | orange/black     | 114       |
| J2-B11                          | EST11                        |  |                              | blue/black       | 115       |
| J2-B12                          | LSO5                         | PWM Output                                       | 4 A continuous, 3 A PWM      | white/orange     | 116       |
| J2-B13                          | EST10                        | Electronic Spark Timing                          | TTL                          | white/yellow     | 117       |
| J2-B14                          | EST9                         |  |                              | tan/green        | 118       |
| J2-B15                          | LSO6                         | PWM Output                                       | 4 A continuous, 3 A PWM      | green/yellow     | 119       |
| J2-B16                          | H3+                          | H-Bridge Output                                  | High Current (10 A)          | green/red        | 120       |
| J2-B17                          | LSO7                         | PWM Output                                       | 4 A continuous, 3 A PWM      | black/green      | 121       |
| J2-B18                          | LSO9                         |  |                              | purple           | 122       |
| J2-B19                          | LSO8                         |  |                              | tan/purple       | 123       |
| J2-B20                          | LSO10                        | PWM Output                                       | 4 A continuous, 3 A PWM      | light blue/white | 124       |
| J2-B21                          | LSO4                         | PWM Output with current<br>feedback              | 4 A continuous, 3 A PWM      | purple/yellow    | 125       |
| J2-B22                          | H2+                          | H-Bridge Output                                  | High Current (10 A)          | tan/white        | 126       |
| J2-B23                          | H2-                          |  |                              | green/black      | 127       |
| J2-B24                          | H3-                          |  |                              | green/blue       | 128       |

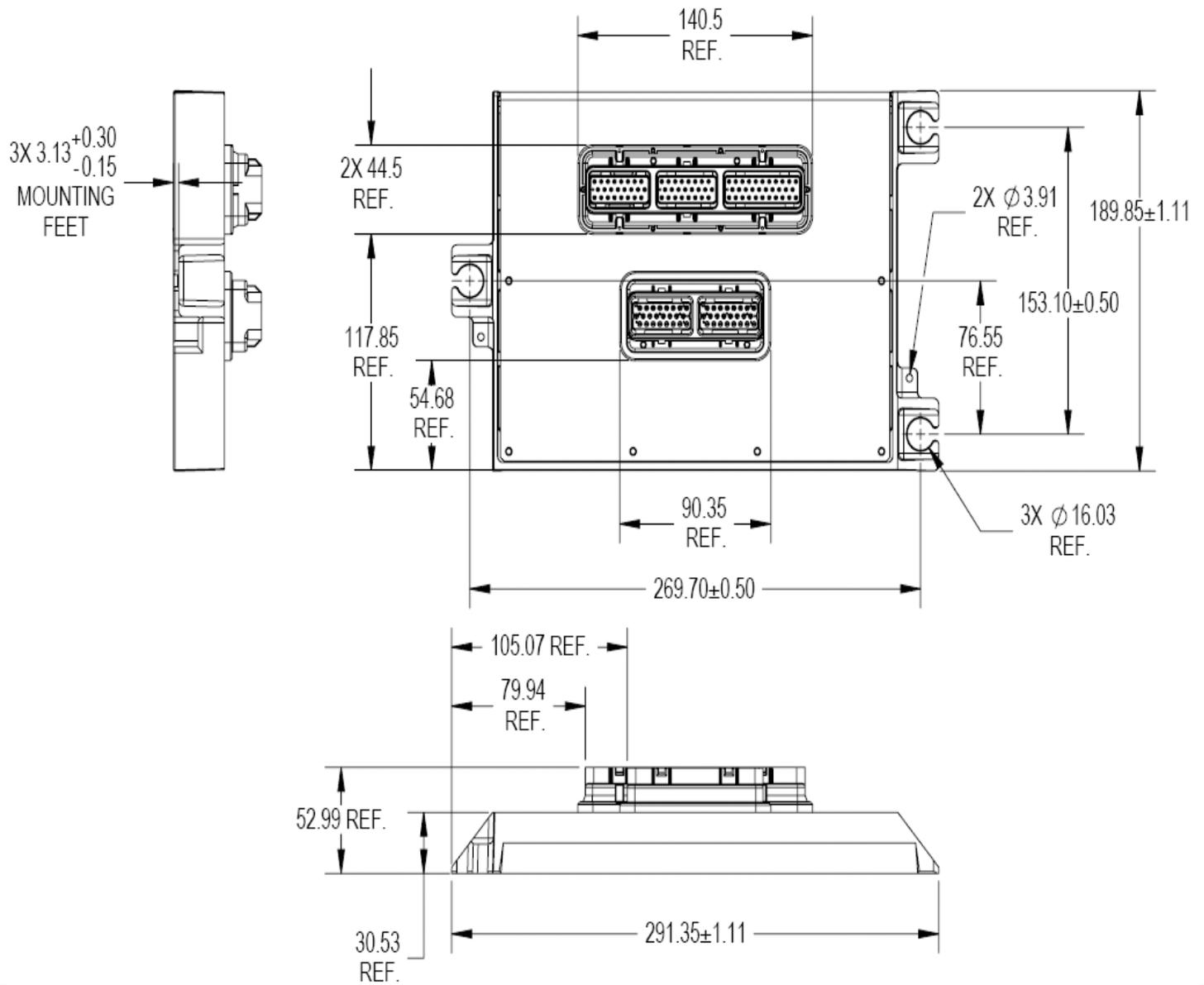
## 4.1-Additional Development Harness Wires

