

# 3K Series Keypad

## Programmers Manual

Grayhill PN: 3KUM1120-1

### Revisions

A	Original Release	7/16/2009
B	Corrected link in Sec. 5 referring to Sec 4.5.4	9/15/2009
C	Clarified that some commands need to be sent from a Source Address of 249 (0xF9)	10/29/2009
D	Corrected J1939 Name bitfield description, Sec 5.7 ECN 386038	10/26/2011
E	Updated section 1.2, programmable features, to clarify configuration options. ECN 389166 RAL 10-8-2012	10/8/2012
F	Added figure 2 showing 6 button keypad numbering. ECN396686 RAL 7-9-2014	7/9/2014
G	Add section 7, 7.1, and 7.2. ECN 412927 RAL 10-24-17	JLF/JJS 11-07-2017

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## 1. Overview

This document describes the functionality and communication of the Grayhill 3K series CAN keypads. The functionality and communication protocol are independent of the number of keys and indicators that a given 3K series keypad version may have.

### 1.1. Reference Documents

The following documents are referenced within this document.

1. SAE-J1939
2. SAE-J1939/11
3. SAE-J1939/21
4. SAE-J1939/71
5. SAE-J1939/81

### 1.2. Programmable Features

The following fields can be configured by Grayhill prior to leaving the factory. Requests for custom configuration will be captured in the top-level CAD drawing

Field Name	Parameter Type	Size (bytes)	Range	Default Value	Comments
ECUID_PN	ASCII CHARS	64		ERASED	Per SAE-J1939/71
ECUID_LOC	ASCII CHARS	64		ERASED	Per SAE-J1939/72
ECUID_TYPE	ASCII CHARS	64		ERASED	Per SAE-J1939/73
J1939_NAME_ECU_INSTANCE	INTEGER	3 bits	0 - 7	0	Section 3.6
J1939_NAME_FUNCTION_INSTANCE	INTEGER	5 bits	0 - 31	0	Section 3.6
J1939_NAME_FUNCTION	INTEGER	8 bits	0 - 255	135	Per SAE-J1939 Base Spec Appx B
J1939_VEHICLE_SYSTEM	INTEGER	7 bits	0 - 127	0	Per SAE-J1939 Base Spec Appx B
J1939_VEHICLE_SYSTEM_INSTANCE	INTEGER	4 bits	0 - 15	0	Section 3.6
J1939_NAME_INDUSTRY_GROUP	INTEGER	3 bits	0 - 7	0	Per SAE-J1939 Base Spec Appx B
J1939_NAME_ARBITRARY_ADDRESS_CAPABLE	INTEGER	1 bit	0 - 1	0	Per SAE-J1939/81
J1939_SOURCE_ADDRESS	BYTE	1	0 - 254	128 (80H)	Per SAE-J1939 Base Spec
ENABLE COMMUNICATION WATCHDOG	ENABLE / DISABLE			DISABLE D	Section 5.10
COMMUNICATION WATCHDOG TIMEOUT	BYTE	1	1-254	254	Section 5.10
BUTTON_PGN		2	0 - 65535	65282 (FF02h)	Section 3.2
BUTTON_PRI		1	0 - 7	6	Section 3.2
BUTTON_SOE (Send On Event)		1	0 - 1	1	Section 3.2
BUTTON_TX_PER		1	0 - 254	10	Section 3.2
ENABLE LED BOOT DIAGNOSTIC (One second blink of indicators and backlights at power up)	ENABLE / DISABLE	1	1	ENABLED	Section 5.1.1
ENABLE DEMO MODE (Allows demo mode)	ENABLE / DISABLE	1	1	ENABLED	Section 2.3

## 2. Keypad Operation

An example of a Grayhill Standard keypad overlay is shown in Figure 1. Keys are numbered starting with 1 (1-20 shown). There are typically 3 indicators per key. The six button keypad numbering is structured as if the last row of an eight key horizontal 3K is still present. This allows customer applications to reuse application code in six button versions of an existing eight button configuration. See figure 2.

