



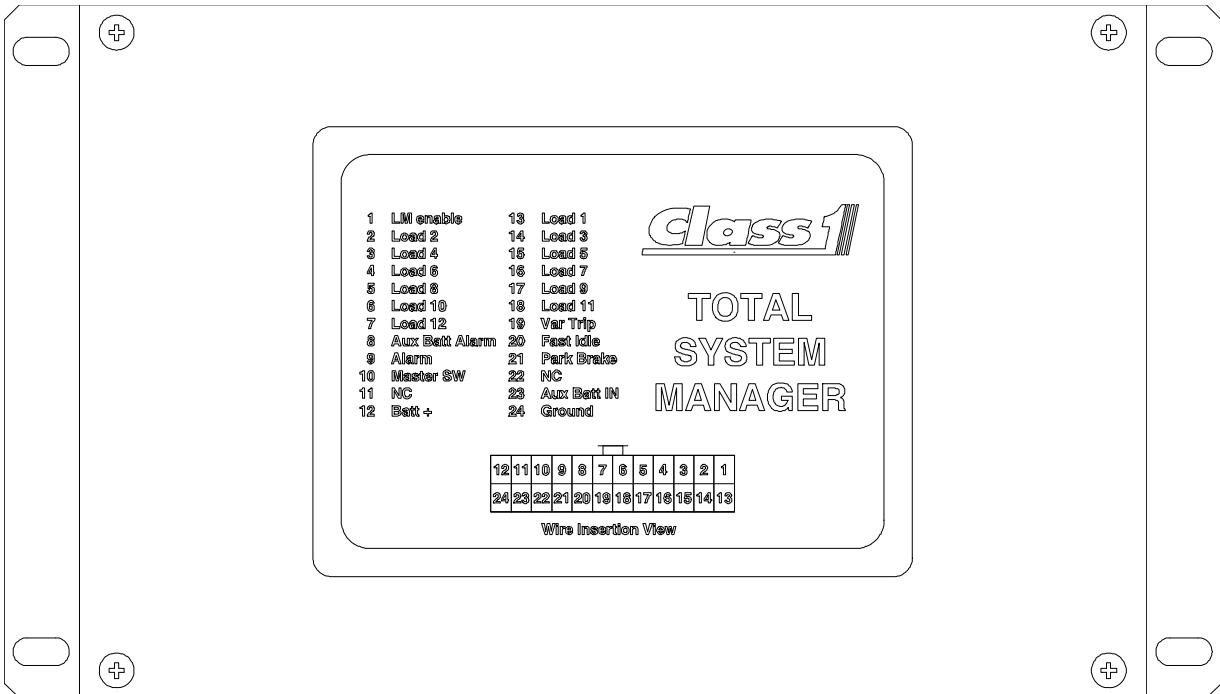
# Class 1


ISO 9001 CERTIFIED

607 NW 27th Ave  
Ocala, FL 34475  
Phone: (352) 629-5020 or 800-533-3569  
Fax: (352)-629-2902

## OPERATION MANUAL

### Total System Manager



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					<b>BY</b>	GMC


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## 1. Revision Log

Rev	Date	Approved	Changes
<b>1.02</b>	8-14-2014	GMC	Added Over-Current Protection and Edited Legacy Replacement Setup
<b>1.01</b>	4-02-2014	MH	Corrected part number for 101750 configuration and added PCB drawing to technical details section.
<b>1.00</b>	3-01-2013	GMC	Initial requirements

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## 2. System Overview

### 2.1. Scope

The Total System Manager provides a highly flexible electrical load management system that is user programmable for each load output.

### 2.2. Features

Total System Manager C1 – p/n 610-00015

- ✓ 12 and 24 volt Selectable Operation.
- ✓ Main Battery Monitoring.
- ✓ Auxiliary Battery Monitoring.
- ✓ Electrical Load Shedding.
- ✓ Electrical Load Sequencing.
- ✓ Reverse Polarity / Short Circuit Protection.
- ✓ Sixteen Available Outputs.
- ✓ Priorities can be set for Individual Loads.
- ✓ Each load can be tied to Response and/or Scene Mode.
- ✓ Individual loads can be configured to the Ignition or Master Warning Switch.
- ✓ Dedicated output for a Fast Idle Function.
- ✓ Low Voltage Alarm Output for main Battery (NFPA 1901).
- ✓ Low voltage Alarm Output for Auxiliary Battery.
- ✓ Variable Trip 'User Selectable' Output Selectable 10.5 to 15 VDC and 21 to 29 VDC.
- ✓ Master, Park Brake, and Load Manage Enable Switch polarity selectable.
- ✓ Digital Display shows System Voltage in Normal Operation.
- ✓ Digital Display shows Configuration Information while in Program Mode.
- ✓ Default Configurations can be restored at any time.
- ✓ Polarity Selectable Outputs .250 AMPS

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### 3. Operational Data

#### 3.1. 12 Volt System.

SHED POINTS		UNSHED POINTS	
Level 0	Never Shed	Level 1	11.4 Volts
Level 1	11.0 Volts	Level 2	11.6 Volts
Level 2	11.4 Volts	Level 3	12.0 Volts
Level 3	11.8 Volts	Level 4	12.2 Volts
Level 4	12.0 Volts	Level 5	12.4 Volts
Level 5	12.2 Volts	Level 6	12.6 Volts
Level 6	12.4 Volts	Level 7	12.8 Volts
Level 7	12.6 Volts	Level 8	13.0 Volts
Level 8	12.7 Volts		

#### 3.2. 24 Volt System.

SHED POINTS		UNSHED POINTS	
Level 0	Never Shed	Level 1	22.8 Volts
Level 1	22.0 Volts	Level 2	23.6 Volts
Level 2	22.8 Volts	Level 3	24.0 Volts
Level 3	23.6 Volts	Level 4	24.4 Volts
Level 4	24.0 Volts	Level 5	24.8 Volts
Level 5	24.4 Volts	Level 6	25.2 Volts
Level 6	24.8 Volts	Level 7	25.6 Volts
Level 7	25.2 Volts	Level 8	26.0 Volts
Level 8	25.4 Volts		

#### 3.3. Sequencing.

Electrical loads will turn on sequentially in priority order from 1 to 8 when their respective switch is activated (either ignition or warning master) and the vehicle is operated in the mode selected for that output (response and/or scene). loads will sequence off in the reverse order. Priority zero loads will be sequenced on and off but will not shed.