Highlighted wires are not directly accessible.

| Additional Harness Wires |           |         |       |     |        |     |
|--------------------------|-----------|---------|-------|-----|--------|-----|
| Wire #                   | FUNCTION  | COLOR   | FROM  | PIN | TO     | PIN |
| 129                      | SC GND    | BLACK   | SPL01 | A   | C07    | B   |
| 130                      | BATTERY + | RED     | C09   | --  | C08    | B   |
| 131                      | FUSED PWR | RED     | C08   | A   | SPL04  | A   |
| 132                      | SC PWR    | RED     | SPL04 | B   | C07    | A   |
| 133                      | FUSED PWR | RED     | C06   | 30  | SPL04  | B   |
| 134                      | COIL PWR  | RED     | C06   | 85  | SPL04  | C   |
| 135                      | DRVP      | RED     | C06   | 87  | SPL03  | A   |
| 136                      | DRVP      | RED     | SPL03 | B   | OUTPUT | --  |
| 137                      | BATTERY - | BLACK   | SPL02 | A   | C10    | --  |
| 138                      | GND CONN  | BLACK   | SPL01 | A   | SPL02  | A   |
| 139                      | KEYSWITCH | GRN-BLK | SPL05 | A   | C07    | F   |
| 140                      | BOOT CKT  | GRN-BLK | SPL05 | C   | C12    | B   |
| 141                      | BOOT CKT  | YEL-BLK | C11   | A   | SPL06  | C   |
| 142                      | BOOT CKT  | YEL-BLK | C12   | A   | SPL06  | B   |
| 143                      | BOOT CKT  | RED     | SPL04 | E   | C11    | B   |
| 144                      | FUSED PWR | RED     | SPL04 | F   | OUTPUT | --  |
| 145                      | GROUND    | BLACK   | SPL02 | A   | OUTPUT | --  |