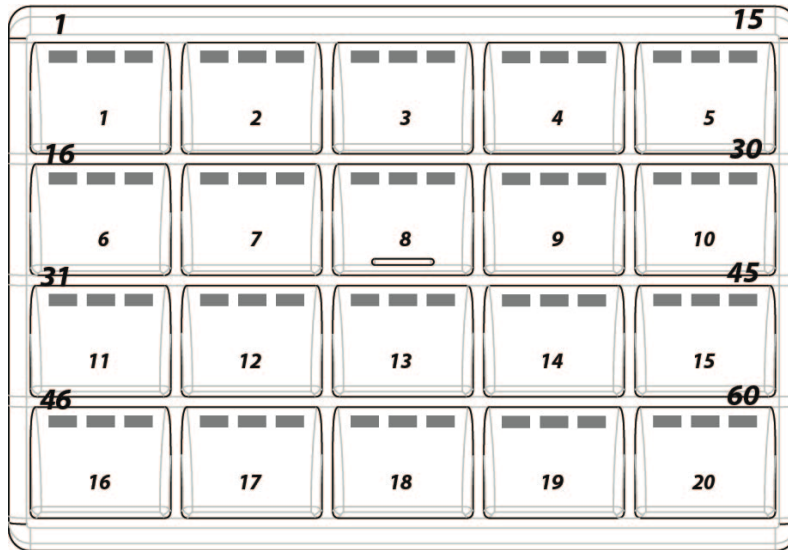


Figure 1 – Typical Key and Indicator Numbering

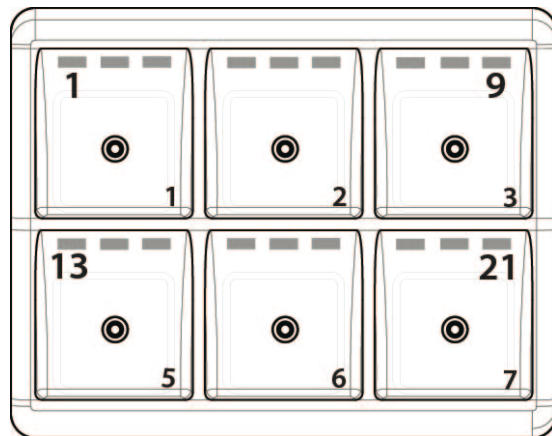


Figure 2 – Six Button Key and Indicator Numbering

### 2.1. Power Up Sequence

Upon first power up, if the Indicator Power Up Diagnostics flag is set the keypad lights all of the indicators and backlights at full brightness for one second. This serves as a visual test that all of the indicators are functional. Afterwards the keypad sends out an Address Claimed message. If the keypad loses arbitration with another device having the same source address and a lower Name value, it will either send another Address Claimed message with a new source address if the keypad is using Dynamic Addressing otherwise it will send out the Cannot Claim Address message. If the keypad is using Dynamic

Addressing and cannot find an unused source address it will then send the Cannot Claim Address message. If a keypad sends out the Cannot Claim Address message it will not enter Run Mode (it will not transmit or act upon any messages).

## 2.2. Run Mode

In Run Mode, the keypad constantly monitors for Configuration and Control Messages and takes action accordingly.

Key information is sent according to its configuration which is either upon a key press, a periodic timer, or both. When a key is pressed the corresponding bit location in the data field is set.

LEDs are manipulated according to their configuration (blinking, on, off). The keypad constantly monitors for Configuration and Control Messages and takes action accordingly.

## 2.3. Demo Mode

Demo mode is entered by pressing and holding the 3<sup>rd</sup> and 4<sup>th</sup> buttons while the keypad initially receives power. It's important to note that the buttons are referenced from the top, left corner and not necessarily the number on the button legends. When demo mode is entered the indicators will blink twice in about a one second time period. This will happen regardless if the Power Up Diagnostics is enabled or not. Anytime a button is pressed the corresponding indicator LED's will change. Pressing it once will light the left. Pressing it again will light the left and center. A third time lights all three. A fourth time will turn them off. Additional presses will repeat the cycle.

Buttons one through six also control the indicator and backlight brightness intensity according to the table below.

Button Pressed	Action
1 <sup>st</sup> button (upper left)	Increases indicator brightness
2 <sup>nd</sup> button	Decreases indicator brightness
3 <sup>rd</sup> button	Increases backlight brightness
4 <sup>th</sup> button	Decreases backlight brightness
5 <sup>th</sup> button	Both indicator and backlights full brightness
6 <sup>th</sup> button	Both indicator and backlights at dimmest level

In demo mode the keypad is still fully functional. To exit demo mode simply cycle power without pressing the 3<sup>rd</sup> and 4<sup>th</sup> buttons.