#### 3.4. Shedding.


Electrical loads will be turned off (shed) when the system voltage drops to the shed point for a minimum of 1 minute (this prevents load shedding due to momentary system power loading such as high current start up devices). Once shed, loads will remain off for a minimum of 5 minutes and until the unshed voltage is achieved for a minimum of 1 minute. Loads will only shed if the Parking Brake is set and the Load Manage Enable input is active.

#### 3.5. Fast dle.

A fast idle output is activated whenever the system voltage is reduced to 12.8 volts on a 12 volt system or 25.6 volts on a 24 volt system for a least one minute. The fast idle will remain ON for a minimum of 10 minutes and until 13.0 volts on a 12 volt system or 26 volts on a 24 volt system is achieved. The fast idle output is dependent on the Parking Brake and Load Manage Enable Input.

Note:

1. This output should only be used as part of a fast idle control system when the proper safety interlocks are present.
2. The FAST IDLE output will turn off immediately when the Load Manage Enable Input is disengaged.

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### 3.6. Low Voltage Alarm.

Whenever the system voltage drops below 11.9 volts for a 12 volt system or 23.8 volts for a 24 volt system a low voltage alarm output is activated. This complies with the N.F.P.A. 1901 requirements.

### 3.7. Switch Sources.

Each load can be programmed to activate by either the Ignition switch or the Warning Master switch.

Ignition: Loads programmed for ignition will sequence on when the vehicle ignition switch is turned ON.

Warning Master: Loads programmed for master warning will sequence on when the master warning switch is turned ON.

### 3.8. User Setpoint / Variable Trip.

This is the user definable output. The user has the option of selecting a 'trip' voltage between 10.5 and 14.5 volts for a 12 volt system or between 21.0 and 29.0 volts for a 24 volt system. If the trip point is set to 13.8 volts or above on a 12 volt system or set to 27.6 volts or above on a 24 volt system the output acts as an overvoltage indicator and will turn on when the selected voltage is reached. If the 'trip' voltage is set below 13.8 volts for a 12 volt system or 27.6 volts for a 24 volt system the output will activate when the voltage drops to the setpoint.

### 3.9. Auxiliary Battery Monitoring.

Terminal #23 can be used to monitor an auxiliary battery. There should be no connections to this terminal if a remote battery is not monitored. If the auxiliary battery voltage drops below 11.9 volts on a 12 volt system or 23.8 volts on a 24 volt system the auxiliary battery output will turn on.

### 3.10. Output Modes.

Each load can be programmed for RESPONSE MODE, SCENE MODE, OR BOTH.

Response Mode: The output is ON only when the Park Brake is **NOT** set.

Scene Mode: The output is ON only when the Park Brake **IS** set.

Both: The output is ON in both Response and Scene Mode.

### 3.11. Output Polarity.

All Outputs can be user selected to operate as a High Side or Low side Output.

### 3.12. Operating voltage.

The unit will operate from 7 to 32 volts DC.

### 3.13. Outputs.

Every output is user selectable to be a High side or a Low Side driver.

High Side: Vmain at 0.5 amp (source).

Low Side: Ground at 0.5 amp (sink).

### 3.14. Transient protection.

The main power supply and all outputs are protected against direct shorts and transient spikes.

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### 3.15. Over-Current protection.

When the Outputs are enabled and either there is a short or over-current condition applied to that output. The output will be shut off and the software will attempt to turn on the output three times. If after the second attempt and the overload or short condition still exists, on the third try the software will leave the output in the off condition. The output will remain off until the load is either cycled off than back on or a complete system restart to start the cycle over again. An output that is in shutdown is indicated by flashing the corresponding indicator LED at a half a second rate.

### 3.16. Override.

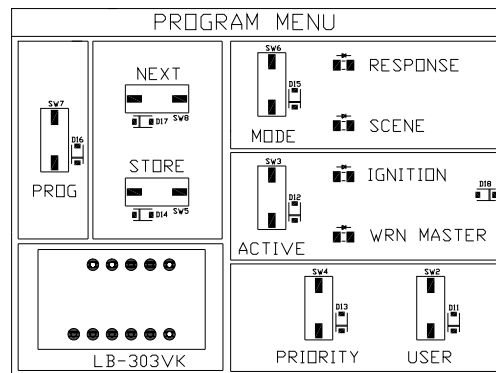
When the Override switch is activated Outputs 1 through 12 will turn on no matter what state they currently operating in. The Override LED will flash at a 500mS rate to indicate that the Override feature has been activated. Caution should be paid attention to the Override feature is intended for quickly turning on all Output loads in time of need. If used to verify that the outputs work in a trouble shooting capacity if the corresponding output LED is turned on and the load attached to the output does not turn on check for a short or proper output polarity.

### 3.17. CAN.

The unit transmits the output states and input states VIA CAN (Control Area Network) utilizing the SAE J1939 proprietary, 250 Kbits/second protocol. See section 9 for more information.

