# *RaceGrade* Motorsport Keypad

*Part # M KEYPAD 8H*
*Part # M KEYPAD 15*



**USER MANUAL**                                    **Version 1.3**

# $\mathcal{RaceGrade}$ **Motorsport Keypad**

9 December, 2015

# *Contents*

# Introduction

This manual details installation of the **RaceGrade** Motorsport Keypad using a MoTeC PDM. The keypad may be controlled via a Keypad Gateway or directly through CAN.

The **RaceGrade** Motorsport Keypad is a fully customized keypad designed specifically for your vehicle. Each button features a custom graphic, called an "icon", which represents the function it controls. The keypad also provides feedback via the 3 LED indicators on top of each button to inform the user of the status for the device controlled by that button. Keypads are available with either 15 buttons or 8 buttons.

## *Operation*

To activate a button, simply press on the icon of that button. Each button is momentary and will activate a channel in the MoTeC PDM. The channel can be programmed for any type of function or to activate any output on the MoTeC PDM.

***Note:*** All buttons on the keypad are "Momentary" not "Latching". If a power cycle occurs in the vehicle, most outputs controlled by the keypad will turn off and remain off after a power cycle. Mission critical switches which must latch should be hard wired with latching switches.

## *LED Indicators*



Each button has 3 indicators along the top. These lights report the status of a specific PDM Output for the function of that key.

Left = solid green = output is on

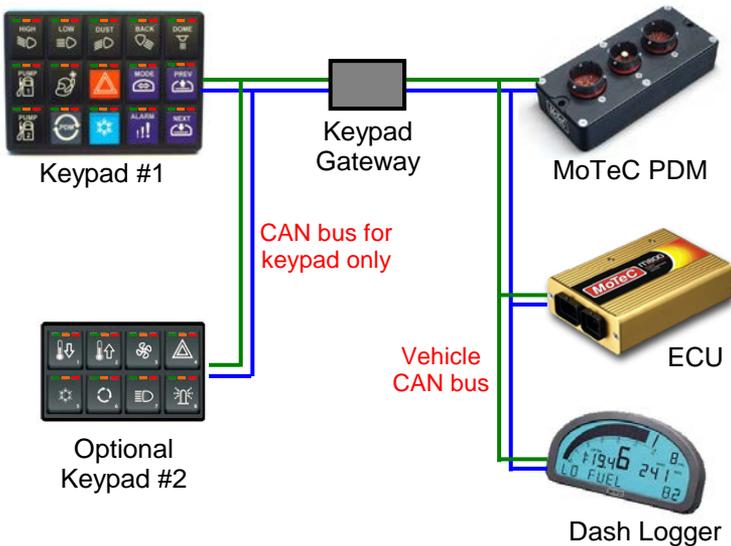Middle = solid orange = output has over current error

Middle = blinking orange = output has faulted off

Right = solid red = output has faulted off and no retries exist

# Setup

## *Wiring*

There are only 4 wires on the keypad itself, and 6 wires on the keypad gateway. Please see the specifications in the appendix for mating connector and pin out information. The keypad operates on a unique CAN bus, which must remain separate from the vehicle's main CAN bus. The keypad gateway is the gateway between both CAN buses and remaps the messages accordingly.



**Keypad #1**

**Keypad Gateway**

**MoTeC PDM**

CAN bus for keypad only

**Optional Keypad #2**

Vehicle CAN bus

**ECU**

**Dash Logger**

*Note:* CAN bus wiring has very strict specifications which must be followed. Failure to insure specifications during wiring harness construction can lead to problematic and non working installations.

*WARNING:* Keypads and the Keypad Gateway box do not have built in CAN resistors. These must be added per CAN specifications. For most installations a single resistor at the keypad connector or keypad adapter will work as the length of the CAN bus is often less than 7 feet.

# Multiple Keypads

It is possible to setup and utilize two keypads (any combination of 15 or 8 button keypads) connected onto the same CAN bus, bringing the total count of keys up to a maximum of 30.

When two keypads are used, they must be identified to the gateway as to which one is the first keypad and which one is the second keypad.

During the first time upon power up, all the LED indicators to blink on both keypads. The user must select which keypad is to be #1 by pressing any key along the top row. Then select keypad #2 by pressing any key along the top row. This selection will remain inside the keypads for all subsequent power ups, until one of the keypads is reset.

