GCM48-2104

Raptor General-Purpose Control Module
P/N: GCM-5605B-048-2104

The GCM48-2104 is a general-purpose control module with 6 CAN buses, 2 LIN Masters and 1 LIN Slave, and configurable discrete inputs and outputs including analog inputs, frequency inputs, a wake input, low-side driver outputs, and an H-bridge driver output. There is also an output that is configured for Fuel Level Indicator Module (FLIM) actuation.

The GCM48-2104 is one of the Raptor™ rugged production controllers that use a software development process based upon MATLAB/Simulink and Raptor-Dev which significantly speeds up algorithm development by using automatic integration and code generation. In addition, developers can quickly test application software using simulation and automated testing.

For more details, visit https://neweagle.net/raptor/
Or contact our Sales Team at sales@neweagle.net

- **Programming**
  - MATLAB Simulink with Raptor 2021a_1.0 or newer
- **Processor**
  - NXP MPC5605B
  - 64 MHz
- **Memory**
  - 512KB App Flash
  - 16KB EEPROM
  - 64 KB Internal RAM
- **16 Inputs**
  - 12 Analog Inputs
  - 4 Frequency Inputs
  - 1 Wake Input
- **9 Outputs**
  - 7 Low Side Drivers (PWM)
  - 1 FLIM Output (PWM)
  - 1 H-Bridge Driver (PWM)
- **8-16 V Operating Voltage**
- **Communication**
  - 6 CAN 2.0B
    - Wake on CAN2
  - 3 LIN
    - 2 LIN Master, 1 LIN Slave
    - Wake on LIN2
- **Environmental**
  - -40°C to 105°C Operating Temp
  - IP6k7 Compliant
- **Compiler**
  - S32DS for Power Architecture Version V2.1
    (Free download from NXP)
- **Aluminum Construction**
- **Weight**
  - 0.6lb (0.3kg)

Table of Contents

1. Controller Overview

Hardware	
Microprocessor	NXP MPC5605B
Clock Speed	64 MHz
Environmental	IP6k7
Operating Temp	-40°C to 105°C

Memory Segments	
Memory Segment	Size
FLASH	1024 KB
EEPROM	16 KB
INTERNAL RAM	224 KB
application_reset_vector	8B
application_descriptor_info	8 KB
application_flash	504 KB

Communication Channels		
Channel	Functions	Options
CAN1	CAN	33k 50k 100k 125k 200k 250k 333k 500k 667k 800k 1000k
CAN2	CAN Wake on CAN2	33k 50k 100k 125k 200k 250k 333k 500k 667k 800k 1000k

Communication Channels		
Channel	Functions	Options
CAN3	CAN	33k 50k 100k 125k 200k 250k 333k 500k 667k 800k 1000k
CAN4	CAN	33k 50k 100k 125k 200k 250k 333k 500k 667k 800k 1000k
CAN5	CAN	33k 50k 100k 125k 200k 250k 333k 500k 667k 800k 1000k
CAN6	CAN	33k 50k 100k 125k 200k 250k 333k 500k 667k 800k 1000k

Communication Channels		
Channel	Functions	Options
LIN1	LIN SLAVE	1200 2400 4800 9600 10400 19200
LIN2	LIN MASTER Wake on LIN2	1200 2400 4800 9600 10400 19200
LIN3	LIN MASTER	1200 2400 4800 9600 10400 19200

Note: CAN1: 500k Default Baud

Inputs				
Resource	Functions	Voltage Ranges	Pull-Up/Down	Note
DG1	freq_in digital_in analog_in	0 - 5 V	1.2k PD	Pin E4
DG2	freq_in digital_in analog_in	0 - 5 V	1.2k PD	Pin D4
DG3	freq_in digital_in analog_in	0 - 5 V	1.2k PD	Pin C4
DG4	freq_in digital_in analog_in	0 - 5 V	1.2k PD	Pin B4
AN1	analog_in	0 - 5 V	51.1K PU	Pin G3
AN2	analog_in	0 - 5 V	1.0K PU	Pin G2
AN3	analog_in	0 - 5 V	15K PU	Pin B2