## 3. Keypad Configuration

The standard keypads have the capability to store configurations in non-volatile memory that control the keypad or provide user information about the keypad.

### 3.1. Source Address

The source address of the keypad can be changed in one of two ways:

1. Using the Commanded Address as explained in SAE-J1939/81. When this is done the keypad will broadcast a new Address Claim message with the new address. If arbitration is lost the keypad will revert back to the original address.

2. Using the [Change Source Address](#) command as described in the Configuration and Control section. The new source address will take effect immediately and will not cause the unit to broadcast an Address Claim message.

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## 3.2. Button Message Parameters

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### 3.2.1. Button PGN

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This parameter holds the 16 bit PGN value of the button message. The default value is 65282 (FF02h).

### 3.2.2. Button Priority

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This parameter controls the priority field in the message ID. Valid values range from 0 to 7. The default value is 6.

### 3.2.3. Transmission Period

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This parameter controls the transmission rate of the button message. When enabled, the period can be set in the range of 10ms to 2.54 seconds with a resolution of 10ms. When disabled (parameter value equals zero) the message is only sent upon button activity. The default value is 100ms.

### 3.2.4. Transmit Upon Change

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This controls if an updated message is sent immediately regardless of if the send timer has expired or if it must wait until the timer has expired. This is automatically enabled if the Transmission Period is set to zero. The default is to transmit upon button change.

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## 3.3. Indicator Parameters

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### 3.3.1. Timeout Period

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The indicators have a Timeout parameter that, when the timer expires, blinks all of the indicators at a fast rate letting the operator know that LED messages were not received within the timeout period. When enabled, the timeout period can range between 100ms to 25.4 seconds. The timeout period is disabled by default. This parameter must be sent from a Source Address of 249 (0xF9).

### 3.3.2. Power Up Diagnostics

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When enabled, all of the indicators and backlights will turn on for approximately one second. The keypad will then operate normally. Disabling this feature enables the keypad to begin normal operation quicker. This parameter is enabled by default. This parameter must be sent from a Source Address of 249 (0xF9).

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## 3.4. Proprietary ID

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The Proprietary ID is programmed into the keypad at the factory and provides the ability for the customer to only allow approved keypads to operate in the customer's system. The Proprietary ID uses a PGN of 65408 (FF80h) with a data length of eight bytes. When not used all eight data bytes will be 255 (FFh).

### 3.5. J1939 ECUID

The ECUID information can be read using a BAM transfer when requesting PGN 64965 (FDC5h). The ECUID consists of four fields:

- ECU Part Number
- ECU Serial Number
- ECU Location
- ECU Type

The ECU serial number is the same as the Identity Number in the Address Claimed NAME field. Refer to [Sec. 5.7](#) to change the ID field.

The remaining three fields can each store up to 64 ASCII characters and are programmed using the commands in Configuration and Control Commands [ECUID Command](#) and [ECUID Field Data](#).

Changing the ECUID fields must be done with a device having a source address of 249 (F9h).

### 3.6. J1939 NAME Fields

All of the fields with the exception of the Manufacturer Code can be modified using the [Changing J1939 NAME Fields](#). Changing the NAME fields must be done with a device having a source address of 249 (F9h).

## 4. Communications

### 4.1. Message Header Description

Figure 2 illustrates the format of the CAN message ID. A brief description of each field follows.

S O F	Identifier 11 Bits											S R R	I D E	Identifier Extension 18 Bits														R T R							
	Priority			R	D P	PDU Format (PF) 6 Bits (MSB)								S R R	I D E	PF (cont.)		PDU Specific (PS) (Destination Address, Group Extension or Proprietary)								Source Address						R T R			
3	2	1	8			7	6	5	4	3	2	1	8			7	6	5	4	3	2	1	8	7	6	5	4	3	2	1	8		7	6	5
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	23	25	26	27	28	29	30	31	32	33			
	28	27	26	25	24	23	22	21	20	19	18			17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0				

Figure 2

#### 4.1.1. Priority

This 3-bit field is used to define the priority during arbitration. '000' is the highest priority and is usually associated with high-speed control messages. Low priority is used for non-critical configuration and information messages.

#### 4.1.2. DP (Data Page)

This 1-bit field defines on which data page (0 or 1) the message is defined in the J1939 specification. Page 0 contains the messages that are presently defined, while Page 1 is for future expansion according to J1939.