Resetting of the keypad identification is accomplished by turn on the keypad gateway with only a single keypad connected. This will reset the identification number on that keypad. Repeat the power up cycle with the other keypad connected by itself to reset that keypad's identification also.

*Note:* It is recommended to always turn off power to the entire system before unplugging or plugging in a keypad. When using multiple keypads, both must be plugged in upon power up in order for them to remember their identification.

# Symbol / Label Setup

Each button on the keypad has a unique graphical picture or icon. These are specified at time of order, and applied to the keypad before shipment. If a button function changes, these labels may be removed and new ones applied. Please contact RaceGrade for a list of available symbols.

# PDM Input Setup

Each button on the keypad will have to be individually added into the
**CAN Inputs** section of PDM Manager as shown below. The actual
channel name should be entered with a descriptive name rather than
just key numbers as listed below. For example, if you had assigned
button 4 to be the wiper switch, then you might call the channel

"**Input.Keypad.Wiper**" instead of "**Input.Keypad.4**".

| Channel | Data Size | CAN Address | Offset | Bit Mask | Divisor | Timeout Value |
|---------|-----------|-------------|--------|----------|---------|---------------|
| Input.Keypad.1 | 8bit | 0x118 | 0 | 01 hex | | 0 |
| Input.Keypad.2 | 8bit | 0x118 | 0 | 04 hex | | 0 |
| Input.Keypad.3 | 8bit | 0x118 | 0 | 10 hex | | 0 |
| Input.Keypad.4 | 8bit | 0x118 | 0 | 40 hex | | 0 |
| Input.Keypad.5 | 8bit | 0x118 | 1 | 01 hex | | 0 |
| Input.Keypad.6 | 8bit | 0x118 | 1 | 04 hex | | 0 |
| Input.Keypad.7 | 8bit | 0x118 | 1 | 10 hex | | 0 |
| Input.Keypad.8 | 8bit | 0x118 | 1 | 40 hex | | 0 |
| Input.Keypad.9 | 8bit | 0x118 | 2 | 01 hex | | 0 |
| Input.Keypad.10 | 8bit | 0x118 | 2 | 04 hex | | 0 |
| Input.Keypad.11 | 8bit | 0x118 | 2 | 10 hex | | 0 |
| Input.Keypad.12 | 8bit | 0x118 | 2 | 40 hex | | 0 |
| Input.Keypad.13 | 8bit | 0x118 | 3 | 01 hex | | 0 |
| Input.Keypad.14 | 8bit | 0x118 | 3 | 04 hex | | 0 |
| Input.Keypad.15 | 8bit | 0x118 | 3 | 10 hex | | 0 |
| Input.Keypad 2nd.1 | 8bit | 0x119 | 0 | 01 hex | | 0 |
| Input.Keypad 2nd.2 | 8bit | 0x119 | 0 | 04 hex | | 0 |
| Input.Keypad 2nd.3 | 8bit | 0x119 | 0 | 10 hex | | 0 |
| Input.Keypad 2nd.4 | 8bit | 0x119 | 0 | 40 hex | | 0 |
| Input.Keypad 2nd.5 | 8bit | 0x119 | 1 | 01 hex | | 0 |
| Input.Keypad 2nd.6 | 8bit | 0x119 | 1 | 04 hex | | 0 |
| Input.Keypad 2nd.7 | 8bit | 0x119 | 1 | 10 hex | | 0 |
| Input.Keypad 2nd.8 | 8bit | 0x119 | 1 | 40 hex | | 0 |
| Input.Keypad 2nd.9 | 8bit | 0x119 | 2 | 01 hex | | 0 |
| Input.Keypad 2nd.10 | 8bit | 0x119 | 2 | 04 hex | | 0 |
| Input.Keypad 2nd.11 | 8bit | 0x119 | 2 | 10 hex | | 0 |
| Input.Keypad 2nd.12 | 8bit | 0x119 | 2 | 40 hex | | 0 |
| Input.Keypad 2nd.13 | 8bit | 0x119 | 3 | 01 hex | | 0 |
| Input.Keypad 2nd.14 | 8bit | 0x119 | 3 | 04 hex | | 0 |
| Input.Keypad 2nd.15 | 8bit | 0x119 | 3 | 10 hex | | 0 |

PDM tree:
- PDM
  - Input Pins
  - CAN Inputs
  - Conditions
  - Output Pins
  - CAN Outputs
  - Global Setup

Window title: RaceGrade Keypad Exammple.pdm  - MoTeC PDM Manager

Menu: File  Edit  View  Online  Tools  Help

**Note:** The "Timeout Value" of 0 is very important on each input. Without
this, if the CAN bus goes down such as during starting, any key being
pressed will remain on until the CAN bus comes back online. This can
keep the start motor going and cause damage.