Inputs				
Resource	Functions	Voltage Ranges	Pull-Up/Down	Note
AN4	analog_in	0 - 5 V	220K PD	Pin C2
AN5	analog_in	0 - 5 V	15K PU	Pin D2
AN6	analog_in	0 - 5 V	1.0K PU	Pin E2
AN7	analog_in	0 - 5 V	220K PD	Pin B3
AN8	analog_in	0 - 5 V	220K PD	Pin C3
AN9	analog_in	0 - 5 V	220K PD	Pin D3
AN10	analog_in	0 - 5 V	220K PD	Pin E3
AN11	analog_in	0 - 5 V	220K PD	Pin F4
AN12	analog_in	0 - 5 V	220K PD	Pin F3
WAKE_INPUT1	analog_in	0 - 5 V	(None)	Pin G1

Outputs				
Resource	Functions	Driver Types	Current Rating	Note
H1+/-	hbridge_out output_status	H-Bridge	5A Continuous 8A Maximum	Short to Battery Short to Ground Pin M1+/M2-
LSO_ENABLE	digital_out	(None)		
LSO1	pwm_out output_status	Low Side	1.5A Continuous 3A Maximum	Short to Battery Short to Ground Pin A3
LSO2	pwm_out output_status	Low Side	1.5A Continuous 3A Maximum	Short to Battery Short to Ground Pin A1
LSO3	pwm_out output_status	Low Side	1.5A Continuous 3A Maximum	Short to Battery Short to Ground Pin B1
LSO4	pwm_out output_status	Low Side	1.5A Continuous 3A Maximum	Short to Battery Short to Ground Pin C1
LSO5	pwm_out output_status	Low Side	1.5A Continuous 3A Maximum	Short to Battery Short to Ground Pin D1

Outputs				
Resource	Functions	Driver Types	Current Rating	Note
LSO6 [FLIM]	pwm_out output_status	Low Side	200mA Maximum	Short to Ground Pin E1 FLIM Circuit
LSO7	pwm_out	Low Side	3A Continuous 5A Maximum	Pin A4
LSO8	pwm_out	Low Side	3A Continuous 5A Maximum	Pin A2

Internal Measurements		
Resource	Units	Note
Sensor Power	V	5V Sensor Power
BATT	V	Battery Voltage
H1_CURRENT	mA	H1 Current Sense