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### 4.1.3. Protocol Data Unit (PDU) - PDU Format (PF)

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This 8-bit field determines the format of the message and is one of the fields that determine the Parameter Group Number of the message (see 4.1.6). If the value is between 0 and 239, the message is a PDU 1 Format message. These messages are sent to specific addresses.

### 4.1.4. Protocol Data Unit (PDU) - PDU Specific (PS)

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The PDU Specific (PS) field is the Destination Address (DA). If the value is between 240 and 255, the message is a PDU 2 Format message. These messages are not sent to a specific address, but are instead broadcast to the entire network. The PS then becomes the Group Extension (GE) field.

### 4.1.5. Source Address

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This 8-bit field is the source address of the device that sent the message.

### 4.1.6. Parameter Group Number

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J1939 defines allowable messages by their Parameter Group Number (PGN). The Parameter Group Number is a 3-byte value that uniquely defines the message purpose. A PGN has the following format: If the PDU Format value for a message is less than 240, then the last 8 bits of the PGN are set to '0'. The specification gives the decimal equivalent of the PGNs. To obtain the PF and PS values to use for a specific message, convert the decimal value from the specification to hexadecimal and use the last two bytes. These values can then be used to either send messages on the network or to request messages from other source addresses.

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## 4.2. Bitfield Location and Byte Ordering

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The byte and bit ordering and location within the data field are per the J1939 specification. The first data byte is sent first and is referenced as Byte 1. The LSB of the data bytes are on the right and are referenced as Bit 1.

The convention used to locate a parameter in the data field is the same as specified in SAE-J1939/71. The format used is "Rx" where R is the byte number and x is the starting bit number within the byte. The length is the number of bits starting at this point.

**Example 1:** Location 4.3 with a length of 3 bits would have the value of 1 as illustrated below.

Byte 4 = 0x67 = 0b011**001**11. The bold value is the three bit field holding a value of 0b001.

**Example 2:** Location 4.3 with a length of 3 bits would have the value of 6 as illustrated below.

Byte 4 = 0x7b = 0b011**110**11. The bold value is the three bit field holding a value of 0b110.

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## 4.3. Keypad Source Address

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The source address of the Grayhill standard keypad is set to 128 (80h) at the factory. This may be modified either dynamically if Dynamic Addressing is turned on, with the Commanded Address message in accordance with J1939-81, or with the proprietary Source Address Command. The source address value is stored in non-volatile memory.



The ability to change the source address will allow multiple keypads to coexist in the same system.

#### 4.4. Physical Layer

The bit rate is 250kbps per J1939/11. The connector is a 4 pin Deutsch equivalent with the following pin out:

1. Power
2. Ground
3. CAN\_H
4. CAN\_L

#### 4.5. Standard Messages

The Key Press Data PGN uses the Proprietary B PDU2 format (PF = 255) that broadcasts to no specific address the status of the keys, and the Control Data PGN uses Proprietary A PDU1 format (PF = 239).

The indicators can be controlled in one of two ways. The first is by using the Auxiliary I/O #2 and #3 PGNs where each two bit field within the 64 bit data bits controls a corresponding indicator. The second is using the Proprietary A PGN where the indicators are in banks with respect to the associated button and addressed in the same way.

##### 4.5.1. Key Press Data PGN

**PGN – 65282 (FF02h), Proprietary B PDU2 Format**

**Direction - Transmit**

**Priority – 6**

**Data Length - 8**

**Transmission Rate – 100ms (programmable)**

**\*The Key Press PGN number can be reassigned using a configuration command.**

Start	Length	Desc.	Values
1.1	2 bits	Key 1	0b00-Key Not Pressed 0b01-Key Pressed 0b10-Error 0b11-Unused Key
1.3	2 bits	Key 2	Same
1.5	2 bits	Key 3	Same
1.7	2 bits	Key 4	Same
2.1	2 bits	Key 5	Same
2.3	2 bits	Key 6	Same
2.5	2 bits	Key 7	Same
2.7	2 bits	Key 8	Same
3.1	2 bits	Key 9	Same
3.3	2 bits	Key 10	Same
3.5	2 bits	Key 11	Same
3.7	2 bits	Key 12	Same
4.1	2 bits	Key 13	Same
4.3	2 bits	Key 14	Same
4.5	2 bits	Key 15	Same
4.7	2 bits	Key 16	Same