## 4. Programming

### 4.1. Program Menu.



Programming the Total System Manager is accomplished using push button switches and a straightforward menu approach. A digital display and 4 LED's provide feedback to the programmer.

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#### 4.2. Program Switch.

The program switch has three modes.

Mode 1:

If you press and hold the **USER** switch and then press the **PROG** switch this will place the unit into program mode indicated by displaying 3 dashes (---) on the digital display and the displaying **L01**.

Mode 2:

If you press and hold the **USER** switch and then press the **PROG** switch. Continue to hold the **PROG** switch for (aprox. 10 seconds) will load the factory defaults. Indicated by displaying **DEF** on the digital display.

Mode 3:

When the unit is in program mode holding the **PROG** switch will save the new values. Indicated by displaying **Pro** on the digital display.

#### 4.3. Next Switch.

Pressing the **NEXT** switch while in program mode will cycle through each output, The Output LOAD LED will turn on for the active output and the digital display will indicate the load selected by displaying **L01-L13**.

#### 4.4. Priority Switch.

The **PRIORITY** switch selects the sequence and shed priority level for the selected output. The digital display will show the current priority as the switch cycles through from **P00** to **P08**. Loads sequence on in priority from 1 to 8 and they shed off in priority from 8 to 1. loads set to priority 0 will never shed but they will sequence on and off.

#### 4.5. Active Switch.

The **ACTIVE** switch toggles the switch source either ignition or warning master for the selected output.

**IGNITION** LED: Output is tied to the Ignition switch.

**WRN MASTER** LED: Output is tied to the master switch.

#### 4.6. Mode Switch.

The **MODE** switch toggles through the available modes for load management.

**RESPONSE** LED: Output in ON only when the Parking Brake is **NOT** set.

**SCENE** LED: Output is ON only when the Parking brake **IS** set.

**BOTH** LED: Output is on regardless of the Parking Brake status.


#### 4.7. User Switch.

The **USER** switch adjust the setpoint voltage for output #13 (term 19). Pressing the button increases the 'trip' point in 0.1 volt increments from 10.5 volts to 14.5 volts for a 12 volt system and 21 volts to 29 volts for a 24 volt system. If the trip point is set to 13.8 volts or above on a 12 volt system or set to 27.6 volts or above on a 24 volt system the output acts as an overvoltage indicator and will turn on when the selected voltage is reached. If the 'trip' voltage is set below 13.8 volts for a 12 volt system or 27.6 volts for a 24 volt system the output will activate when the voltage drops to the setpoint.

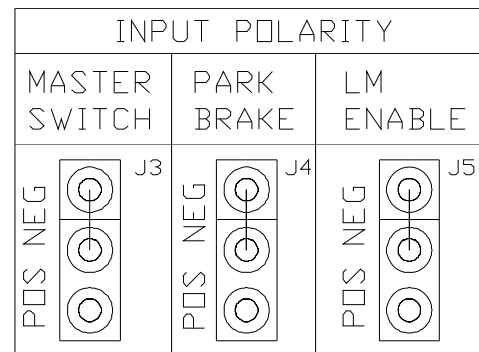
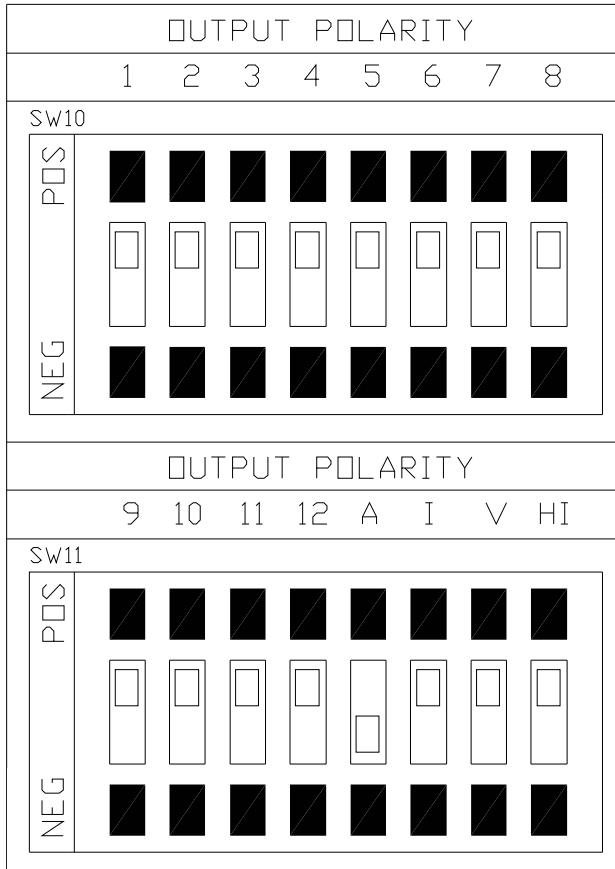
#### 4.8. Store Switch.

The **STORE** switch saves the current configuration for the selected output. The display will indicate that the value has been saved by showing 3 dashes (---) and then the load number (**Lxx**) on the digital display.



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**4.9. Input Output Polarity.**



The output polarity switches control the output polarity for loads 1 through 16. The polarity of the outputs is set on power up of the unit. changes to the polarity switches will not take place until the next power cycle. Caution should be taken to make sure the polarity is selected correctly for the individual output based on the load it is attached to.

The input polarity shunts control the polarity for Master Warning, Park Brake, and Load Manage Enable inputs.

**4.10. System Voltage selection.**

When the unit is in programming mode press the *NEXT* switch until the digital display reads either **-12** or **-24** (the default setting is **-12**). Selecting the *USER* switch will change between **-12** or **-24**. Once the desired setting has been selected press the *STORE* switch until 3 dashes (---) are displayed on the digital display. Press and hold the *PROG* switch until *Pro* appears on the digital display this will indicate the setting has been saved.