2. Block Diagram

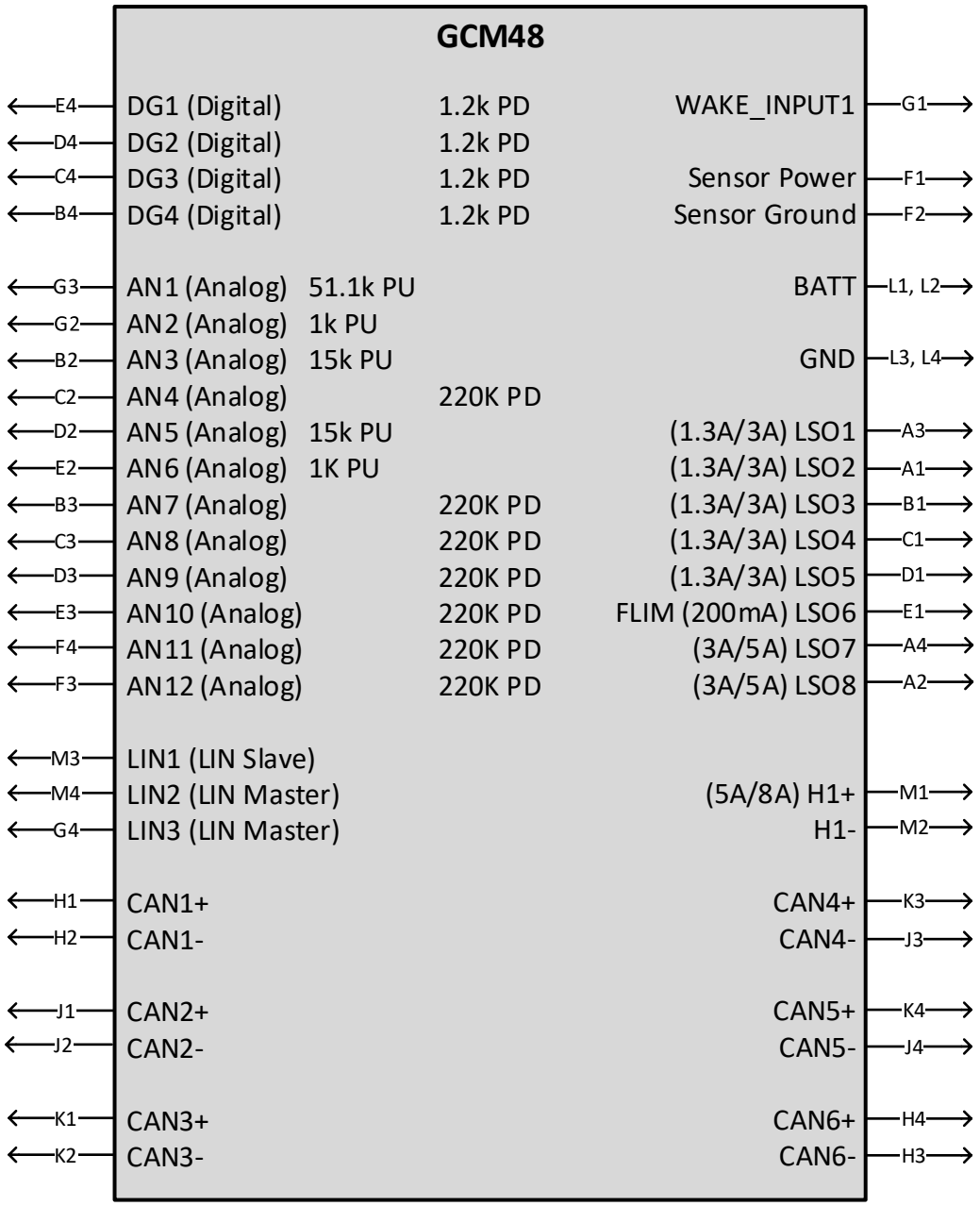


Figure 1: GCM-5605B-048-2104 Block Diagram

3. Communication

The GCM48-2104 contains a total of 6 CAN 2.0 buses. The module is capable of Wake on CAN2.
The GCM48-2104 also contains a total of 3 LIN buses. LIN 2 and LIN3 are configured as LIN Master while LIN 1 is configurable in Raptor as either LIN Master or LIN Slave. The Module is capable of Wake on LIN2.
There is no internal termination of the CAN Buses.

4. Power

The logical battery input should be permanently connected to battery voltage. This battery input is needed to power the microprocessors when awake. It should be fused independently of the entire system to ensure that there is not excess current on the logic power traces.

Note: The ECU is protected against reverse polarity supply voltage of U = 13.8 V for up to 5 minutes.
Note: Jump Start with battery voltage of 17V is permitted up to 5 minutes at ambient temperature 23°C +/-5°C. The battery of the vehicle must be connected.

4.1 Max Ratings

	Min	Nom	Max	Units
Input Voltage: Normal Operation	8	12	16	V
Load Dump Protection			30	V
Jump Start (Up to 5 min)			17	V
Reverse Battery Protection (Up to 5 min)			-13.8	V
Current Draw: Off-State Current			0.5	mA

4.2 Power Inputs (BATT, WAKE_INPUT1, GND)

Connect the power source positive to the BATT input (8V-16V) and the power source common to GND

Note: If the power source is a battery, make sure an alternator or other battery-charging device is included in the system.

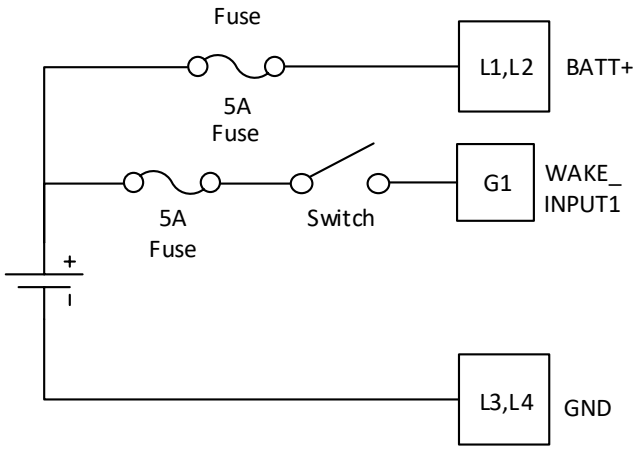


Figure 2: Input Power Circuit Diagram

Note: Avoid using long wires and run the power leads directly from the power source to the control. Do not power other devices with leads common to the control's power inputs.

4.3 Internal Battery Measurement (Analog)

Within the software, the BATT input is available as an internal measurement through the “internal measurement” block.