5.1	2 bits	Key 17	Same
5.3	2 bits	Key 18	Same
5.5	2 bits	Key 19	Same
5.7	2 bits	Key 20	Same
6.1	2 bits	Key 21	Same
6.3	2 bits	Key 22	Same
6.5	2 bits	Key 23	Same
6.7	2 bits	Key 24	Same
7.1	2 bits	Key 25	Same
7.3	2 bits	Key 26	Same
7.5	2 bits	Key 27	Same
7.7	2 bits	Key 28	Same
8.1	2 bits	Key 29	Same
8.3	2 bits	Key 30	Same
8.5	2 bits	Key 31	Same
8.7	2 bits	Key 32	Same

Example: Pressing key 12 will cause the following message to be transmitted. (Assume a 20 key device).

ID=0x18FF0280, LEN=8, DATA=0x00,0x00,0x40,0x00,0x00,0xFF,0xFF,0xFF

Example: Pressing keys 12 and 13 will cause the following message to be transmitted. (Assume a 20 key device).

ID=0x18FF0280, LEN=8, DATA=0x00,0x00,0x40,0x01,0x00,0xFF,0xFF,0xFF

#### 4.5.2. LED Indicator PGN #1

\*Only available with Rev B firmware or later

**PF – 167 (A7h)**

**PS – DA, The Source Address of the keypad. Default value: 128 (80h)**

**PGN – 42752 (A700h), Auxiliary I/O #2, PDU1 Format**

**Direction - Receive**

**Data Length – 8**

Start	Length	Button	LED Pos	Values
1.1	2 bits	1	Left	0b00-Indicator Off 0b01-Indicator On 0b10-Indicator Blink Medium 0b11-No Change
1.3	2 bits	1	Center	Same
1.5	2 bits	1	Right	Same
1.7	2 bits	2	Left	Same
2.1	2 bits	2	Center	Same
2.3	2 bits	2	Right	Same
2.5	2 bits	3	Left	Same
2.7	2 bits	3	Center	Same
3.1	2 bits	3	Right	Same
3.3	2 bits	4	Left	Same
3.5	2 bits	4	Center	Same

3.7	2 bits	4	Right	Same
4.1	2 bits	5	Left	Same
4.3	2 bits	5	Center	Same
4.5	2 bits	5	Right	Same
4.7	2 bits	6	Left	Same
5.1	2 bits	6	Center	Same
5.3	2 bits	6	Right	Same
5.5	2 bits	7	Left	Same
5.7	2 bits	7	Center	Same
6.1	2 bits	7	Right	Same
6.3	2 bits	8	Left	Same
6.5	2 bits	8	Center	Same
6.7	2 bits	8	Right	Same
7.1	2 bits	9	Left	Same
7.3	2 bits	9	Center	Same
7.5	2 bits	9	Right	Same
7.7	2 bits	10	Left	Same
8.1	2 bits	10	Center	Same
8.3	2 bits	10	Right	Same
8.5	4 bits	N/A	N/A	Unused

#### 4.5.3. LED Indicator PGN #2

\*Only available with Rev B firmware or later

**PF – 166 (A6h)**

**PS – DA, The Source Address of the keypad. Default value: 128 (80h)**

**PGN – 42496 (A600h), Auxiliary I/O #3, PDU1 Format**

**Direction - Receive**

**Data Length – 8**

Start	Length	Button	LED Pos	Values
1.1	2 bits	11	Left	0b00-Indicator Off 0b01-Indicator On 0b10-Indicator Blink Medium 0b11-No Change
1.3	2 bits	11	Center	Same
1.5	2 bits	11	Right	Same
1.7	2 bits	12	Left	Same
2.1	2 bits	12	Center	Same
2.3	2 bits	12	Right	Same
2.5	2 bits	13	Left	Same
2.7	2 bits	13	Center	Same
3.1	2 bits	13	Right	Same
3.3	2 bits	14	Left	Same
3.5	2 bits	14	Center	Same
3.7	2 bits	14	Right	Same
4.1	2 bits	15	Left	Same
4.3	2 bits	15	Center	Same

4.5	2 bits	15	Right	Same
4.7	2 bits	16	Left	Same
5.1	2 bits	16	Center	Same
5.3	2 bits	16	Right	Same
5.5	2 bits	17	Left	Same
5.7	2 bits	17	Center	Same
6.1	2 bits	17	Right	Same
6.3	2 bits	18	Left	Same
6.5	2 bits	18	Center	Same
6.7	2 bits	18	Right	Same
7.1	2 bits	19	Left	Same
7.3	2 bits	19	Center	Same
7.5	2 bits	19	Right	Same
7.7	2 bits	20	Left	Same
8.1	2 bits	20	Center	Same
8.3	2 bits	20	Right	Same
8.5	2 bits	LED Between buttons 14 and 15		Same
8.7	2 bits	N/A	N/A	Unused

\* For keypads equipped with this LED effectively making an LED barograph with 7 LED's spanning across buttons 14 and 15.