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## 5. Programming Example

### 5.1. Programming Example

You want load #3 to shed at a voltage level of 12.0 volts. It needs to be tied to the Master Switch and be activated in the Scene Mode.

1. Depress the **USER** and **PROG** switches until (---) is displayed.
2. Press the **NEXT** switch until **L03** is displayed on the digital display.
3. Press the **MODE** switch until only the **SCENE** LED is on.
4. Press the **ACTIVE** switch until only the **WRM MASTER** LED is on.
5. Press the **PRIORITY** switch until **P04** is displayed on the digital display.
6. Press the **STORE** switch until 3 dashes (---) are displayed on the digital display.
7. If you want to configure another output select the **NEXT** switch and repeat the procedure to program that output.
8. When all the outputs are programmed press and hold **PROG** switch until **Pro** is displayed on the digital display.

Note: If you do not press the STORE switch after each Output is configured that Output will not be changed.


## 6. Connector Information

### 6.1. Terminal Function and Polarity

Terminal	Function	Polarity	Terminal	Function	Polarity
1	Load Manage Enable	POS/GND	13	Output Load # 1	POS/GND
2	Output Load # 2	POS/GND	14	Output Load # 3	POS/GND
3	Output Load # 4	POS/GND	15	Output Load # 5	POS/GND
4	Output Load # 6	POS/GND	16	Output Load # 7	POS/GND
5	Output Load # 8	POS/GND	17	Output Load # 9	POS/GND
6	Output Load # 10	POS/GND	18	Output Load # 11	POS/GND
7	Output Load # 12	POS/GND	19	VAR Trip Output	POS/GND
8	AUX Battery Alarm	POS/GND	20	Output Fast Idle	POS/GND
9	Low Voltage Alarm	POS/GND	21	Parking Brake Input	POS/GND
10	Master Switch Input	POS/GND	22	CAN LOW	N/A
11	CAN HIGH	N/A	23	Aux Battery Input	Positive
12	Main Battery Power	Positive	24	Ground	Ground

Mating connector	AMP 770587-1	
Socket(Loose Form)	AMP 171639-1	16-18 Ga
Socket(Strip form)	AMP 171637-1	16-18 Ga
Crimping Tool	AMP 90760-1	Pro Crimper
Contact Extraction Tool	AMP 189727-1	
Connector and Socket Kit	Class1 P.N. 101536	
Mating Pigtail	Class1 P.N. 101538	

The Main battery power (term #12) and ground (term #24) should be wired direct to the battery as possible.

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## 7. Default Settings

### 7.1. Defaults.

The Total System manager is shipped with the following default settings.

Priority	Shed Point	UnShed Point
8	12.7	13.0
7	12.6	12.8
6	12.4	12.6
5	12.2	12.4
4	12.0	12.2
3	11.8	12.0
2	11.4	11.6
1	11.0	11.4

Unit is set to work for a 12 volt system

Loads 1 through 8 are set to priority 1 through 8 respectively and are tied to the Master Warning Switch. These loads will sequence on 1 through 8 and sequence off 8 through 1. They will shed 8 through 1 when the system voltage falls to the shed point for that priority level.

Loads 9 through 12 are set to priority zero and come on with the ignition switch. These loads will sequence on and off but will not shed due to voltage.

Load 1 through 12 are configured to **BOTH** modes **SCENE** and **RESPONSE**. The default polarity for outputs 1 through 12 is positive.


Load 13 is the user configurable Output. The default polarity setting output 13 is positive. The default setting for the 'Variable Trip' Point is 14.5 volts.

Load 14 is the AUXILIARY Battery Alarm. The default polarity setting output 14 is positive.

Load 15 is the Fast Idle Output. The default polarity setting for output 15 is positive. This load becomes active when the system voltage drops to 12.8 volts.

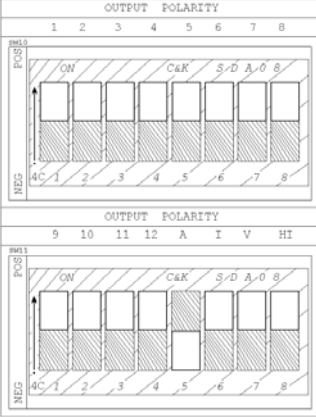
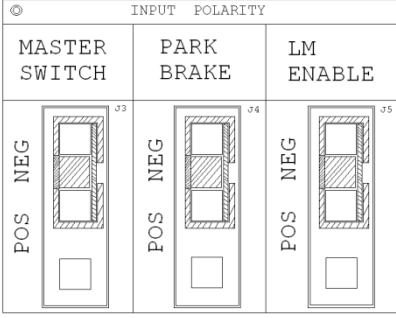
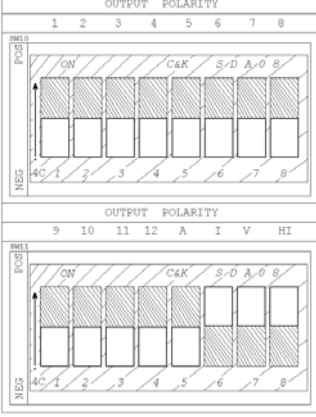
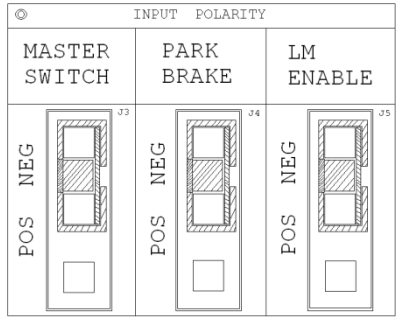
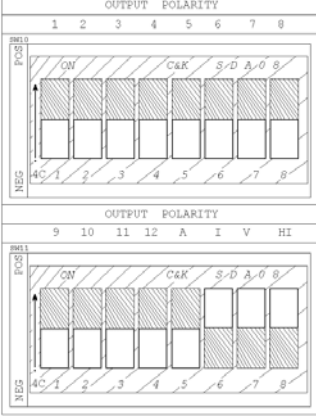
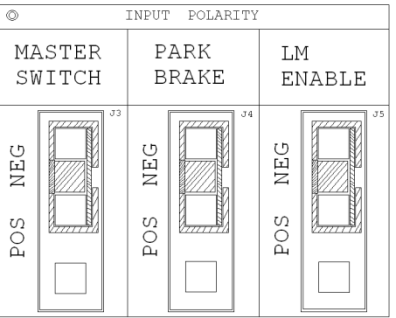
Load 16 is the Low Voltage Alarm Output. The default polarity for output 16 is negative. This load becomes active when the system voltage drops below 11.9 volts.


