MotoHawk Control Solutions

HCM-0563-048-0803-C/F

Hydraulic Control Modules
(Part Nos. 1751-6529 / 1751-6358)
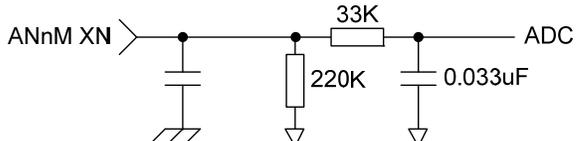
Description

Presenting the HCM-0563-048-0803-C/F hydraulic control modules from Woodward's new MotoHawk Control Solutions product line. These rugged embedded controllers are capable of operating in harsh automotive, marine, and off-highway applications. Over 300,000 successful marine applications prove the capability of this module. Based on a proven microprocessor, the HCM-0563-048-0803-C/F modules are capable of delivering complex control strategies. The onboard floating point unit and the high clock frequency allow software to be developed in shorter times. Dual CAN 2.0B datalinks ensure interoperability with other system components.

The HCM-0563-048-0803-C/F modules are part of the ControlCore® family of embedded control systems. MotoHawk Control Solutions' ControlCore operating system, MotoHawk® code-generation product, and MotoHawk's suite of development tools enable rapid development of complex control systems.
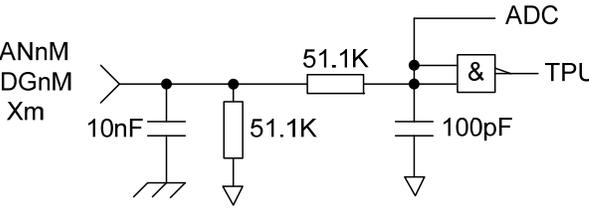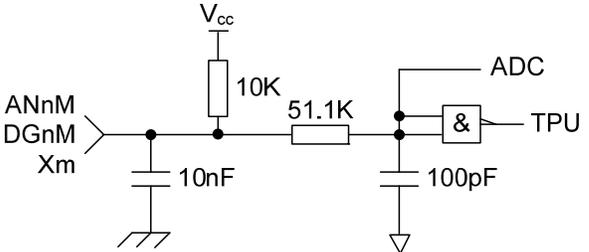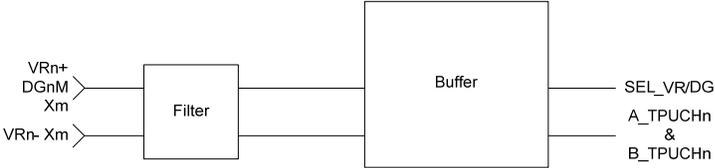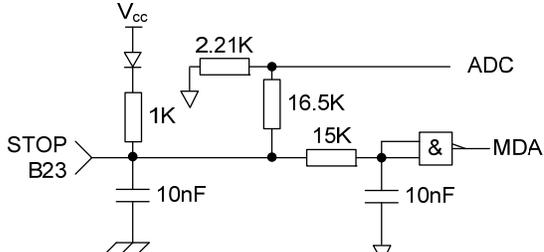
IMPORTANT **Woodward does not warranty these ECMs based on information supplied in this datasheet, but only with an express and specific production supply agreement based on customer's operating mode. Information in this datasheet is subject to change without prior notice. Please contact MotoHawk Control Solutions sales for more information.**

- **Microprocessor**: Freescale MPC563, 40 MHz

- **Memory**: 512K Flash, 32K RAM (4K overlayable), 128K parallel EEPROM (HCM-0563-048-0803-C)

- **Operating Voltage**: 8–32 Vdc

- **Operating Temperature**: –40 to +105 °C

- Sealed connectors operable to 10 ft (3 m) submerged

- **Inputs:**
  Up to 16 Analog
  Up to 8 Discrete/ Frequency
  Up to 2 VR/Hall Frequency
  1 Stop

- **Outputs:**
  6x 2.5 A Low Side Drivers w/ Current Feedback
  4x 3 A Low Side Drivers
  1x 1 A EasyLink/Low Side Driver
  1x Relay Driver (Main Power)

- **Datalinks:**
  2 CAN 2.0B Channels

1–Input Signal Conditioning	See Freescale MPC563 Datasheet for description of processor resources.