Software Resource	ADC Range	Theoretical Range
BATT	0-4096	0-38V

4.4 Wake Input (Pin Name: WAKE_INPUT1)

There is no main power relay on this ECU, but there is an analog input for Wake (WAKE_INPUT1). The software needs to turn the module into sleep mode, normally the Main Power Relay block would do this, but that block does not work since there is no MPRD pin. Thus, you need to create your own code to manage sleep mode of the block. The model will still compile with the MPR block, but the block will not do anything.

4.5 Sensor Power Outputs

The GCM48-2104 control provides an external Sensor Power source of up to +5 Vdc. This power output is protected against over-voltage, over-temperature, short circuits, and reverse power.

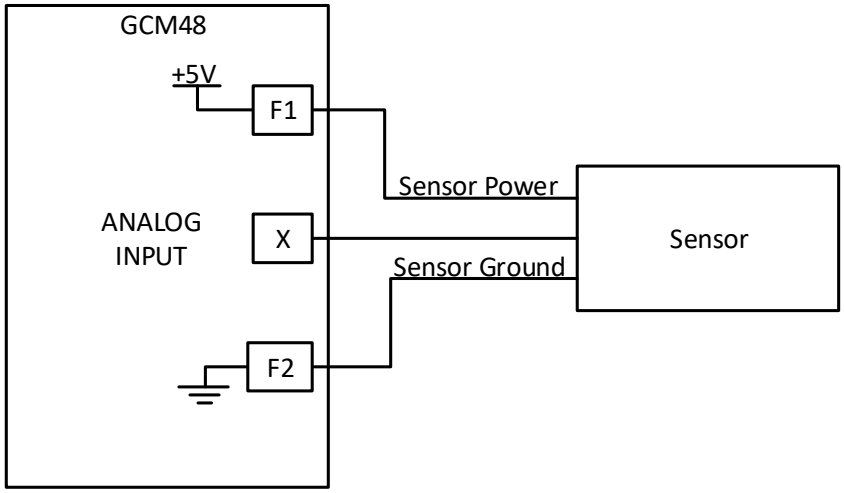


Figure 3: Sensor Output Power Circuit Diagram

4.5.1 Sensor Output Specifications

Output	Voltage	Current Limit
SENSOR POWER	5 V ± 2.5 %	500 mA

4.6 Internal Sensor Power Measurement (Analog)

Resource	ADC	Theoretical Range
SENSOR POWER	0-4096	0-5V

5. Inputs

5.1 Analog Inputs

All analog inputs have the following properties:

	Min	Nom	Max	Units
Input voltage range	0		5	V
Resolution		12		bits
Overvoltage			VBATT	V
ADC	0		4096	
Cutoff Frequency		146		Hz
RC Time Constant (τ)		1		ms

5.1.1 Analog Input (AN1)

This analog input is configured with a 51.1kΩ pull-up resistor.

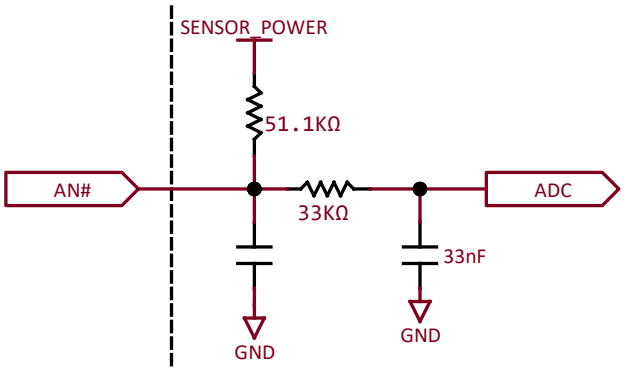


Figure 4: Analog Input 1 Circuit Diagram

5.1.2 Analog Inputs (AN2, AN6)

These analog inputs are configured with a 1kΩ pull-up resistor.