The default polarity for the Master Warning Input, Park Brake Input, and Load Manage Enable input is negative.

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## 8. Legacy Replacement Setup

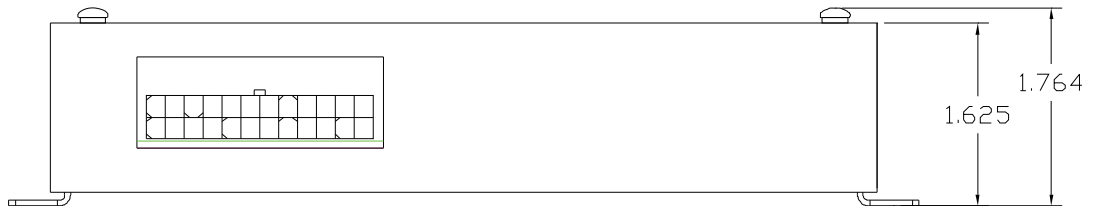
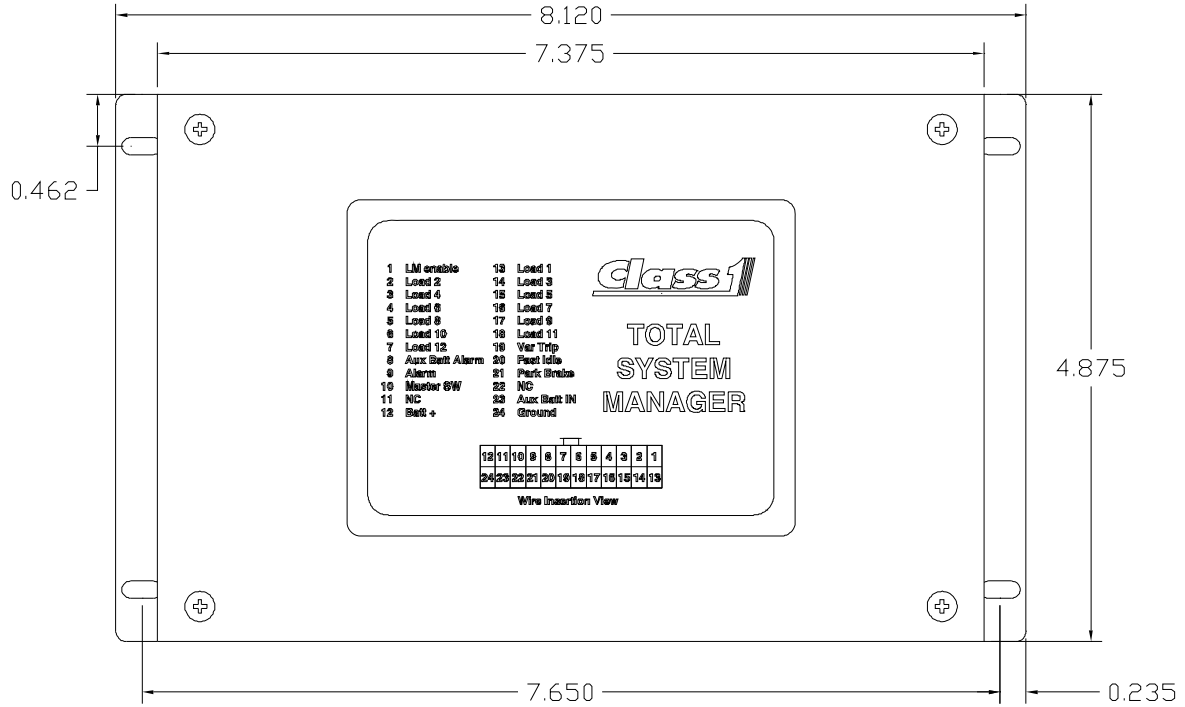
### 8.1. Legacy configuration settings for 101490, 101540, and 101750