The buttons are numbered on the keypad going from left to right, then top to bottom through each row.
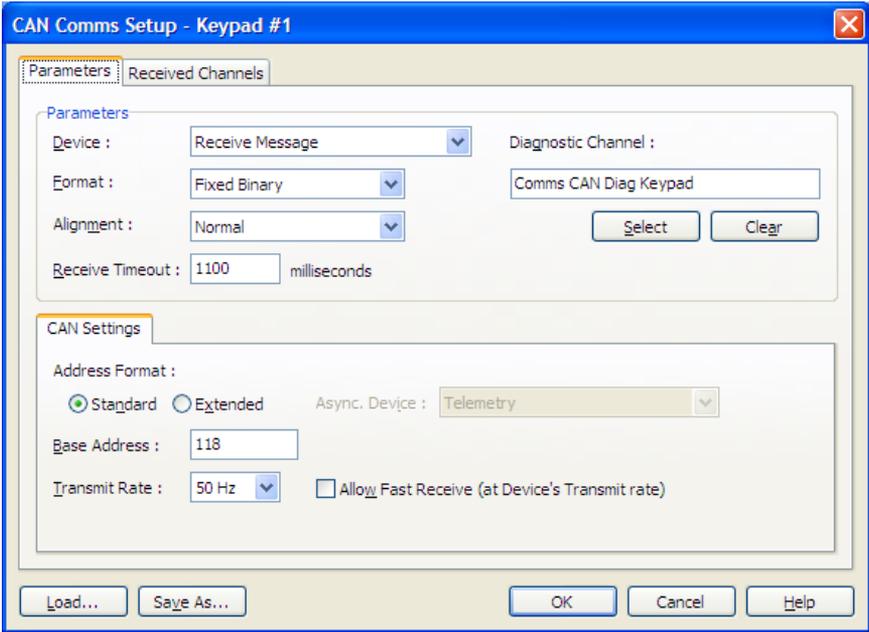




Each key will then be mapped to individual channels in the PDM via the **Offset** and **Bit Mask** entries in the **CAN Input Properties** window shown below.
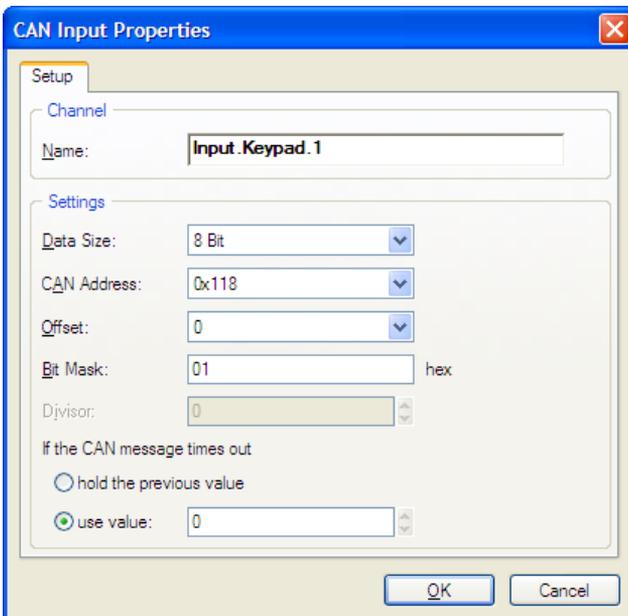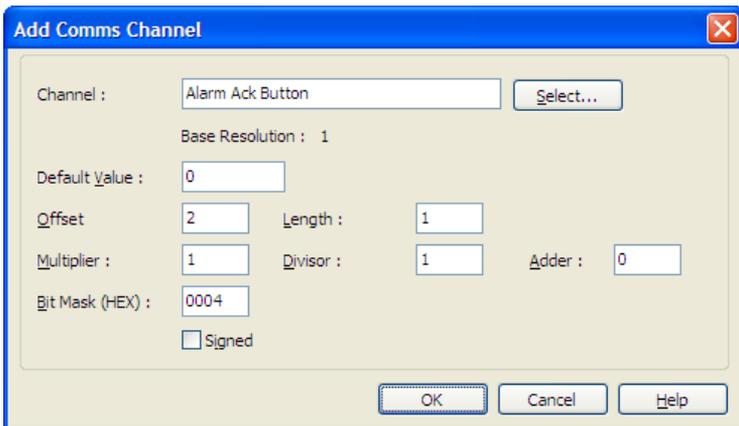
# Dash Input Setup