#### 4.5.4. Configuration and Control PGN

**PF – 239, Proprietary A PDU1 Format**

**PS – DA, The Source Address of the keypad. Default value: 128 (80h)**

**PGN = 61184**

**Direction - Receive**

**Data Length – 8**

Start	Length	Desc.	Values
1.1	1 Byte	Configuration and Control Command	Command Byte as described in Sec. 4
2.1	7 Bytes	Configuration and Control Data	Variable as described in Sec. 4

#### 4.5.5. Proprietary ID Message

\*Only available with Rev B firmware or later

**PGN – 65408 (FF80h), Proprietary B PDU2 Format**

**Priority – 7**

**Data Length - 8**

**Transmission Rate – Upon request**

Start	Length	Desc.	Values
1.1	8 Byte	Proprietary Unit ID Message	0 – 255. If all eight bytes are 255 then the ID is considered unprogrammed.

## 5. Configuration and Control Commands

Changing the configuration and how the keypad behaves is done with the Configuration and Control message described in Sec 4.5.4. The first byte serves as the command byte. Where applicable, changes take effect immediately and are stored in non-volatile memory unless otherwise noted. Note that some commands will only take effect if sent from a source address of 249 (F9h).

### 5.1. Indicator Data

1-32 (01h-20h)

This is an alternative to using the LED Indicator PGN's 1 and 2 that allows three different blink rates.

Data field

Start	Length	Desc.	Value
1.1	8 bits	Indicator Bank	01h to 20h (Corresponding to the Key number 1 to 32).
2.1	4 bits	Left Most Indicator in the Bank	0b0000-Off 0b0001-On 0b0010 - Blink Slow (approx. 1/2 Hertz) 0b0011 - Blink Med. (approx. 1 Hertz) 0b0100 - Blink Fast (approx. 2 Hertz) 0b1111 – Not Available
2.4	4 bits	Center Indicator	Same
3.1	4 bits	Right Indicator	Same

Not stored in nonvolatile memory.

Example: Sending the following message to a keypad having the default address of 0x80 will leave the center indicator unchanged while turning off the left indicator and fast blink the right indicator of button three.

ID=18EF8021, LEN=8, Data=0x03, 0xF0, 0xF4, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF

### 5.2. Backlight and Indicator Intensity

128 (80h)

Data Field

Start	Length	Desc.	Value
1.1	1 Byte	Indicator & Backlight Intensity	128 (80h)
2.1	1 Byte	Indicator Intensity	0 – Dimmest 254 – Brightest 255 – Not Available
3.1	1 Byte	Backlight Intensity	0 – Off 254 – Brightest 255 – Not Available
4.1	6 bytes	Unused	255 – Not Available

Example: Sending the following message to a keypad having an address of 0x85 will set the indicator brightness to 50% while leaving the backlight brightness alone.

ID=18EF8521, LEN=8, Data=0x80, 0x80, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF

### 5.3. Source Address

224 (E0h)

Data field

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
E0h	dd	xx	xx	xx	xx	55h	AAh

**dd** - Has a value between 0 and 255 and is the new source address

**xx** - Don't Care. Should be FFh following J1939 convention

**55h** - Low byte of 16 bit key

**AAh** - High byte of 16 bit key

### 5.4. Key Press Data PGN

225 (E1h)

Data field

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
E1h	aa	bb	xx	xx	xx	55h	AAh

**aa** - The least significant byte of the new PGN. Valid Range: 0. 255

**bb** - The most significant byte of the new PGN. Valid Range: 0. 255

**xx** - Don't Care. Should be FFh following J1939 convention

**55h** - Low byte of 16 bit key

**AAh** - High byte of 16 bit key

### 5.5. Key Press Data Priority

226 (E2h)

Data field

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
E2h	dd	xx	xx	xx	xx	55h	AAh

**dd** - The new priority. Valid Range: 0. 7

**xx** - Don't Care. Should be FFh following J1939 convention

**55h** - Low byte of 16 bit key

**AAh** - High byte of 16 bit key

## 5.6. Key Press Data Transmission Period

227 (E3h)

Data field

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
E3h	dd	Event	xx	xx	xx	55h	AAh

**dd** – The value multiplied by 10ms. Valid range: 1. 255 yielding between 10ms to 2.54 seconds. A value of zero automatically assumes transmit upon event.