<p><b>101490</b></p> <p>To configure the unit to work as the 101490:</p> <ul style="list-style-type: none"> <li>Set the Input polarity shunts to the negative position.</li> <li>Set the Output polarity switch 1-12 to the positive position.</li> <li>Set the Output polarity switch A (Low voltage alarm) to the negative position.</li> <li>Set the Output polarity switch I (Auxiliary Voltage alarm) to the positive position.</li> <li>Set the Output polarity switch V (Variable Trip) to the positive position.</li> <li>Set the Output polarity switch HI (High Idle) to the positive position.</li> <li>Set the system voltage to 12 volts (see section 4.10 in the operation manual).</li> </ul>		
<p><b>101540</b></p> <p>To configure the unit to work as the 101540:</p> <ul style="list-style-type: none"> <li>Set the Input polarity shunts to the negative position.</li> <li>Set the Output polarity switch 1-12 to the negative position.</li> <li>Set the Output polarity switch A (Low voltage alarm) to the negative position.</li> <li>Set the Output polarity switch I (Auxiliary Voltage alarm) to the positive position.</li> <li>Set the Output polarity switch V (Variable Trip) to the positive position.</li> <li>Set the Output polarity switch HI (High Idle) to the positive position.</li> <li>Set the system voltage to 12 volts (see section 4.10 in the operation manual).</li> </ul>		
<p><b>101750</b></p> <p>To configure the unit to work as the 101750:</p> <ul style="list-style-type: none"> <li>Set the Input polarity shunts to the negative position.</li> <li>Set the Output polarity switch 1-12 to the negative position.</li> <li>Set the Output polarity switch A (Low voltage alarm) to the negative position.</li> <li>Set the Output polarity switch I (Auxiliary Voltage alarm) to the positive position.</li> <li>Set the Output polarity switch V (Variable Trip) to the positive position.</li> <li>Set the Output polarity switch HI (High Idle) to the positive position.</li> <li>Set the system voltage to 24 volts (see section 4.10 in the operation manual).</li> </ul>		


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					<b>BY</b>	GMC

## 9. Installation

### 9.1. Mounting dimensions



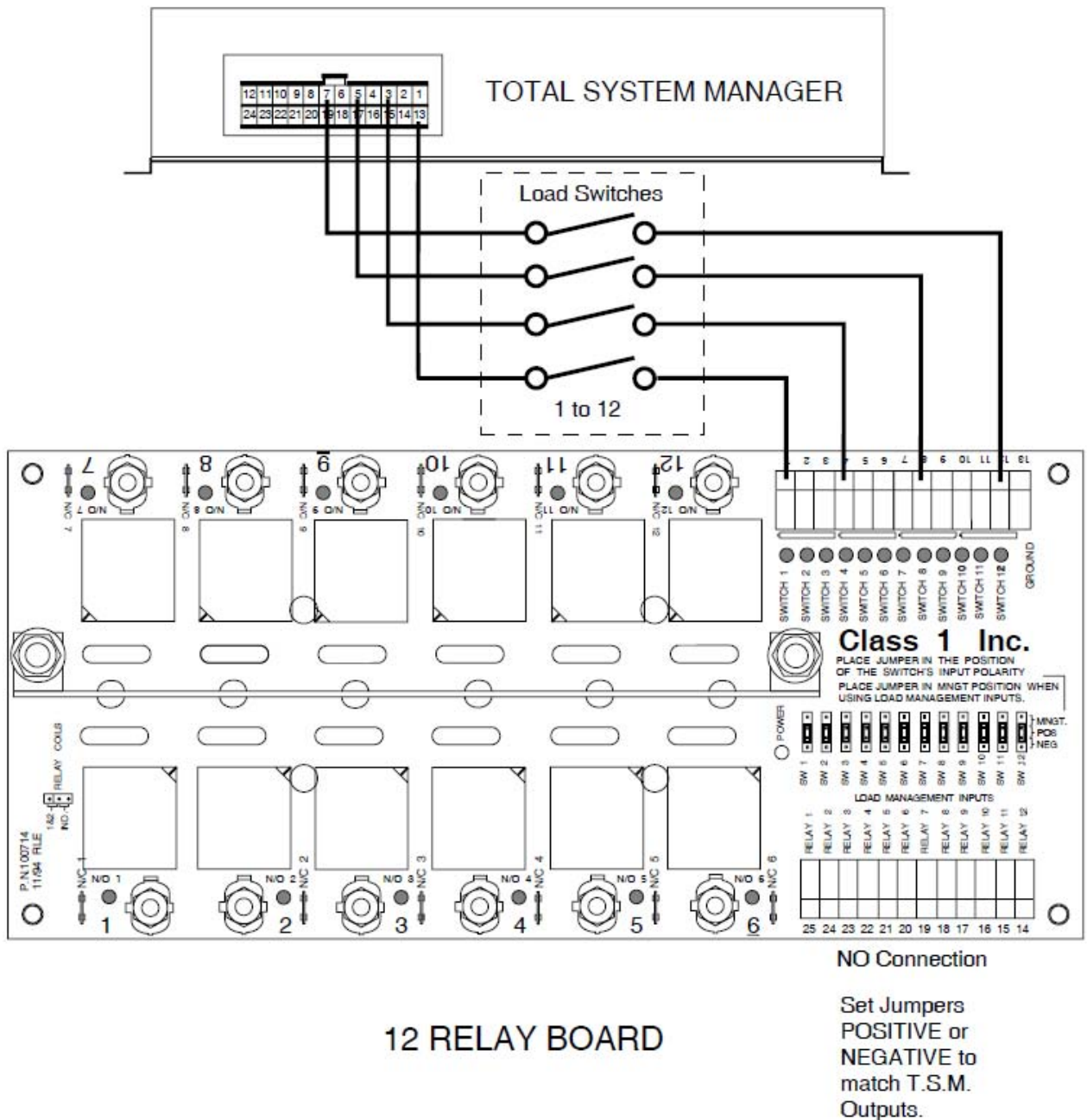
Unit of scale: inches

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	<b>PRODUCT</b>	Total System Manager			<b>REV</b>	1.02
					<b>BY</b>	GMC