1.1 KEY_SW (B8), DRVP (A20, A21), DRVG (A16, A24, B17), XDRG (B1)

The **KEY_SW** input wakes the module power supply regulator. The DRVP inputs are wired via the Main Power Relay which will supply the loads while the MPRD signal is asserted (see below). The processor will hold the module power on after the **KEY_SW** signal is removed for controlled shutdowns. Inputs are monitored by the processor.
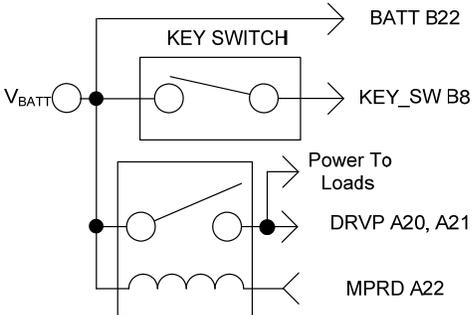
The DRVG inputs are the system (battery) ground connections.
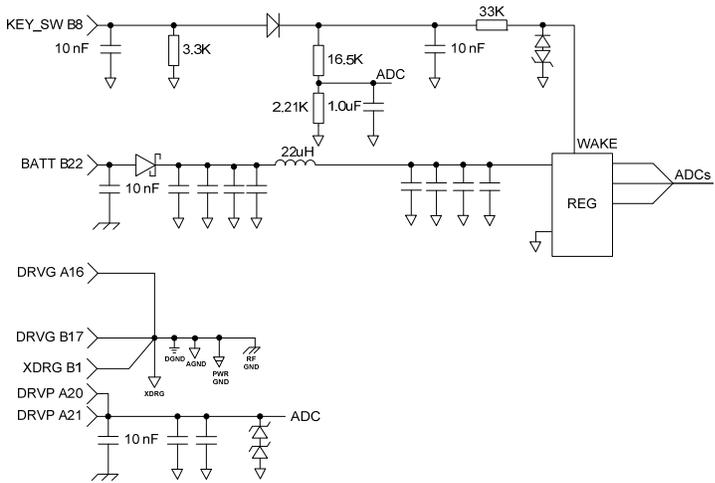
1.2 AN1M (B2)

This input is a 10-bit 0–5 V ADC, τ = 1 ms.
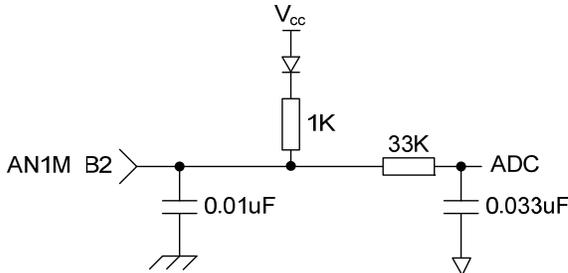
1.3 AN2M, AN4M (B3, B11)

These inputs are 10-bit 0–5 V ADCs, τ = 1 ms.

1.4 AN3M (B10)

This input is a 10-bit 0–5 V ADC, τ = 1 ms.
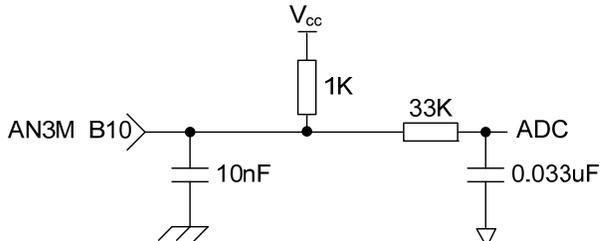
1.5 AN5M, AN6M, AN7M, AN8M (A10, A11, A9, A12)