**Event** – Valid settings is 0 or 1. A value of one sends the key message upon change in key information. Upon transmission the timer is reset. A value of zero will cause the message to be transmitted at the specified time interval.

**xx** – Don't Care. Should be FFh following J1939 convention

**55h** – Low byte of 16 bit key

**AAh** – High byte of 16 bit key

## 5.7. Changing J1939 NAME Fields

228 (E4h)

**\*Note: Must be sent from source address of 249 (0xF9)**

Data field

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
E4h	subcmd	db0	db1	db2	xx	55h	AAh

**subcmd** – Represents the field within the name to change.

**db0, db1, db2** – Data bytes associated with the sub command, LSB to MSB respectively.

**xx** – Don't Care. Should be FFh following J1939 convention

**55h** – Low byte of 16 bit key

**AAh** – High byte of 16 bit key

Sub Commands

Sub Cmd	Field	Description
0	ID	21 bits of db0.2
1	ECU Instance	Bits 3..1 of Byte 5 (Most Significant at 3)
2	Function Instance	Bits 8..4 of Byte 5 (Most Significant at 8)
3	Function	Bits 8..1 of Byte 6 (Most Significant at 8)
5	Vehicle System	Bits 8..2 of Byte 7 (Most Significant at 8)
4	Vehicle System Instance	Bits 4..1 of Byte 8 (Most Significant at 4)
6	Industry Group	Bits 7..5 of Byte 8 (Most Significant at 7)
7	Arbitrary Addr. Capable	Bit 8 of Byte 8

Refer to J1939 base document for field value ranges and relationships.

## 5.8. Change ECUID Command

229 (E5)

**\*Note: Must be sent from source address of 249 (0xF9)**

Data field

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
E5h	0..2	dd	xx	xx	xx	55h	AAh

- 0 – Selects ECUID Part Number to change
- 1 – Selects ECUID Location to change
- 2 – Selects ECUID Type to change
- dd – Number of ASCII characters in the field, max of 64

### 5.9. Change ECUID Field Data 230 (E6h)

**\*Note: Must be sent from source address of 249 (0xF9)**

Data field

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
E6h	1 to 7 bytes of ASCII Data						

\* No Key used in bytes 7 and 8

### 5.10. Communication Watchdog Timeout Period 231 (E7h)

\*Only available with Rev B firmware or later

**\*Note: Must be sent from source address of 249 (0xF9)**

Data field

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
E7h	dd	xx	xx	xx	xx	55h	AAh

dd – This holds the timeout value in units of 100ms that controls when and if all of the indicators will blink rapidly indicating CAN messages that control the indicators' state have not been received within the timeout period. A value of zero disables this feature. A value of FFh results in no change.

Bytes 3 through 6 should be set to FFh for possible future expandability.

### 5.11. Indicator Diagnostics and Demo 232 (E8h)

\*Only available with Rev B firmware or later

**\*Note: Must be sent from source address of 249 (0xF9)**



Data field

Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
E8h	DIAG	DEMO	xx	xx	xx	55h	AAh

**DIAG** – A non-zero value, with the exception of FFh, causes the keypad to blink all of the indicators and backlights on for about one second to serve as a visual tool that the keypad is powered up and the indicators are functioning properly. A value of zero bypasses this routine and, in turn, speeds up the bootup process. If the value is equal to FFh the command is ignored.

**DEMO** – A non-zero value, with the exception of FFh, causes the keypad to have the ability to enter demo mode. Demo mode will be entered if the 3<sup>rd</sup> and 4<sup>th</sup> buttons are pressed during power up. All of the indicators will blink twice and demo mode entered regardless of the DIAG setting. If the value is equal to FFh the command is ignored.

Bytes 4 through 6 should be set to FFh for possible future expandability.

## 6. Other J1939 Commands

The following messages are defined in the J1939 documents and are implemented in the keypad.