## 10. Example Installations

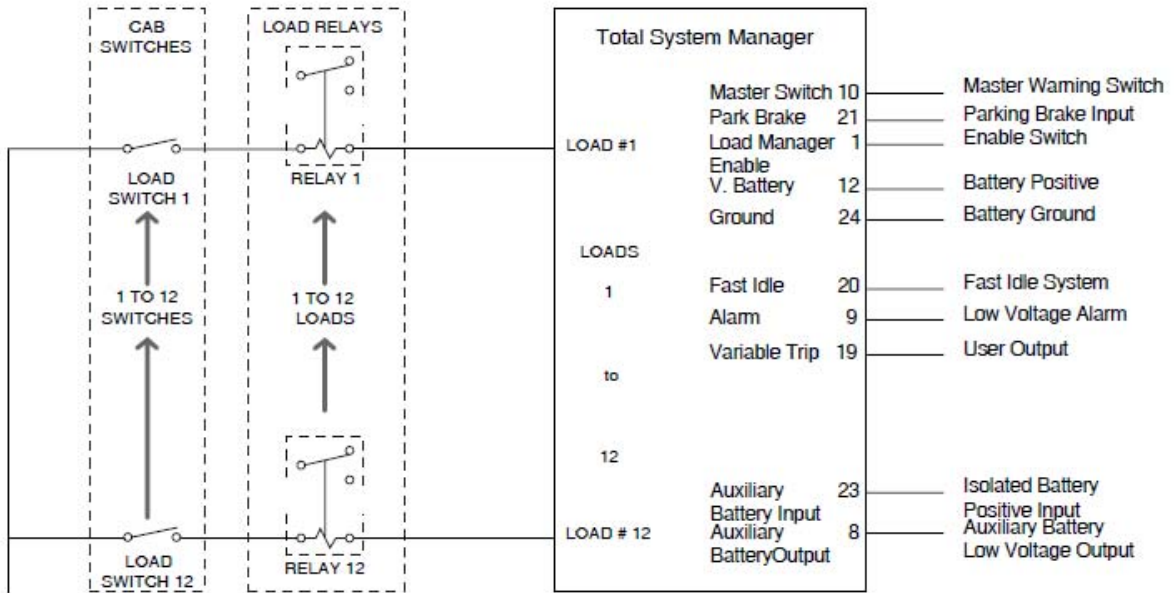
### 10.1. Example.

Connections to the vehicle electrical system can be simplified by using the Class1 12 relay board. Simply install the cab loads switches in series between the Total System Manager and the 12 relay board switch inputs. This installation allows the dash switches to illuminate only when a load is enabled, giving the operator a quick check of the vehicles electrical system ready status.



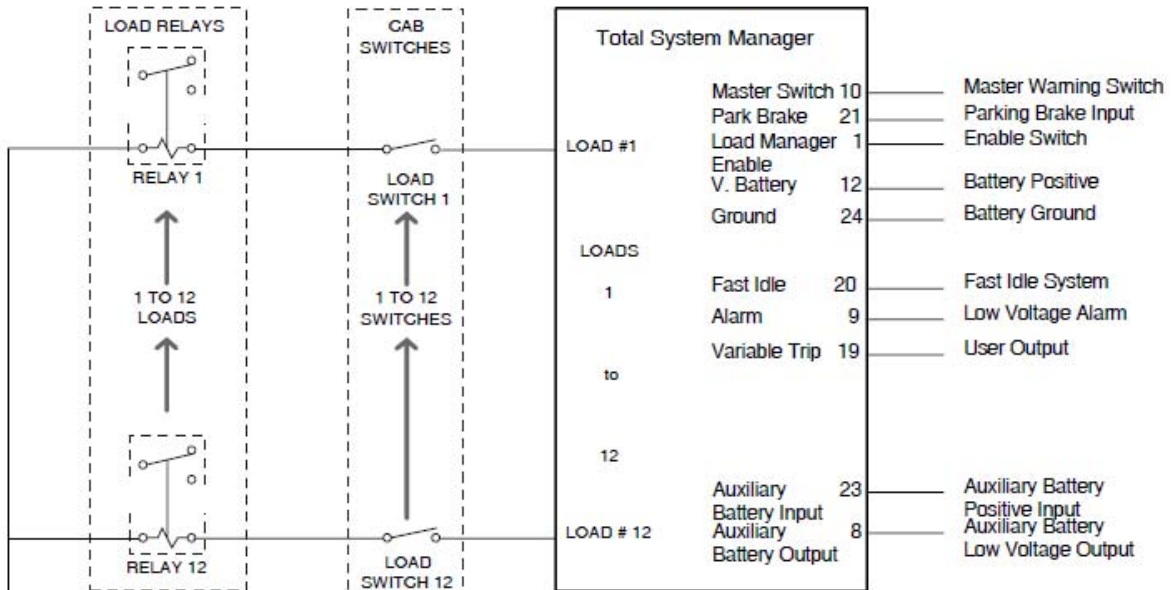


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Positive or Negative dependent on T.S.M.

Two methods for interfacing the **Class 1** Total System Manager into a vehicle's electrical system. The TSM outputs are designed to drive relays to control the loads, so a wide variety of installations can be made.



Positive or Negative dependent on T.S.M.

