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## Marlin Keypad Module Slave Protocol

Marlin Keypad modules are designed to operate in slave fashion and communicate status over a Controller Area Network (CAN) using the industry standard J1939 messaging protocol. LED Indicators are controlled via CAN messages from the master control unit (MCU). Key status and Module status are reported via "Proprietary A" PGN's at user selected intervals or upon request.

### Key Orientation

KEYs are numbered consecutively from 1 to 12, beginning with the upper left key.

LEDs are numbered consecutively from 1 to 36 beginning with the left most LED of KEY 1.

See diagram below:

1	2	3	4	5	6	7	8	9
<b>1</b>			<b>2</b>			<b>3</b>		
10	11	12	13	14	15	16	17	18
<b>4</b>			<b>5</b>			<b>6</b>		
19	20	21	22	23	24	25	26	27
<b>7</b>			<b>8</b>			<b>9</b>		
28	29	30	31	32	33	34	35	36
<b>10</b>			<b>11</b>			<b>12</b>		

INDICATOR NUMBERING

BUTTON KEY NUMBERING

## Key Status

The Keypad module uses the J1939 AUXIO1 message to broadcast key status information. The message Data Field contains the current state of each key.

Auxiliary Input/Output Status #1					PGN: 65241
					hex: 0FED9
Description	This message is broadcast periodically or on change of state to indicate the status of the keypad switches.				
PGN	65241				
Priority	6				
Destination	Global				
Data Length	8				
Direction	Transmit				
Update Rate	250 mS periodic and upon change of state (configurable, no faster than 20 mS)				
Start	Bits	Name	SPN	Notes	
1.7	2	Key Switch #1	701	00 <sub>2</sub> - Key is Not Pressed	
1.5	2	Key Switch #2	702	01 <sub>2</sub> - Key is Pressed	
1.3	2	Key Switch #3	703	10 <sub>2</sub> - Error	
1.1	2	Key Switch #4	704	11 <sub>2</sub> - Not Available	
2.7	2	Key Switch #5	705		
2.5	2	Key Switch #6	706		
2.3	2	Key Switch #7	707		
2.1	2	Key Switch #8	708		
3.7	2	Key Switch #9	709		
3.5	2	Key Switch #10	710		
3.3	2	Key Switch #11	711		
3.1	2	Key Switch #12	712		
4.7	2	Not Used	713	All bits set to 1	
4.5	2	Not Used	714		
4.3	2	Not Used	715		
4.1	2	Not Used	716		
5.1	16	Not Used	1083		
7.1	16	Not Used	1084		

## Indicator LED Command Messages

The Keypad module uses the J1939 AUXIO2 and AUXIO3 messages to control the Indicator LEDs. The message Data Field contains the desired state for each indicator.

Auxiliary Input/Output Status #2					PGN: 42752
					hex: 0A700
Description	This message will set the state of the LED Indicators.				
PGN	42752				
Priority	6				
Destination	Keypad				
Data Length	8				
Direction	Receive				
Update Rate	N/A				
Start	Bits	Name	SPN	Notes	
1.7	2	LED #1 (Key 1 - Left)	3840	00 <sub>2</sub> - Indicator OFF	
1.5	2	LED #2 (Key 1 - Center)	3841	01 <sub>2</sub> - Indicator ON	
1.3	2	LED #3 (Key 1 - Right)	3842	10 <sub>2</sub> - Indicator Blink - 2 Hz	
1.1	2	LED #4 (Key 2 - Left)	3843	11 <sub>2</sub> - No Change	
2.7	2	LED #5 (Key 2 - Center)	3844		
2.5	2	LED #6 (Key 2 - Right)	3845		
2.3	2	LED #7 (Key 3 - Left)	3846		
2.1	2	LED #8 (Key 3 - Center)	3847		
3.7	2	LED #9 (Key 3 - Right)	3848		
3.5	2	LED #10 (Key 4 - Left)	3849		
3.3	2	LED #11 (Key 4 - Center)	3850		
3.1	2	LED #12 (Key 4 - Right)	3851		
4.7	2	LED #13 (Key 5 - Left)	3852		
4.5	2	LED #14 (Key 5 - Center)	3853		
4.3	2	LED #15 (Key 5 - Right)	3854		
4.1	2	LED #16 (Key 6 - Left)	3855		
5.7	2	LED #17 (Key 6 - Center)	3856		
5.5	2	LED #18 (Key 6 - Right)	3857		
5.3	2	LED #19 (Key 7 - Left)	3858		
5.1	2	LED #20 (Key 7 - Center)	3859		
6.7	2	LED #21 (Key 7 - Right)	3860		
6.5	2	LED #22 (Key 8 - Left)	3861		
6.3	2	LED #23 (Key 8 - Center)	3862		
6.1	2	LED #24 (Key 8 - Right)	3863		
7.7	2	LED #25 (Key 9 - Left)	3864		
7.5	2	LED #26 (Key 9 - Center)	3865		
7.3	2	LED #27 (Key 9 - Right)	3866		
7.1	2	LED #28 (Key 10 - Left)	3867		
8.7	2	LED #29 (Key 10 - Center)	3868		
8.5	2	LED #30 (Key 10 - Right)	3869		
8.3	2	Not Used	3870	All bits set to 1	
8.1	2	Not Used	3871		