These inputs are 10-bit 0–5 V ADCs, τ = 1 ms.
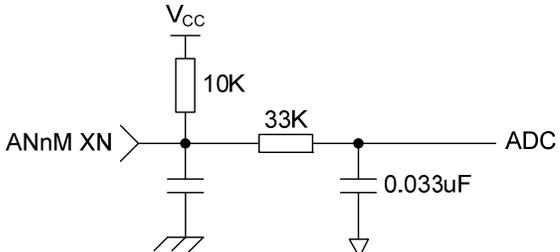
1–Input Signal Conditioning	(continued)
1.6 AN9M, AN10M **(B9, B12)** These inputs are 10-bit 0–5 V ADCs, τ = 1 ms.	V_{cc} — 51.1K — 33K — ADC ANnM Xm — 10nF — 0.033uF
1.7 AN11M_DG3M, AN12M_DG4M, AN13M_DG5M **(B18, B19, A15)** These inputs are 10-bit 0–5 V ADCs, τ = 5.1 µs.	ADC ANnM DGnM Xm — 51.1K — & — TPU 10nF — 51.1K — 100pF
1.8 AN14M_DG6M, AN15M_DG7M, AN16M_DG8 **(A6, A3, A19)** These inputs are 10-bit 0–5 V ADCs, τ = 5.1 µs.	V_{cc} — 10K — ADC ANnM DGnM Xm — 51.1K — & — TPU 10nF — 100pF
1.9 VR1+_DG1M, VR2+_DG2M, VR1-, VR2- **(B5, B16, B4, B15)** Variable Reluctance/Hall Effect/Discrete switch input. V_{IL}=2.0 Vmax. V_{IH}=2.5 Vmin, τ =100 µs.	VRn+ DGnM Xm — Filter — Buffer — SEL_VR/DG VRn- Xm — A_TPUCHn & B_TPUCHn
1.10 STOP **(B23)** This is the emergency stop input. It is activated by switching to ground.	V_{cc} — 2.21K — ADC 1K — 16.5K STOP B23 — 15K — & — MDA 10nF — 10nF
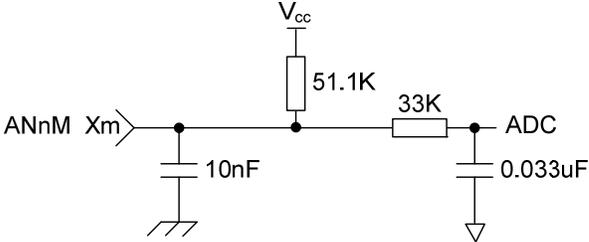
2–Output Signal Conditioning