### 6.1.1. Address Claimed

**PF – 238, Address Claimed**

**PS – 255, The destination address should always be the Global Address**

**PGN = 60928**

**Direction – Transmit and receive**

**Data Length – 8**

**Priority - 6**

**Transmission Rate – Upon boot or whenever requested**

Start	Length	Desc.	Values
1.1	21 Bits	Identity Number	0 to 2 <sup>21</sup> -1
3.6	11 Bits	Manufacturers Code	294 (Assigned to Grayhill by SAE)
5.1	3 Bits	ECU Instance	0 (Default)
5.4	5 Bits	Function Instance	0 (Default)
6.1	8 Bits	Function	135 (Keypad, Default) *
7.1	1 Bit	Reserved	0 (Defined by SAE)
7.2	7 Bits	Vehicle System	0 (Default) *
8.1	4 Bits	Vehicle System Instance	0 (Default)
8.5	3 Bits	Industry Group	0 = Global (Default) * 1 = On-Highway Equipment 2 = Agricultural and Forestry Equipment 3 = Construction Equipment 4 = Marine 5 = Industrial-Process Control-Stationary 6 & 7 = Reserved

8.8	1 Bit	Arbitrary Address Capable	0 = Not Capable 1 = Capable (Default)
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\*Refer to J1939 base document for the Function value based on the Industry Group and Vehicle System combinations

### 6.1.2. PGN Request

**PF – 234, PGN Request**

**PS – DA, The Source Address of the keypad to respond or the Global Address**

**PGN = 59904**

**Direction - Receive**

**Data Length – 3**

Start	Length	Desc.	Values
1.1	1 Byte	Byte 1 of PGN being requested (LSB)	0 to 255
2.1	1 Byte	Byte 2 of PGN being requested	0 to 255
3.1	1 Byte	Byte 3 of PGN being requested (MSB)	0

The following are the supported PGN's that can be requested from the keypad. If the request is unsupported the keypad responds with a NACK (Refer to J1939-21).

#### 6.1.2.1. ECU Identification Information

**PGN = 64965 (FDC5)**

**Direction - Transmit**

**Data Length – Variable**

**Transmission Rate – Upon Request**

**Multi Packet Transferred – Yes, BAM only**

Start	Length	Desc.	Values *
A	<=64	ECU Part Number	Ex. "3KYY1001-1"
B	<=64	ECU Serial Number	Ex. "123456"
C	<=64	ECU Location	Ex. "CAB"
D	<=64	ECU Type	"KEYPAD"

\*All fields asterisk delimited

### 6.1.2.2. Software Identification

PGN = 65242 (0xFEDA)  
 Direction - Transmit  
 Data Length – Variable  
 Transmission Rate – Upon Request  
 Multi Packet Transferred – Yes, BAM only

Start	Length	Desc.	Values
1	1 Byte	Number of software fields	1 to 125
2-N	Variable	Software ID field	ASCII characters. Each field delimited with an asterisk and up to 200 characters

### 6.1.3. Acknowledgement Message

PF = 232 (0xE8)  
 PS = DA  
 PGN = 64965 (0xE800)  
 Direction - Transmit  
 Data Length – 8  
 Priority - 6  
 Transmission Rate – Upon appropriate response

Start	Length	Desc.	Values *
1	1 Byte	Control Byte	0 = Positive Acknowledgement 1 = Negative Acknowledgement 2 = Access Denied 3 = Cannot Respond
2	1 Byte	Group Function	Refer to SAE-J1939-21
3-5	3 Bytes	Reserved by SAE	
6-8	3 Bytes	Parameter Group being Acknowledged	

This message is send in response to a PGN Request of an unsupported PGN with the Control Byte having a value of one.

## 7. Errata

### 7.1. Data page and Key Byte Issues

Per section 5.6, the key bytes 7 & 8 were supposed to be set as 55h AAh to set the transmission period. However, it has been determined that the key press data transmission rate will change with any value for key bytes 7 & 8.

Per section 4.1.2, messages with data page 1 were to be ignored. It has been determined that the product will respond to messages with the data page set as 0 or 1.

### 7.2. Data Page filtering – October 15, 2017

All new custom configured 3K keypad part numbers created on or after November 1, 2017 will be produced with updated firmware that ignores messages with the data page set as 1 and responds correctly to key bytes 7 & 8 for the data transmission period. Legacy part numbers created prior to the effective date will not be updated and will continue to ship

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with the legacy firmware. Grayhill catalog standard 3K part numbers will include this update.