The keypad buttons may also be received on the vehicle CAN bus by any other device such as the dash logger. Below is a picture of the receive template settings for a MoTeC dash logger.

**CAN Comms Setup - Keypad #1**

Parameters | Received Channels

Parameters

Device :    Receive Message        Diagnostic Channel :

Format :    Fixed Binary        Comms CAN Diag Keypad

Alignment :    Normal        Select    Clear

Receive Timeout :   1100    milliseconds

CAN Settings

Address Format :

   ⦿ Standard    ◯ Extended     Async. Device :   Telemetry

Base Address :    118

Transmit Rate :    50 Hz     ☐ Allow Fast Receive (at Device's Transmit rate)

Load...    Save As...        OK    Cancel    Help

The individual buttons are setup under the Received Channels tab. Select an appropriate channel, or rename any of the general purpose on/off channels. Each button will use the same CAN settings found in the PDM input setup picture on page 6. See example below.

**Add Comms Channel**

Channel :    Alarm Ack Button        Select...

       Base Resolution :   1

Default Value :    0

Offset    2     Length :    1

Multiplier :    1     Divisor :    1     Adder :    0

Bit Mask (HEX) :    0004

       ☐ Signed

       OK    Cancel    Help

# PDM Output Setup

The indicators on each button are controlled by the status channel for that corresponding output in the PDM. Therefore you must assign each output of the PDM to its correct button on the keypad. This is done in the **CAN Outputs** section of PDM Manager.
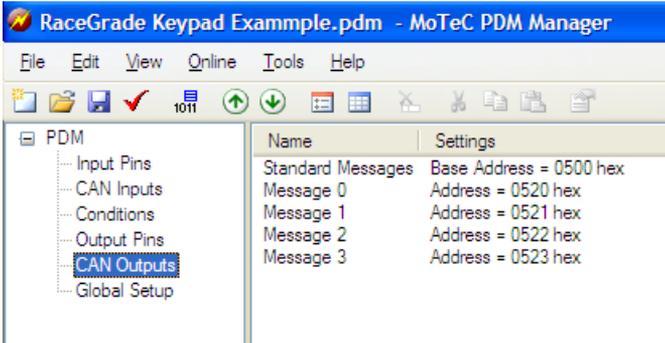


There are four available messages:

**Message 0 :** CAN Address 520, keypad #1, buttons 1-8

**Message 1 :** CAN Address 521, keypad #1, buttons 9-15 & brightness

**Message 2 :** CAN Address 522, keypad #2, buttons 1-8

**Message 3 :** CAN Address 523, keypad #2, buttons 9-15 & brightness


*Note:* When using an 8 button keypad, the second message is still required if you want to have brightness control.