2.1 XDRP **(B24)** This output is for powering sensor transducers and is monitored by the processor. 5 V, 300 mA	V_{BATT} — TLE6368G — XDRP B24 5V, 400mA; KEY_SW → WAKE ← SPI
2.2 LSO1, LSO2, LSO3, LSO4, LSO5, LSO6 **(A2, A13, A7, A8, A14, A5)** This output is a sink driver, 2.5 A max. with current feedback. Short circuit protection, open circuit and short circuit detection.	DRVP — R_{SHUNT} — LSOn Xm; 2.5A; TPU; ADC; ADC
2.3 LSO7_EASYLINK **(A23)** This output is a sink driver, 1 A max., it may also be used to drive EasyLink gauges (with external pull-up resistor). Short circuit protection, open circuit and short circuit detection.	LSO7 EASYLINK A23; 1A; TPU
2.4 LSO8, LSO9, LSO10, LSO11 **(A4, A18, A1, A16)** This output is a sink driver, 3 A typical. Short circuit protection, open circuit and short circuit detection.	LSOn Xm; 3A; TPU
2.5 MPRD **(A22)** This output energizes the Main Power Relay. Short circuit protection, open circuit and short circuit detection.	MPRD A22; 1A; MPIO
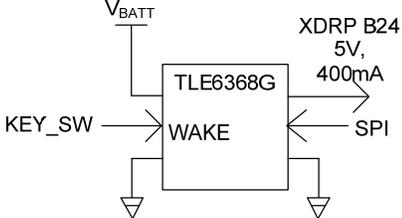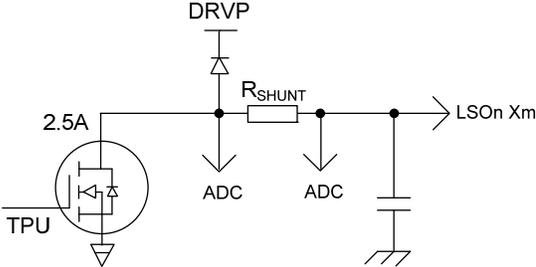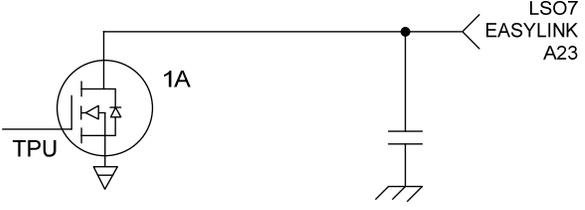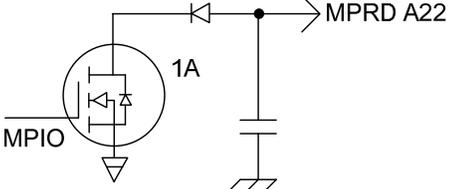
3–Connector Definitions
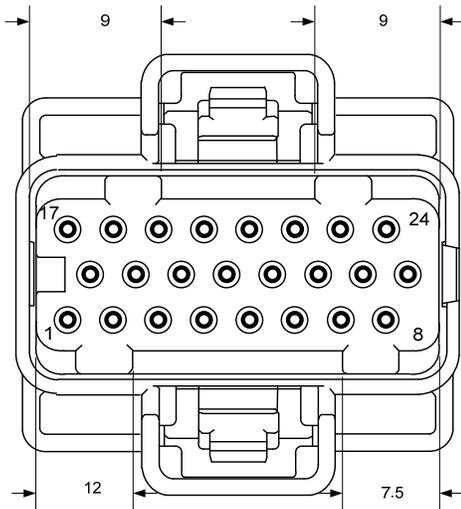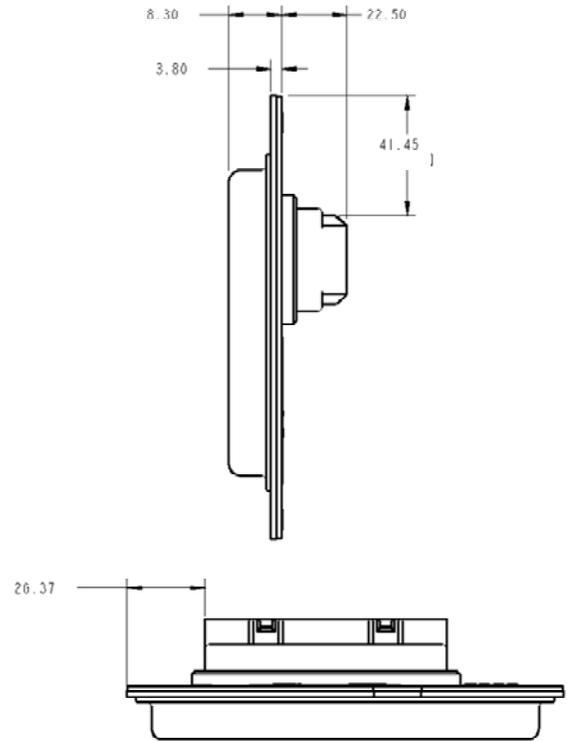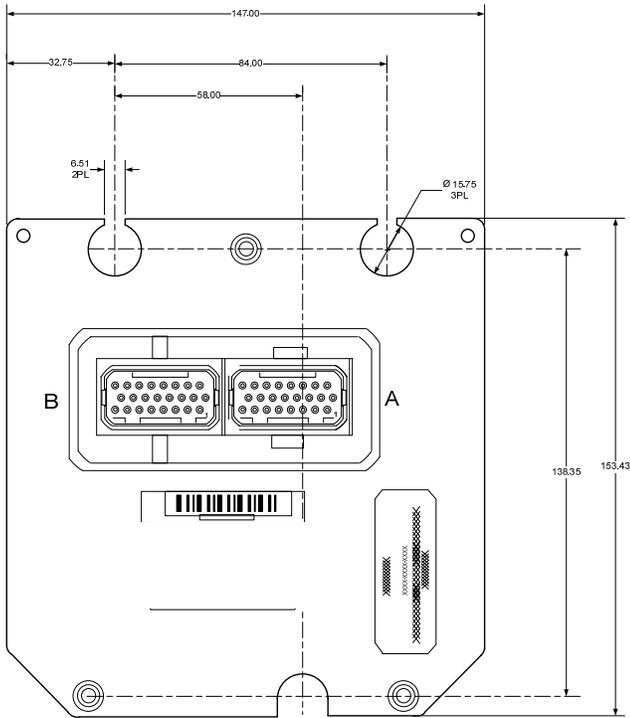
CON-FEML-001A
A
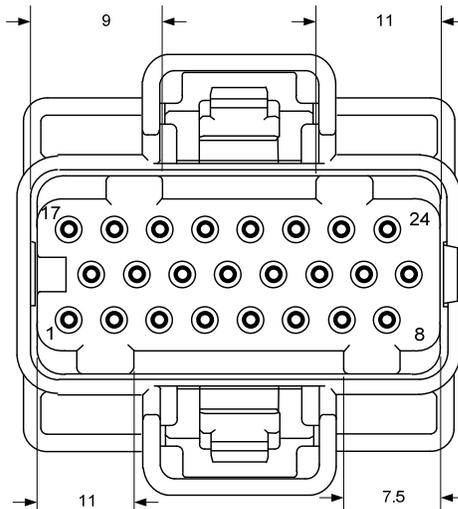
CON-FEML-001B
B