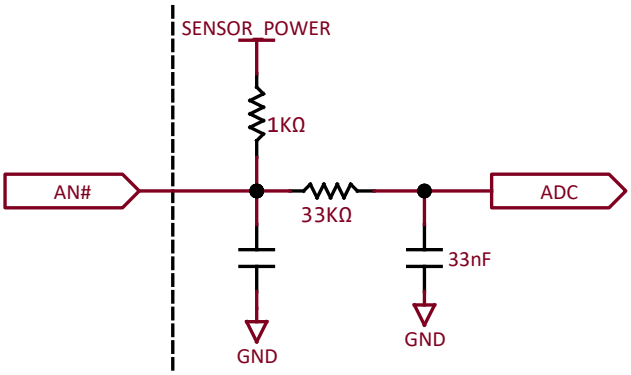


Figure 5: Analog Input 2 and 6 Circuit Diagram

5.1.3 Analog Inputs (AN3, AN5)

These analog inputs are configured with a 15KΩ pull-up resistor.

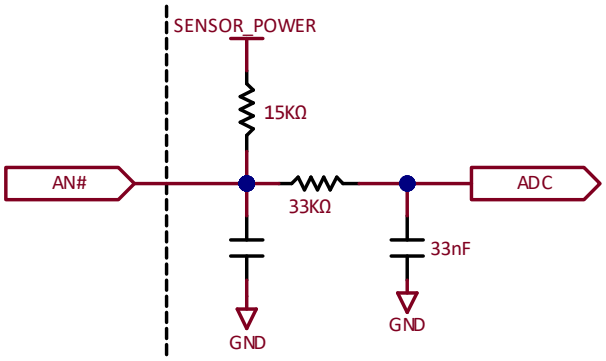


Figure 6: Analog Input 3 and 5 Circuit Diagram

5.1.4 Analog Inputs (7, 8)

These analog inputs are configured with a 220kΩ pull-down resistor.

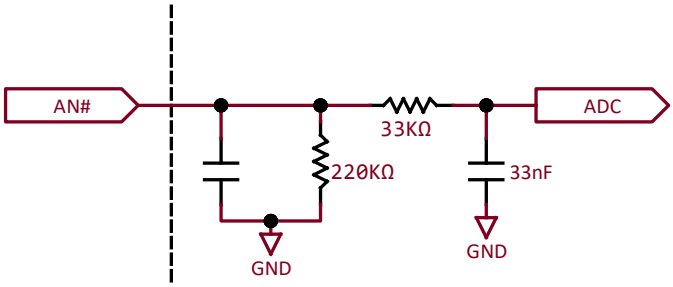


Figure 7: Analog Inputs 7 and 8 Circuit Diagram

5.1.5 Analog Inputs (4, 9, 10, 11, 12)

These analog inputs are configured with a 220kΩ pull-down resistor in hardware.

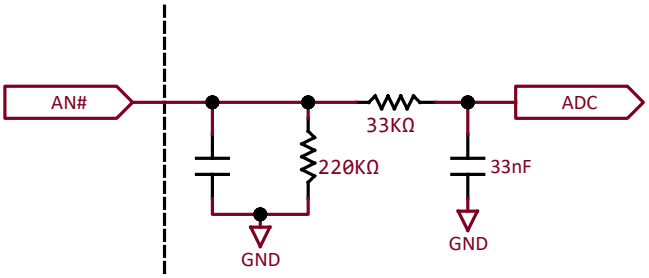


Figure 8: Analog Inputs 4, 9, 10, 11, and 12 Circuit Diagram

5.2 Digital/Frequency Inputs

5.2.1 DG1-DG4

These inputs on the GCM48-2104 are configured to utilize a 1.2kΩ pull-down resistor which is set in hardware. These inputs can operate as either a Digital Input (Logic High/Low) or as Frequency Inputs (Frequency/ Duty Cycle). These inputs can also be switched to BATT.

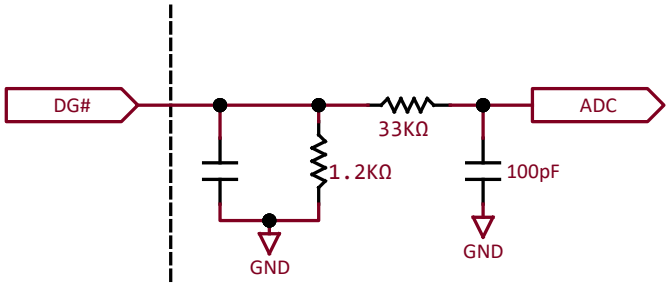


Figure 9: DG Input wiring with 1.2k PD resistor

	Min	Nom	Max	Units
Max Voltage	0		5	V
Max Frequency	200		5,000	Hz
Logic High Threshold	3			V
Logic Low Threshold			1.9	V
Cutoff Frequency		48.253		kHz