Setting up a message involves entering the CAN address, then chosing which output corresponds to which button through the 8 channels labeled 0 through 7. So button #1 would be Channel 0, button #2 would be Channel 1, button #3 would be Channel 2, etc. When choosing the PDM output, select its **Status** channel.
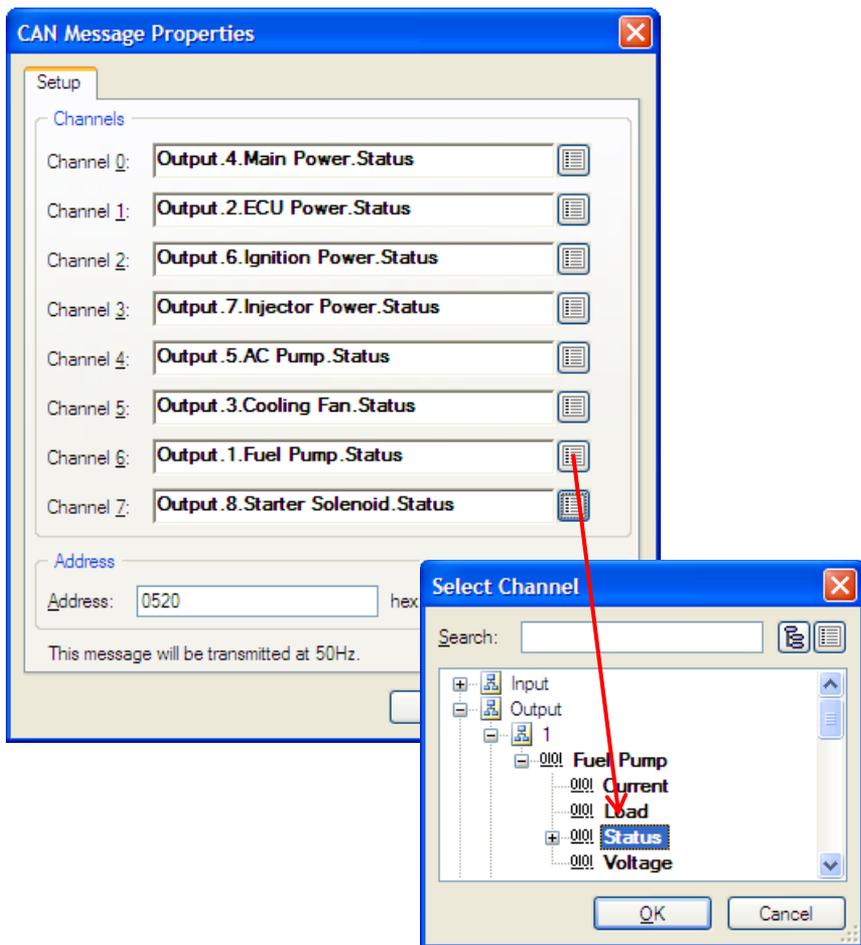
For buttons which do not actually control a PDM output, the left green light can be used as an indicator that the button is being pressed. This is useful for dash control buttons like Mode, Next Line and Alarm Acknowledge. The easiest method to accomplish this is to setup those buttons as inputs in the PDM, then use the PDM to transmit them back to the keypad. Then select the input channel to be sent back to the PDM. An example is shown below.
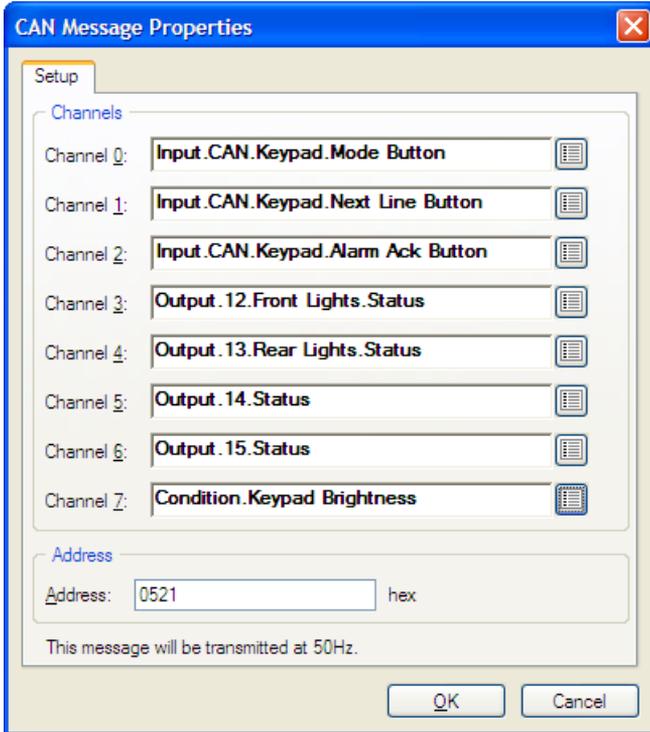