3.1 Block Diagram — HCM-0563-048-0803-C/F

HCM-0563-048-0803

Pin	Signal		Signal	Pin
			MPRD (1A)	A22
B22	BATT_IN		DRVP-1	A20
B08	KEY_SW (PD 3K)		DRVP-2	A21
B23	STOP-DIG/AN IN (PD 18.7K, PU 100 w/Diode)			
B05	VR1+_DIG1		LSO1-W-CS AND RECIRC (2.5A)	A02
B04	VR1-		LSO2-W-CS AND RECIRC (2.5A)	A13
B16	VR2+_DIG2		LSO3-W-CS AND RECIRC (2.5A)	A07
B15	VR2-		LSO4-W-CS AND RECIRC (2.5A)	A08
B24	XDRP-300mA		LSO5-W-CS AND RECIRC (2.5A)	A14
B02	AN1 (PU 100 W DIODE)			
B03	AN2 (PD 220K)		LSO6-W-CS AND RECIRC (2.5A)	A05
B10	AN3 (PU 1K)		EASY LINK LSO7 (1A) PWM	A23
B11	AN4 (PD 220K)		LSO8 (3A)	A04
A10	AN5 (PU 10K)		LSO9 (3A)	A18
A11	AN6 (PU 10K)		LSO10 (3A)	A01
A09	AN7 (PU 10K)		LSO11 (3A)	A24
A12	AN8 (PU 10K)			
B09	AN9 (PU 51.1K)		N/C	A17
B12	AN10 (PU 51.1K)			
B18	AN11-DIG3 (PD 51. 1K)			
B19	AN12-DIG4 (PD 51. 1K)			
A15	AN13-DIG5 (PD 51. 1K)			
A06	AN14-DIG6 (PU 10K)			
A03	AN15-DIG7 (PU 10K)			
A19	AN16-DIG8 (PU 10K)			
B13	NC			
B14	NC			
B01	XDRG			
B20	CAN1+			
B21	CAN1-		GND	A16
B07	CAN2+			
B06	CAN2-		GND	B17

3.2 Connector Pinouts			3.2.1 Resource by Connector Pin	
Pin # ECM	ControlCore Resource Name	Function Name	Notes	Wire Number Color Code
A1	LSO10	Low Side Out 10	3 A	1 Pink/Light Blue
A2	LSO1	Low Side Out 1	2.5 A, Current Sense, Diode	2 Pink/Orange
A3	AN15_DG7	Analog/Discrete In	10K to Vcc	3 Yellow/Black
A4	LSO8	Low Side Out 8	3 A	4 White
A5	LSO6	Low Side Out 6	2.5 A, Current Sense, Diode	5 White/ Dark Blue
A6	AN14_DG6	Analog/Discrete In	10K to Vcc	6 Black/Red
A7	LSO3	Low Side Out 3	2.5 A, Current Sense, Diode	7 Yellow/Orange
A8	LSO4	Low Side Out 4	2.5 A, Current Sense, Diode	8 Light Blue
A9	AN7	Analog In 7	10K to Vcc	9 Tan/Light Blue
A10	AN5	Analog In 5	10K to Vcc	10 Gray
A11	AN6	Analog In 6	10K to Vcc	11 Dark Blue
A12	AN8	Analog In 8	10K to Vcc	12 Dark Blue/White
A13	LSO2	Low Side Out 2	2.5 A, Current Sense, Diode	13 White/Light Blue
A14	LSO5	Low Side Out 5	2.5 A, Current Sense, Diode	14 White/Black
A15	AN13_DG5	Analog/Discrete In	51.1K to GND	15 Black/Yellow
A16	GND	System Ground	Battery Ground	16 Black/White
A17	N/C		No Internal Connection	
A18	LSO9	Low Side Out 9	3 A	18 Pink/Brown
A19	AN16_DG8	Analog/Discrete In	10K to Vcc	19 Orange
A20	DRVP	Driver Power	Wire via MPR contacts	20 Orange/White
A21	DRVP	Driver Power	Wire via MPR contacts	21 Black/Blue
A22	MPRD	Main Power Relay Driver	1.0 A max.	22 Yellow/Purple
A23	LSO7/EasyLink	Low Side Out 7	1 A	23 Red/Blue
A24	LSO11	Low Side Out 11	3 A	24 Black/White