6. Outputs

6.1 LSO Characteristics and Capabilities

Function	Drive Capability	Current	Notes
LSO1-5	Boolean or PWM	1.5A Cont. | 3A Max	Fault Detection Available in Output Status Block: Shorted Load Short to Ground Open Load No Fault
LSO7-8	Boolean or PWM	3A Cont. | 5A Max	No Fault Detection Options Available

Max Ratings	Min	Nom	Max	Units
Frequency	200		10,000	Hz
Voltage			VBATT	V

6.1.1 Low-Side Outputs (LSO1-5, 7-8)

The GCM48-2104 control has a total of 7 low-side outputs (LSO's) that can be used as Boolean Outputs for driving relays, or as PWM outputs to drive solenoids. These LSOs are protected against short circuits.

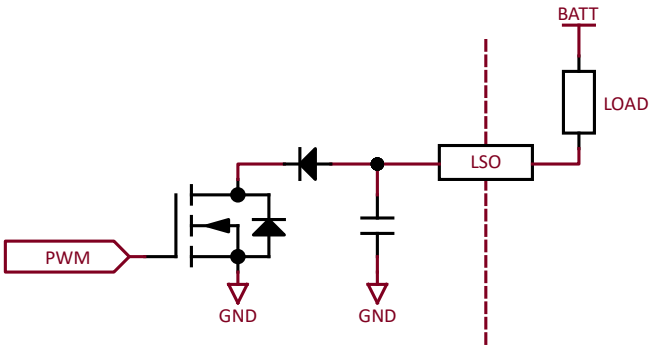


Figure 10: LSO Circuit Diagram

6.1.2 FLIM (LSO6)

LSO6 is configured to be able to interface with a Fuel Level Indicator. It is able to actuate the fuel level indicator by the user adjusting %Duty Cycle which will change the variable resistance of the output between 2.43Ω and 250Ω.

Note: This output is not protected against Reverse Battery or Short to Battery Conditions. If the unit is connected in a reverse or short to battery condition, there is a risk that this output can be damaged unless the external circuitry limits the current to be less than 200mA.

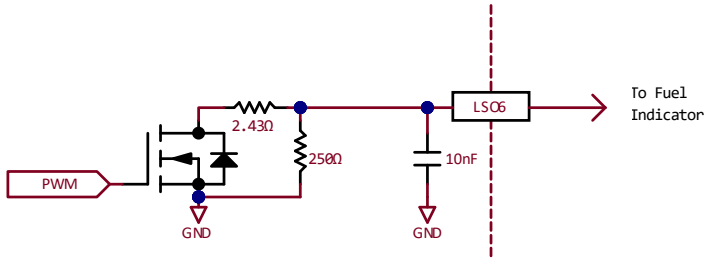


Figure 11: FLIM Circuit Diagram

6.2 H-Bridge (H1+/-)

This output is a full-bridge motor driver. The GCM48-2104 also has an internal measurement for the H-Bridge Output (H1) and can be monitored in Raptor. The H-Bridge output has the following properties:

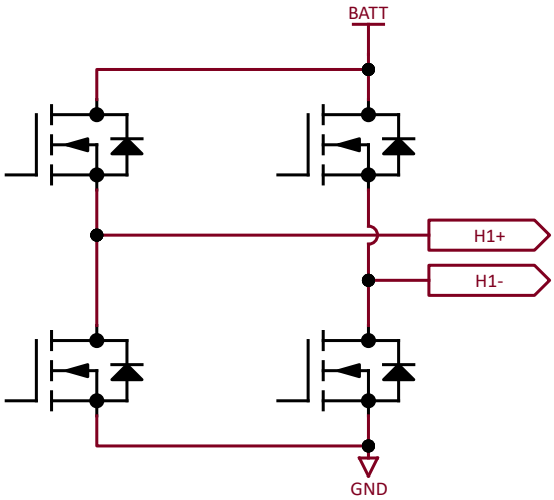
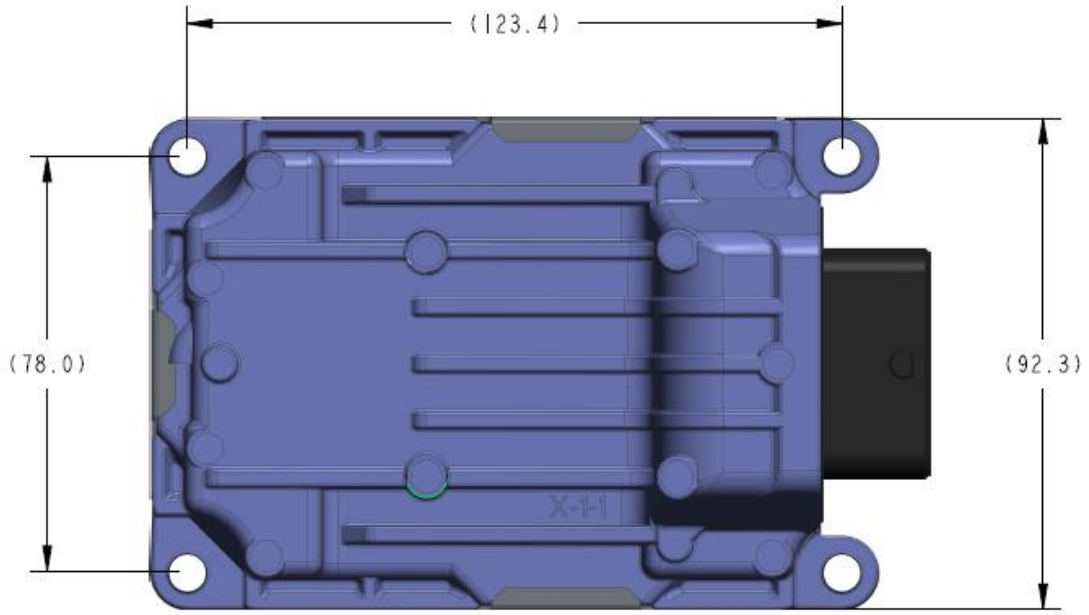


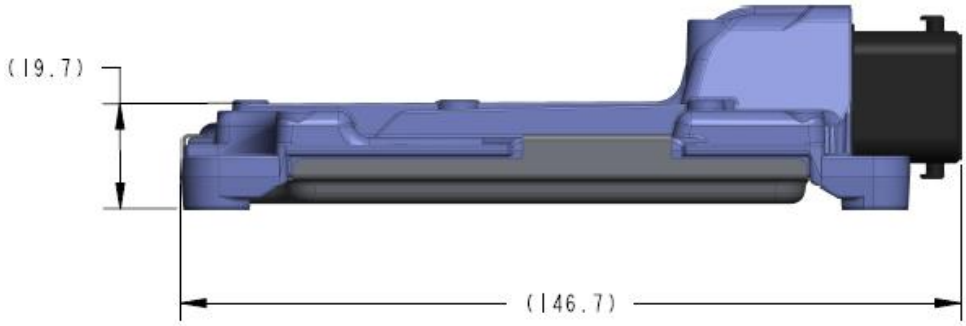
Figure 12: H-Bridge Circuit Diagram

	Min	Nom	Max	Units
Output Current		5	8	A
High-Side Current Limitation	8	12	16	A
Frequency	4		2,500	Hz

H-Bridge Internal Current Measurement (H1_CS)	Notes
Gain	1.2177
Offset	42.204
ADC Max	4096
Measurement Range	0 – 2500 mA

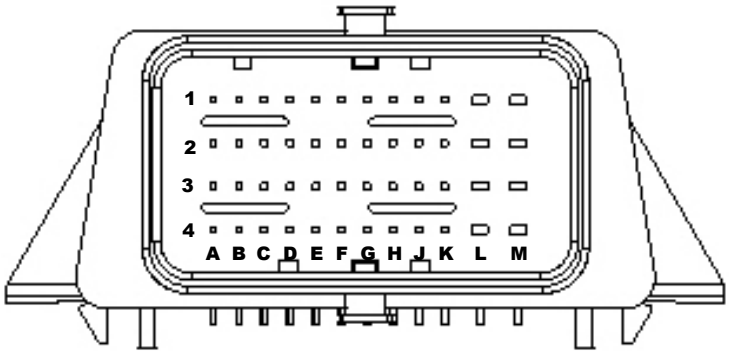
7. Dimensions (mm)





8. Connector and Pinout

The GCM48-2104 has a single 48 pin connector, as follows: Molex 643201311 (Black Keying)