If you are using the keypad with only a dash and have no PDM in the vehicle, you may transmit indicator controls or any other status to the keypad using a similar CAN output structure. The following values equal the corresponding indicators:

Left = solid Green = channel value of 1

Middle = solid Orange = channel value of 2

Middle = blinking Orange = channel value of 4

Right = solid Red = channel value of 8

**Note:** The keypad may only receive indicator controls from one device, such as a MoTeC PDM or dash, not both.

# Brightness Control

The keypad has brightness control for both the LED indicators and the backlighting of the icons. This brightness control is accomplished with a single channel that is transmitted from the PDM to the keypad. There are three methods of controlling the brightness:

**Method 1 - Two Stage:** The brightness will swap between two predefined levels, as the value of the brightness channels toggles between 0 and 1. This method must be chosen when no dash is installed in the vehicle.

**Method 2 - Variable via dash:** The brightness channel being transmitted to the keypad will vary anywhere between a value of 2 and 100, corresponding to brightness values of 2% to 100%. This method requires a dash generated value to be sent to the PDM, then relayed from the PDM to the keypad.

Channel Value = Brightness Level

0 = High brightness, 100%

1 = Low brightness, 30%

2 to 100 = Variable brightness levels

over 100 = Full brightness, 100%

**Method 3 - Variable via PDM:** It is possible to hook up a variable potentiometer onto a PDM input. This would vary the voltage of that input, in which the input voltage channel could be transmitted to the PDM for its backlight brightness control.

## *Method 1 PDM Setup*

Add a new condition under the **Conditions** category in the PDM software. This will consist of a toggle condition where the activate channel is the corresponding button on the keypad for brightness control. This button should be already setup under CAN Inputs first. See the example below:



Once this condition is setup, add the channel into the **CAN Outputs** section. See the picture on page 11 where Channel 7 is the brightness channel created from this condition. It is the 8th Byte of the second CAN transmission message on ID 0x521 for the first keypad or 0x523 for the second keypad.

## *Method 2 Dash Controlled*

This requires setting up a brightness channel in the dash, then transmitting its value over CAN to the PDM. Then the PDM sends brightness to the keypad. Contact your MoTeC dealer for further information on this application specific method.

# Appendix

## Specifications

Operating Voltage: 8v to 30v

Operating Temperature: -40°C to 85°C

Keypad 15 button
     Size:  130 mm x 90 mm x 16 mm
     Weight:    175 grams

Keypad 8 button Horizontal
     Size:  105 mm x 63 mm x 16 mm
     Weight:    105 grams

Gateway Box
     Size:  100 mm x 69 mm x 23 mm
     Weight:    141 grams

## Connection for Keypad

Mating Connector:  DT-04

Pin 1 - Power in, 12v
Pin 2 - Ground
Pin 3 - CAN HI
Pin 4 - CAN LO

## Connection for Keypad Gateway

Mating Connector: DTM-12S

Pin 1 - Ground in
Pin 2 - CAN LO 1, for MoTeC PDM side  (1 Mbit/s)
Pin 3 -   *no connection. reserved for future use*
Pin 4 - CAN LO 2, for RaceGrade Keypad side
Pin 5 -   *no connection. reserved for future use*
Pin 6 - Ground out
Pin 7 - Power out, 12v
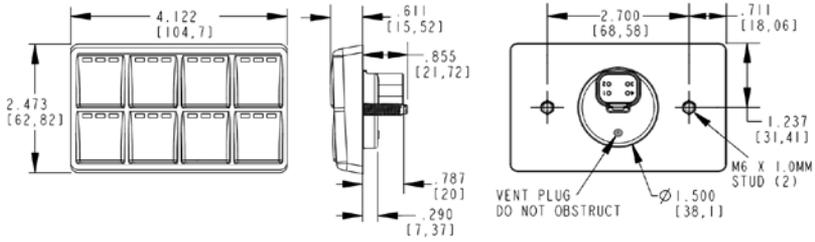Pin 8 -   *no connection. reserved for future use*
Pin 9 - CAN HI 2, for RaceGrade Keypad side
Pin 10 -   *no connection. reserved for future use*
Pin 11 - CAN HI 1, for MoTeC PDM side (1 Mbit/s)
Pin 12 -  Power in, 12v

## M Keypad 8H



## M Keypad 15