3.2 Connector Pinouts			**3.2.1 Resource by Connector Pin** (continued)	
Pin # ECM	**ControlCore Resource Name**	**Function Name**	**Notes**	**Wire Number Color Code**
B1	XDRG	Transducer Ground	Low Current Return	25 Black/Orange
B2	AN1	Analog In 1	100 W to Vcc via Diode	26 Tan
B3	AN2	Analog In 2	220K Pull Down, τ = 1 ms	27 Yellow
B4	VR1-	Return VR Input	Leave open for Hall	28 Dark Blue/Pink
B5	VR1+	VR Sensor Positive	VR, Hall, Discrete	29 Red/Pink
B6	CAN2-	CAN2 Negative		30 White
B7	CAN2+	CAN2 Positive		31 White/Green
B8	KEY_SW	Key Switch	Module Wake	32 Brown/White
B9	AN9	Analog In 9	51.1K Pull Up, τ = 1 ms	33 Gray/Red
B10	AN3	Analog In 3	1K to Vcc, τ = 1 ms	34 Orange/Black
B11	AN4	Analog In 4	220K Pull Down, τ = 1 ms	35 Blue/Black
B12	AN10	Analog In 10	51.1K Pull Up, τ = 1 ms	36 White/Orange
B13	NC	No Connection		
B14	NC	No Connection		
B15	VR2-	Return VR Input	Leave open for Hall	37 White/Yellow
B16	VR2+	VR Sensor Positive	VR, Hall, Discrete	38 Tan/Green
B17	GND	System Ground	Battery Ground	39 Green/Yellow
B18	AN11_DG3	Analog/Discrete In	51.1K to GND	40 Green/Red
B19	AN12_DG4	Analog/Discrete In	51.1K to GND	41 Black/Green
B20	CAN1+	CAN1 Positive		42 Purple
B21	CAN1-	CAN1 Negative		43 Tan/Purple
B22	BATT_IN	Battery Connection	Module Power	44 Light Blue/White
B23	STOP_DIG_AN	E-STOP Input	100 W to Vcc via Diode, 16.5K to GND	45 Purple/Yellow
B24	XDRP	Transducer Power	300 mA	46 Black/ Orange

3.2 Connector Pinouts			3.2.2 Resource by Name	
ControlCore Resource Name	**Pin # ECM**	**Function Name**	**Notes**	**Wire Number Color Code**
AN1	B2	Analog In 1	1K to Vcc via Diode	26 Tan
AN2	B3	Analog In 2	220K Pull Down, τ = 1 ms	27 Yellow
AN3	B10	Analog In 3	1K to Vcc, τ = 1 ms	34 Orange/Black
AN4	B11	Analog In 4	220K Pull Down, τ = 1 ms	35 Blue/Black
AN5	A10	Analog In 5	10K to Vcc	10 Gray
AN6	A11	Analog In 6	10K to Vcc	11 Dark Blue
AN7	A9	Analog In 7	10K to Vcc	9 Tan/Light Blue
AN8	A12	Analog In 8	10K to Vcc	12 Dark Blue/White
AN9	B9	Analog In 9	220K Pull Down, τ = 1 ms	33 Gray/Red
AN10	B12	Analog In 10	220K Pull Down, τ = 1 ms	36 White/Orange
AN11_DG3	B18	Analog/Discrete In	51.1K to GND	40 Green/Red
AN12_DG4	B19	Analog/Discrete In	51.1K to GND	41 Black/Green
AN13_DG5	A15	Analog/Discrete In	51.1K to GND	15 Black/Yellow
AN14_DG6	A6	Analog/Discrete In	10K to Vcc	6 Black/Red
AN15_DG7	A3	Analog/Discrete In	10K to Vcc	3 Yellow/Black
AN16_DG8	A19	Analog/Discrete In	10K to Vcc	19 Orange
BATT_IN	B22	Battery Connection	Module Power	44 Light Blue/White
CAN1-	B21	CAN1 Negative		43 Tan/Purple
CAN1+	B20	CAN1 Positive		42 Purple
CAN2-	B6	CAN2 Negative		30 White
CAN2+	B7	CAN2 Positive		31 White/Green
DRVP	A20	Driver Power	Wire via MPR contacts	20 Orange/White
DRVP	A21	Driver Power	Wire via MPR contacts	21 Black/Blue
GND	A16	System Ground	Battery Ground	16 Black/White
GND	B17	System Ground	Battery Ground	39 Green/Yellow
KEY_SW	B8	Key Switch	Module Wake	32 Brown/White
LSO1	A2	Low Side Out 1	2.5 A, Current Sense, Diode	2 Pink/Orange
LSO2	A13	Low Side Out 2	2.5 A, Current Sense, Diode	13 White/Light Blue
LSO3	A7	Low Side Out 3	2.5 A, Current Sense, Diode	7 Yellow/Orange
LSO4	A8	Low Side Out 4	2.5 A, Current Sense, Diode	8 Light Blue
LSO5	A14	Low Side Out 5	2.5 A, Current Sense, Diode	14 White/Black
LSO6	A5	Low Side Out 6	2.5 A, Current Sense, Diode	5 White/ Dark Blue
LSO7/EasyLink	A23	Low Side Out 7	1 A	23 Red/Blue
LSO8	A4	Low Side Out 8	3 A	4 White
LSO9	A18	Low Side Out 9	3 A	18 Pink/Brown
LSO10	A1	Low Side Out 10	3 A	1 Pink/Light Blue
LSO11	A24	Low Side Out 11	3 A	24 Black/White
MPRD	A22	Main Power Relay Driver	1.0 A max.	22 Yellow/Purple
STOP_DIG_AN	B23	E-STOP Input	100 Ω to Vcc via Diode, 16.5K to GND	45 Purple/Yellow
VR1-	B4	Return VR Input	Leave open for Hall	28 Dark Blue/Pink
VR1+	B5	VR Sensor Positive	VR, Hall, Discrete	29 Red/Pink
VR2-	B15	Return VR Input	Leave open for Hall	37 White/Yellow
VR2+	B16	VR Sensor Positive	VR, Hall, Discrete	38 Tan/Green
XDRG	B1	Transducer Ground	Low Current Return	25 Black/Orange
XDRP	B24	Transducer Power	300 mA	46 Black/Orange