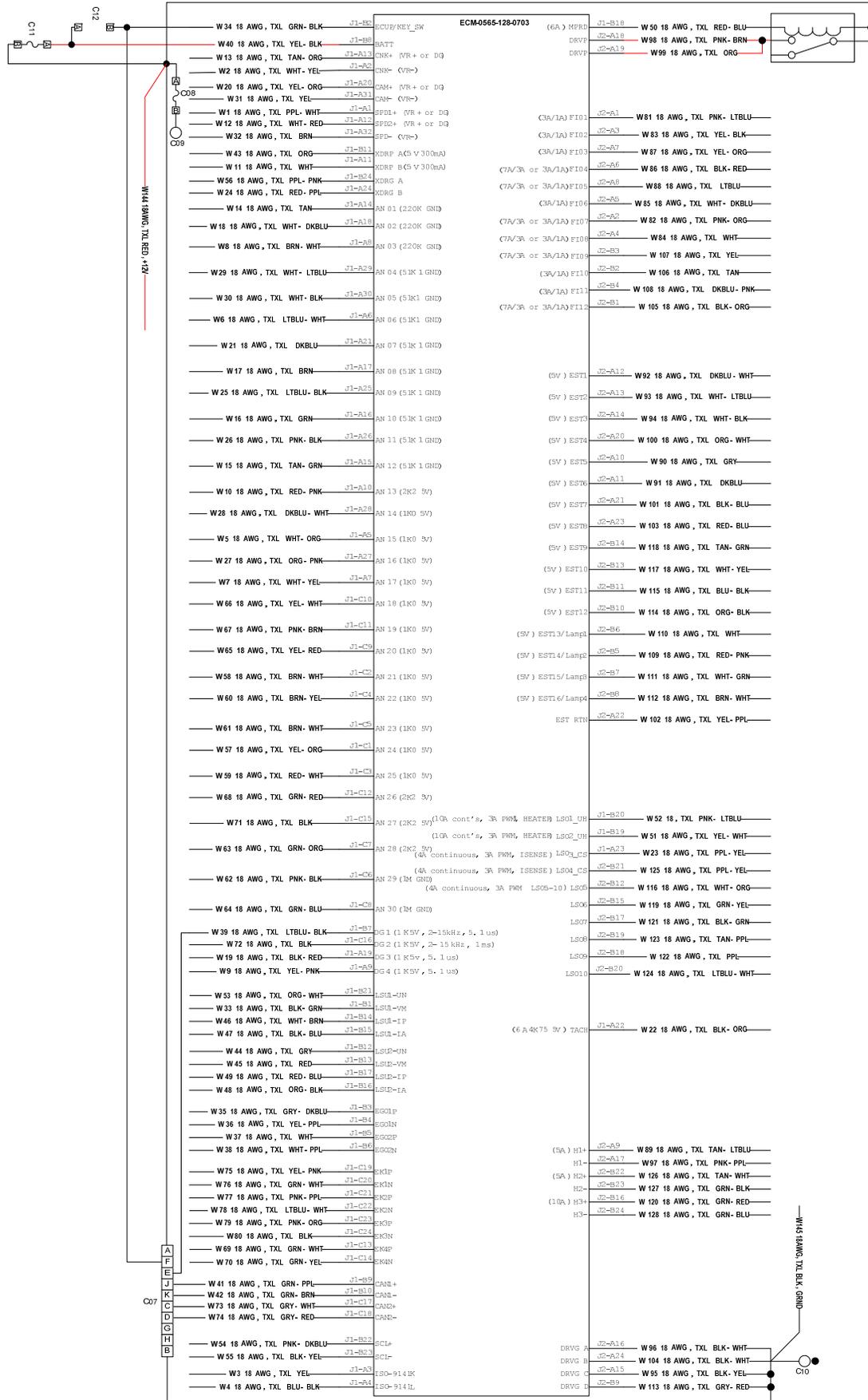
## 5-Physical Dimensions

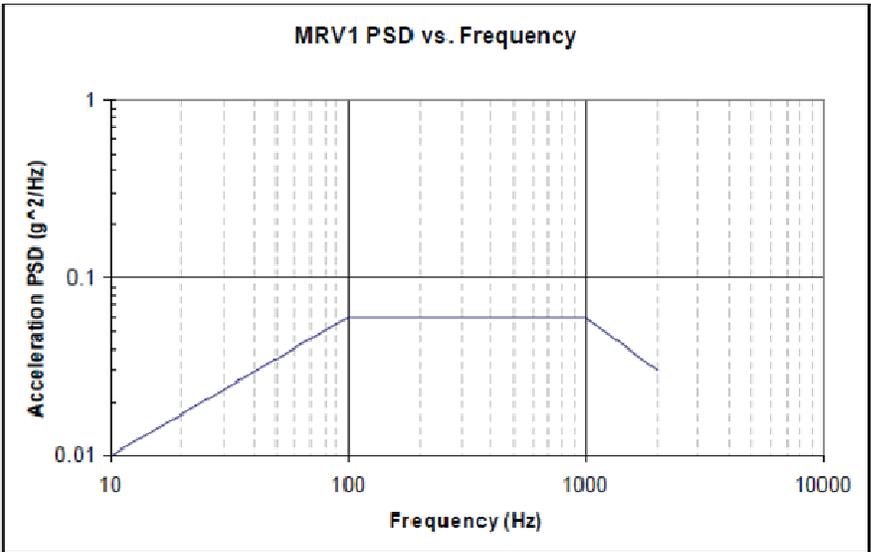
All dimensions are in millimeters.