Pin #	Pin Name	Pin #	Pin Name
A1	LSO2	G1	WAKE_INPUT1
A2	LSO8	G2	AN2
A3	LSO1	G3	AN1
A4	LSO7	G4	LIN3
B1	LSO3	H1	CAN1+
B2	AN3	H2	CAN1-
B3	AN7	H3	CAN6-
B4	DG4	H4	CAN6+
C1	LSO4	J1	CAN2+
C2	AN4	J2	CAN2-
C3	AN8	J3	CAN4-
C4	DG3	J4	CAN5-
D1	LSO5	K1	CAN3+
D2	AN5	K2	CAN3-
D3	AN9	K3	CAN4+
D4	DG2	K4	CAN5+
E1	LSO6 [FLIM]	L1	BATT
E2	AN6	L2	BATT
E3	AN10	L3	GND
E4	DG1	L4	GND
F1	SENSOR POWER	M1	H1+
F2	SENSOR GROUND	M2	H1-
F3	AN12	M3	LIN1
F4	AN11	M4	LIN2

Figure 13: GCM-5605B-048-2104 Connections

9. Recovery Procedure

1. Power down the GCM completely.
2. Open the Raptor-Cal application.
3. Select CAN 1 and set the baud rate to 500K.
4. Click on **Flash**. The window will say “No Modules Found”.
5. Click on **Recover**. Select **GCM-5605B-048** in the drop-down, select “Go” and follow prompted steps.
6. If your module is found, select it and choose an appropriate .RPG file.
   If you do not see your module, double check that it is powered, the key-switch is ON, and that your CAN-to-USB device is connected properly.
7. Success! Your module has been recovered and will be flashed with the selected .RPG file.
   If this step fails, the software package may be to blame. Try a different .RPG file.

10. Related Products

Part	New Eagle Store Part Number
CONNECTOR KIT – GCM48-2104	CON-KIT-GCM48-2104
HARNESS – GCM48-2104 PIGTAIL 12 FT	HARN-GCM48-2104-001

11. Environmental Ratings

Condition	Notes
This GCM 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, and vibration. EMC Tests include ISO7637-2 pulses, BCI, Radiated and Conducted Emissions, Battery Voltages, Short to Battery/Short to Ground, and ESD. The customer must contact New Eagle and provide the intended environmental conditions in the application for verification of performance capability.	
Storage Temperature	–40 °C to +105 °C
Operating Temperature	–40 °C to +105 °C
Thermal Shock	SAE J1455, section 4.1.3.2 –40 °C to +125 °C, 500 Cycles
Fluid Resistance	Two-stroke motor oil, four-stroke motor oil, unleaded gasoline, ASTM Reference 'C' fuel
Humidity Resistance	SAE J1455; section 4.3.3.2 90% Humidity at 85°C for 1000 Hours
Salt Fog Resistance	SAE J1455; section 4.3.3.2 500 Hours, 5% Salt Fog @ 35°C
Immersion	SAE J1455; section 4.3.3.2 4.34 psi test (simulated 3m / 10ft), salt water, 20 min
Mechanical Shock	MIL-STD 810H, Method 516.8, Procedure I 50 G’s, 11 ms, half-sine wave, 4 shocks per direction.
Drop Test	SAE J1455 6 drops on concrete from 1m, no hidden damage
Vibration	MIL-STD-810H Method 514.8

Condition	Notes
ISO7637-2 Pulses	Pulse1, 1B, 2A, 2B, 3A, 3B, 5B, and Waveforms A1, and A2
BCI	ISO 11452-4
Radiated Immunity	ISO 11452-2
Radiated and Conducted Emissions	CISPR25
Battery Voltages	8-16V Steady State, 5.5V minimum operating voltage, 18V Max Overvoltage
Reverse Battery Voltage	-13.8V for up to 5 minutes
Short to Battery/Short to Ground	All pins shall tolerate short to battery and short to ground connections
ESD	Up to 4kV Handling, up to 15kV Operating

12. Production Warranty Approval Process

New Eagle does not warranty prototype or development ECUs based on the information supplied in this datasheet. Production applications using this hardware require application review by New Eagle Engineering prior before production warranty coverage can be granted. Typically, this review is performed as part of the Production Supply Agreement and involves a review of the application's operating mode, environmental conditions, and I/O usage details to assure that the application is utilizing the hardware within its design specifications. Involving New Eagle's Application Engineering team early can help to expediate the approval process.