4–Environmental

Environmental Ratings:	The ECM is designed to meet automotive industry standard under hood environmental requirements for 12/24 volt systems, and also meets marine industry environmental requirements. Validation tests include extreme operating temperatures (–40 to +85 °C), thermal shock, humidity, salt spray, salt fog, immersion, fluid resistance, mechanical shock, vibration, steam pressure wash, and EMC. It is the responsibility of the application engineer to ensure 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.
4.1 Storage Temperature:	–50 to +125 °C
4.2 Operating Temperature:	–40 to +85 °C
4.3 Thermal Shock:	–40 to +125 °C temperature stable for 6 seconds at each point for 500 cycles
4.4 Fluid Resistance:	An extensive list of solvents, caustics, etc.
4.5 Humidity Resistance:	85% humidity at 85 °C for 1000 hours
4.6 Salt Fog Resistance:	500 hours of operation, 5% salt fog, 35 °C
4.7 Immersion:	Submersible in 8% salt water solution to 10 ft (3 m)
4.8 Mechanical Shock:	50 g's, 11 ms, 1/2 sine wave, 4x each axis (+ & –)
4.9 Drop:	Drop tests on concrete from 1 meter, 6 surfaces

4.10 Vibration:

Engine mountable and designed to high-performance levels, the ECM has been tested according to the schedule shown at right:

Electrical and mechanical isolation is via a bushing, grommet, and washer, as shown:
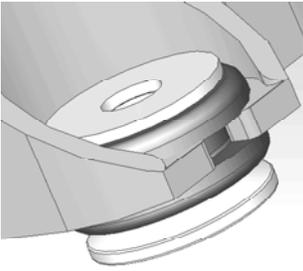
Chassis, 5.82 Grms	
Break-point Frequency	PSD [G2/Hz]
1	1.E-02
1.6	1.E-02
3	3.E-02
4	3.E-01
5	3.E-02
10	3.E-01
10	3.E-01
30	3.E-01
60	5.E-02
100	5.E-02
230	1.E-02
330	1.E-01
1300	1.E-03
2000	1.E-03

4.11 Abnormal Supply Voltage Resistance:

Condition	Supplied Voltage	Time
Reverse Battery	–36 Vdc	5 minutes
Double Battery	36 Vdc	5 minutes
Minimum Battery	8 Vdc	Indefinitely
Low Battery Condition	6.3 Vdc	Indefinitely

4.12 Power Dropout Susceptibility:

Test	Vsupply	Time	Response
1	Interrupt	< 100 µs	No resets
2	Slow Decal	> 10 min	No abnormal behaviors

5–Using a Boot Key/Cable	Use Boot Key and Reprogram the Module

5–Using a Boot Key/Cable

Errors made in programming a module (via .srz file), such as errors within the CAN software or model, can inadvertently prevent communication with the module. When this happens, module operation appears to be locked up when communicating with the module, as when using MotoTune®.

In such a case, use the Boot Key or Cable to force the module into reboot mode, in order to reprogram the module (with a known, valid .srz file) in order to allow resumption of module communication.

Use boot key part. no. HARNINTR00801 (part no. 1635-1800). See diagram below for boot connection scenario.