# 5.1-Block Diagram

# Development Harness Connections (HARN-P128-002)



| 6-Environmental Ratings   |   |                |                                       |    |      |     |      |      |      |      |      |
|---|---|----------------|---------------------------------------|----|------|-----|------|------|------|------|------|
| <b>6.1 GENERAL:</b>   | <p>The ECM is designed to meet automotive industry standard under hood environmental requirements for 12 volt and 24 volt systems, and also meets marine industry environmental requirements.</p> <p>Validation tests included extreme operating temperatures (–40 to +105 °C), thermal shock, humidity, salt spray, salt fog, immersion, fluid resistance, mechanical shock, vibration, and EMC.</p> <p>It is the responsibility of the application engineer to assure that the application does not exceed the demonstrated capabilities of the unit; vibration or thermal. It may be necessary to perform additional tests to validate the unit in the application.</p>                          |                |                                       |    |      |     |      |      |      |      |      |
| <b>6.2 STORAGE TEMPERATURE:</b>   | –40 to +125 °C  |                |                                       |    |      |     |      |      |      |      |      |
| <b>6.3 OPERATING TEMPERATURE:</b>   | –40 to +105 °C  |                |                                       |    |      |     |      |      |      |      |      |
| <b>6.4 THERMAL SHOCK:</b>   | –40 to +125 °C transition within 10 s for 500 cycles  |                |                                       |    |      |     |      |      |      |      |      |
| <b>6.5 FLUID RESISTANCE:</b>  | Two stroke motor oil, Four-stroke motor oil, Unleaded gasoline, ASTM Reference 'C' fuel   |                |                                       |    |      |     |      |      |      |      |      |
| <b>6.6 HUMIDITY RESISTANCE:</b>   | 85% humidity at 85 °C for 1000 hours of operation   |                |                                       |    |      |     |      |      |      |      |      |
| <b>6.7 SALT FOG RESISTANCE:</b>   | 1000 hours  |                |                                       |    |      |     |      |      |      |      |      |
| <b>6.8 IMMERSION:</b>   | Submersible in 8% saltwater solution to 10 ft (3 m)   |                |                                       |    |      |     |      |      |      |      |      |
| <b>6.9 MECHANICAL SHOCK:</b>  | 50 hours of 50 g's  |                |                                       |    |      |     |      |      |      |      |      |
| <b>6.10 DROP:</b>   | Random drop tests on concrete from 6 ft (1.8 m)   |                |                                       |    |      |     |      |      |      |      |      |
| <b>6.11 VIBRATION:</b><br>For engine-mounted applications, rubber isolators are required and available from Woodward. | <p>3 hours per axis per the below accelerated hard-mount profile. Application vibration levels must be reviewed and approved by Woodward for warranty coverage.</p> <div style="text-align: center;">  <p><b>MRV1 PSD vs. Frequency</b></p> <table border="1"> <caption>MRV1 PSD vs. Frequency Data Points</caption> <thead> <tr> <th>Frequency (Hz)</th> <th>Acceleration PSD (g<sup>2</sup>/Hz)</th> </tr> </thead> <tbody> <tr> <td>10</td> <td>0.01</td> </tr> <tr> <td>100</td> <td>0.06</td> </tr> <tr> <td>1000</td> <td>0.06</td> </tr> <tr> <td>2000</td> <td>0.03</td> </tr> </tbody> </table> </div> | Frequency (Hz) | Acceleration PSD (g <sup>2</sup> /Hz) | 10 | 0.01 | 100 | 0.06 | 1000 | 0.06 | 2000 | 0.03 |
| Frequency (Hz)  | Acceleration PSD (g <sup>2</sup> /Hz)   |                |                                       |    |      |     |      |      |      |      |      |
| 10  | 0.01  |                |                                       |    |      |     |      |      |      |      |      |
| 100   | 0.06  |                |                                       |    |      |     |      |      |      |      |      |
| 1000  | 0.06  |                |                                       |    |      |     |      |      |      |      |      |
| 2000  | 0.03  |                |                                       |    |      |     |      |      |      |      |      |
| <b>6.12 ABNORMAL SUPPLY VOLTAGE RESISTANCE:</b>   |   |                |                                       |    |      |     |      |      |      |      |      |
| <b>Conditions</b>   | <b>Supply Voltage</b>   | <b>Time</b>    |                                       |    |      |     |      |      |      |      |      |
| Reverse Battery   | –24 Vdc   | 5 Minutes      |                                       |    |      |     |      |      |      |      |      |
| Abnormal Alternator Output  | 36 Vdc  | 5 Minutes      |                                       |    |      |     |      |      |      |      |      |
| Minimum Battery   | 6 Vdc   | <i>Indef.</i>  |                                       |    |      |     |      |      |      |      |      |