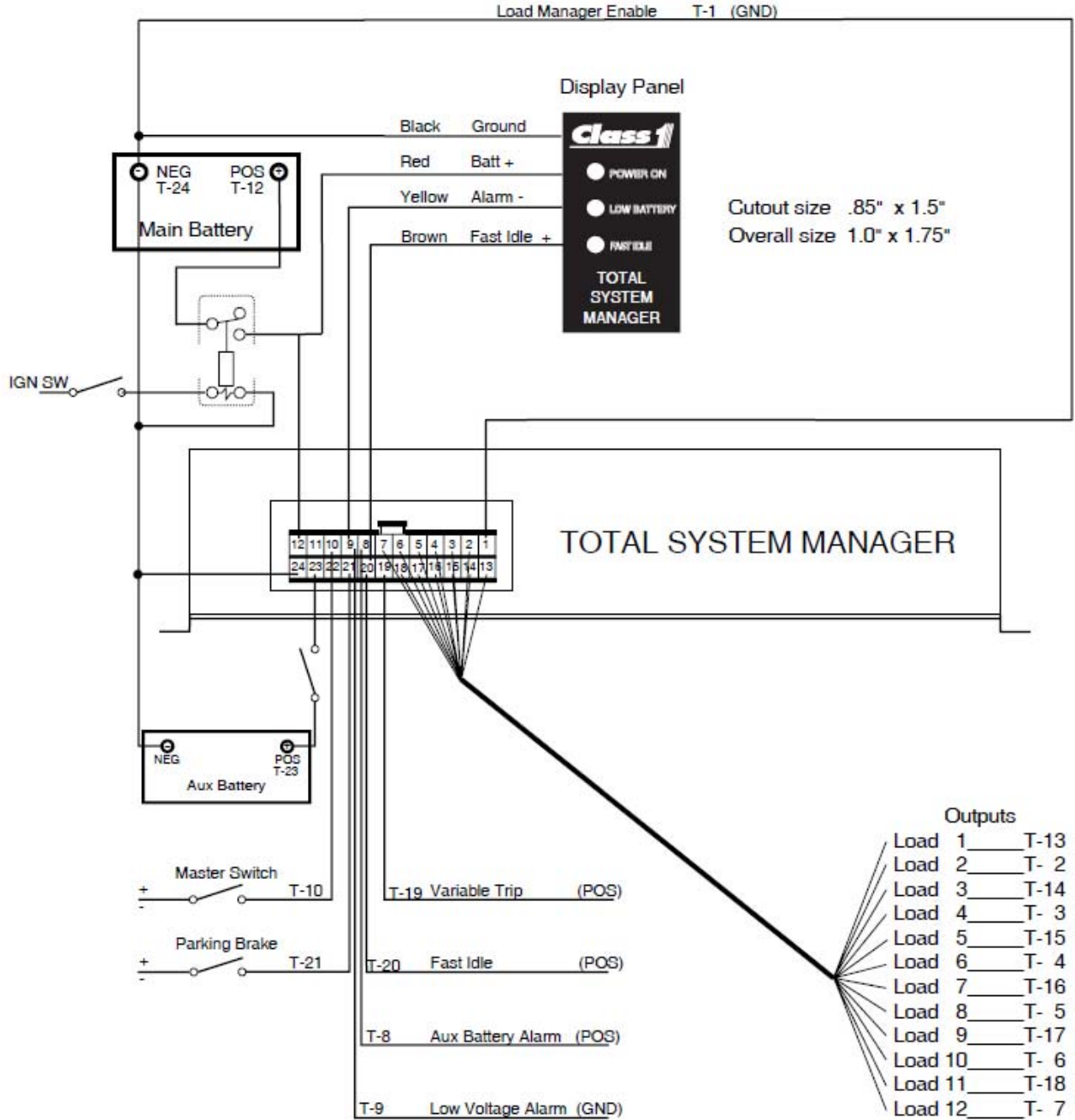


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## 11. Device Network TX CAN messages

### 11.1. Software version message (ES-Key designation 0x9A to 0xFF)

Priority:	6	Datapage:	0
PDU Format:	239	PDU Specific:	255
Source addr:	154	Message frequency:	10 per second

Byte 5 – Software version (high nibble = major rev, low nibble = minor rev)

### 11.2. Output States message (ES-Key designation 0x9A to 0x9B)


Priority:	6	Datapage:	0
PDU Format:	239	PDU Specific:	30
Source addr:	154	Message frequency:	10 per second

Byte 0 – Load 1 through Load 8 state (Load 0 is in the LSb position)  
 Byte 1 – Load 9 through Load 16 state (Load 9 is in the LSb position)  
 Byte 2 – System Voltage (Low Byte)  
 Byte 3 – System Voltage (High Byte)  
 Byte 4 – Iso Battery Voltage (Low Byte)  
 Byte 5 – Iso Battery Voltage (High Byte)  
 Byte 6 – User Set Point (Low Byte)  
 Byte 7 – User Set Point (High Byte)

### 11.3. Input States message (ES-Key designation 0x9A to 0x9C)

Priority:	6	Datapage:	0
PDU Format:	239	PDU Specific:	30
Source addr:	154	Message frequency:	10 per second

Byte 0 – Master Switch state (0x00 OFF 0x01 ON)  
 Byte 1 – Park Brake Switch state (0x00 OFF 0x01 ON)  
 Byte 2 – Load Manage Switch state (0x00 OFF 0x01 ON)  
 Byte 3 – System Voltage Mode (0x00 12 volt system 0x01 24 volt system)  
 Byte 4 – Override State (0x00 OFF 0x01 ON)  
 Byte 5 – Fast Mode (0x00 OFF 0x01 ON) used for factory testing  
 Byte 6 – 0x00  
 Byte 7 – 0x00

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## 12. Technical details

### 12.1. Technical details

Product category	Load Managers
Voltage range	+7VDC...+32VDC
Power consumption with no loads	
@13.8VDC (25°C)	125 mA
@27.6VDC (25°C)	125 mA
Operational temperature range	-40°C...+85°C
Environmental range	IP 63 - IP 64 unit is conformal coated
CAN specification	SAE J1939 proprietary, 250 Kbits/second
Protection	Internal thermal fuse
	Reverse voltage protection (pins 1 and 12 of connector)
	CAN buses protected to 24V
	ESD voltage protected to SAE J1113 specifications
Transient voltage protected to SAE J1113 specifications	
Dimensions (W x H x D) in inches [mm]	8.125 x 4.875 x 1.625