⚠ 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.**
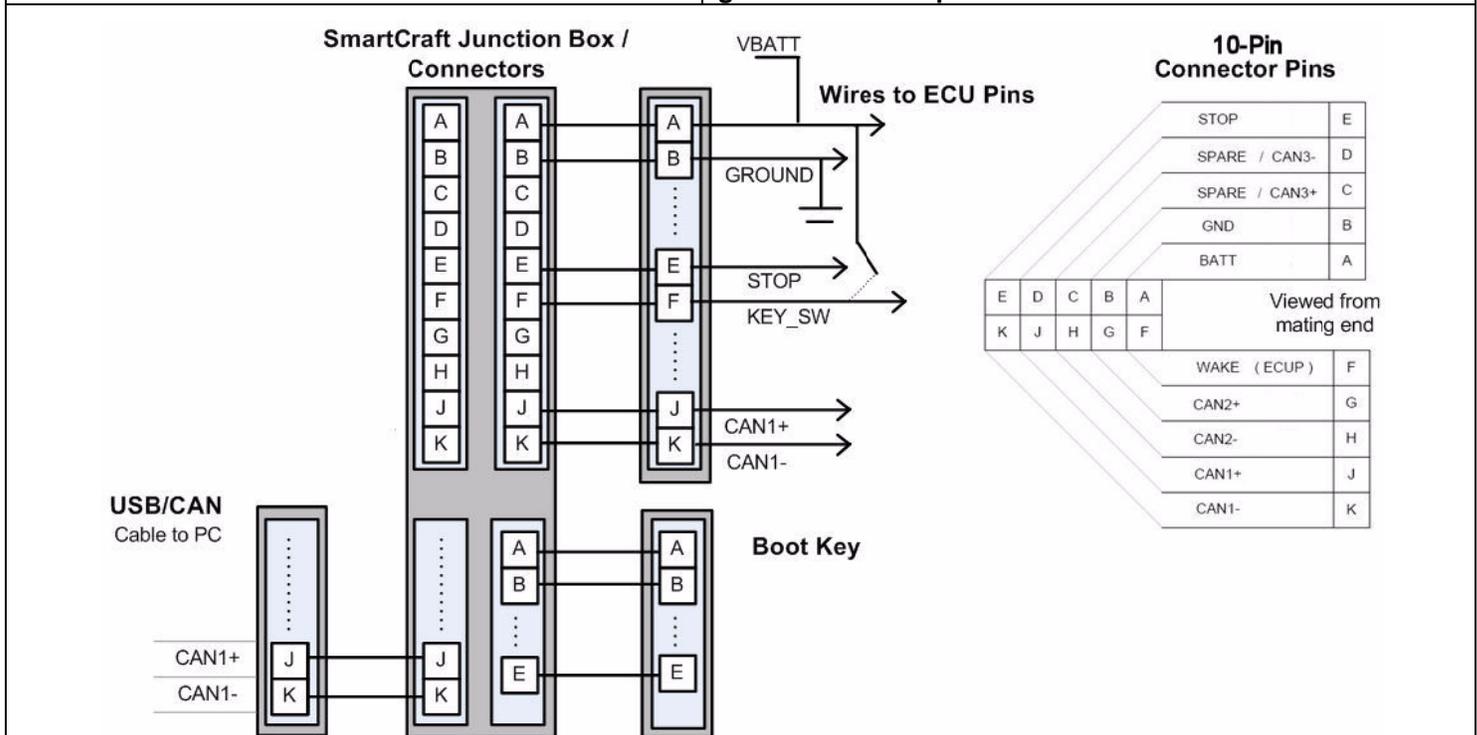
Use Boot Key and Reprogram the Module

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" (KEY_SW on) with the boot key or cable applied in order to initiate a reboot and to absorb the selected program.

IMPORTANT **A boot key provides a 555 Hz, 50% duty cycle, V=Vbatt, square wave signal to the STOP pin, which may be duplicated by applying a signal from a signal generator to that pin.**

SmartCraft Junction Box / Connectors — Wires to ECU Pins — VBATT, GROUND, STOP, KEY_SW, CAN1+, CAN1- — USB/CAN Cable to PC (CAN1+ J, CAN1- K) — Boot Key

10-Pin Connector Pins

STOP	E
SPARE / CAN3-	D
SPARE / CAN3+	C
GND	B
BATT	A

E	D	C	B	A
K	J	H	G	F

Viewed from mating end

WAKE (ECUP)	F
CAN2+	G
CAN2-	H
CAN1+	J
CAN1-	K

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