## 7-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 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.

**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.

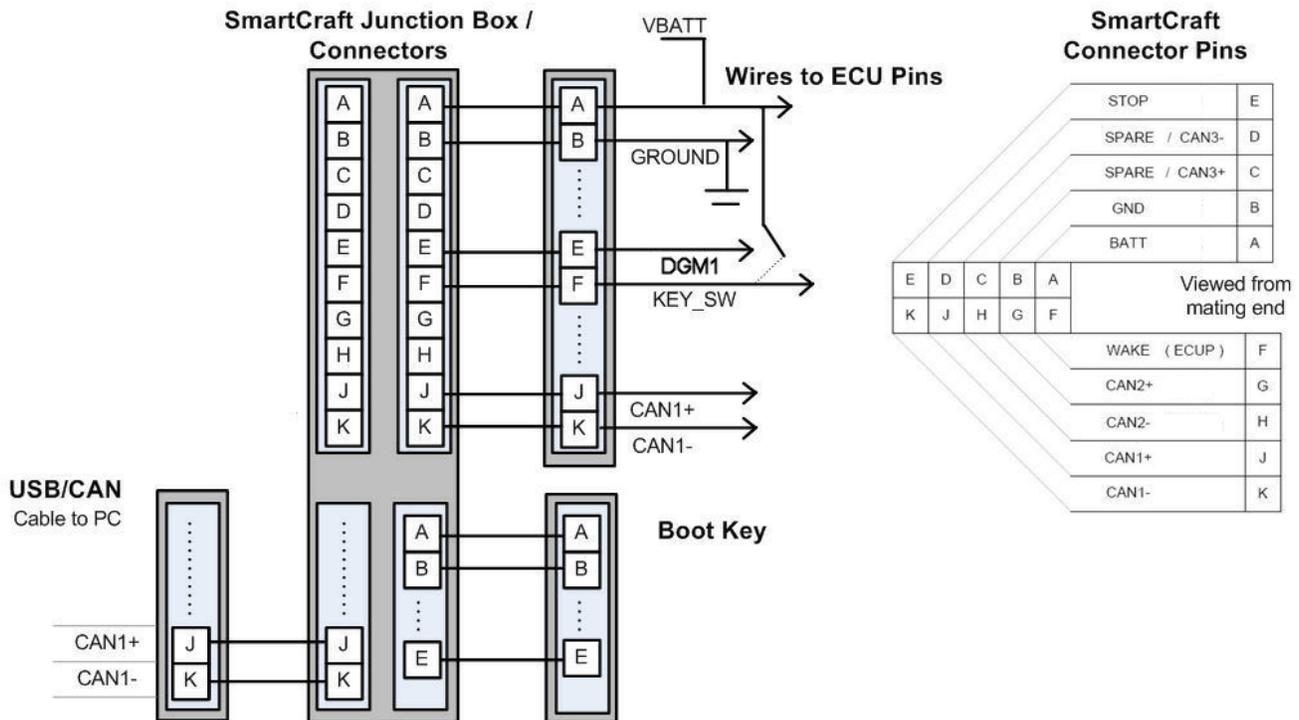
## Use Boot Key and Reprogram the Module

### 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 on) with the boot key or cable connections applied as described in order to initiate a reboot and to absorb the selected program.



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