Auxiliary Input/Output Status #3					PGN: 42496
					hex: 0A600
Description	This message will set the state of the LED Indicators.				
PGN	42496				
Priority	6				
Destination	Keypad				
Data Length	8				
Direction	Receive				
Update Rate	N/A				
Start	Bits	Name	SPN	Notes	
1.7	2	LED #31 (Key 11 - Left)	3872	00 <sub>2</sub> - Indicator OFF	
1.5	2	LED #32 (Key 11 - Center)	3873	01 <sub>2</sub> - Indicator ON	
1.3	2	LED #33 (Key 11 - Center)	3874	10 <sub>2</sub> - Indicator Blink - 2 Hz	
1.1	2	LED #34 (Key 12 - Right)	3875	11 <sub>2</sub> - No Change	
2.7	2	LED #35 (Key 12 - Left)	3876		
2.5	2	LED #36 (Key 12 - Center)	3877		
2.3	2	Not Used	3878	All bits set to 1	
2.1	2	Not Used	3879		
3.7	2	Not Used	3880		
3.5	2	Not Used	3881		
3.3	2	Not Used	3882		
3.1	2	Not Used	3883		
4.7	2	Not Used	3884		
4.5	2	Not Used	3885		
4.3	2	Not Used	3886		
4.1	2	Not Used	3887		
5.7	2	Not Used	3888		
5.5	2	Not Used	3889		
5.3	2	Not Used	3890		
5.1	2	Not Used	3891		
6.7	2	Not Used	3892		
6.5	2	Not Used	3893		
6.3	2	Not Used	3894		
6.1	2	Not Used	3895		
7.7	2	Not Used	3896		
7.5	2	Not Used	3897		
7.3	2	Not Used	3898		
7.1	2	Not Used	3899		
8.7	2	Not Used	3900		
8.5	2	Not Used	3901		
8.3	2	Not Used	3902		
8.1	2	Not Used	3903		

## Backlight Intensity

The Keypad module uses the J1939 Cab Illumination message to control the keypad icon backlighting. The message Data Field contains the desired intensity.

Cab Illumination					PGN: 53248
					hex: 0D000
Description	This message sets the brightness of the keypad backlight and Indicators.				
PGN	53248				
Priority	6				
Destination	Keypad				
Data Length	8				
Direction	Receive				
Update Rate	N/A				
Start	Bits	Name	SPN	Notes	
1.1	8	Illumination Brightness Percent	1487	0 - 100 Percent	0.4% per bit
2.1	8	Not Used		Set all bits to 1	
3.1	8	Not Used			
4.1	8	Not Used			
5.1	8	Not Used			
6.1	8	Not Used			
7.1	8	Not Used			
8.1	8	Not Used			

## Module Status

The Keypad module uses a Proprietary J1939 message to broadcast system health.

Module Status					PGN: 65376
					hex: 0FF60
Description	This message is broadcast periodically or upon request to indicate the module system status.				
PGN	65376				
Priority	6				
Destination	Global				
Data Length	8				
Direction	Transmit				
Update Rate	5000 mS (configurable) periodic and upon request				
Start	Bits	Name	SPN	Notes	
1.1	16	Supply Voltage	N/A	Resolution 1 mV / bit	
3.1	16	Core Temperature	N/A	Resolution 0.1 °C / bit	
5.1	16	Reserved			
7.1	16	Reserved			

## Module Configuration

All module configuration is performed using the Proprietary-A CAN message, PGN 61184 (0xFE00). The message Data Field will contain the configuration command function, action to be taken and any parameter data. All configuration commands must be sent from Service Tool Source Address 249 (0xF9).

Upon receiving a Configuration Message, the module will attempt to execute the operation and then will return the Configuration Message with the Function Extension configured to convey the status of the operation. The service tool must wait for this message to be returned before the module will be ready to accept another Configuration Message.

Proprietary-A					PGN: 61184
					hex: 0EF00
Description	This message is used for module configuration.				
PGN	61184				
Priority	5				
Destination	Keypad				
Data Length	8				
Direction	Receive				
Update Rate	N/A				
Start	Bits	Name	Value	Notes	
1.1	8	Function Code	0x10	Enter Configuration Mode	
2.1	8	Action Code	0xFF		
3.1	8	Service Tool Address	0xF9		
4.1	8	Module Address	DA	<-- destination address (keypad)	
5.1	8	Security Key0	0x44		
6.1	8	Security Key1	0x55		
7.1	8	Security Key2	0x66		
8.1	8	Security Key3	0x77		
1.1	8	Function Code	0x11	Save and Exit Configuration Mode	
2.1	8	Action Code	0xFF		
3.1	8	Service Tool Address	0xF9		
4.1	8	Module Address	DA	<-- destination address (keypad)	
5.1	8	Security Key0	0x44		
6.1	8	Security Key1	0x55		
7.1	8	Security Key2	0x66		
8.1	8	Security Key3	0x77		
1.1	8	Function Code	0x12	Reset to Factory Defaults	
2.1	8	Action Code	0xFF		
3.1	8	Service Tool Address	0xF9		
4.1	8	Module Address	DA	<-- destination address (keypad)	
5.1	8	Security Key0	0x44		
6.1	8	Security Key1	0x55		
7.1	8	Security Key2	0x66		
8.1	8	Security Key3	0x77		
1.1	8	Function Code	0x13	Cancel and Exit Configuration Mode	
2.1	8	Action Code	0xFF		
3.1	8	Service Tool Address	0xF9		
4.1	8	Module Address	DA	<-- destination address (keypad)	
5.1	8	Security Key0	0x44		
6.1	8	Security Key1	0x55		
7.1	8	Security Key2	0x66		
8.1	8	Security Key3	0x77		

Proprietary-A (continued)					PGN: 61184
					hex: 0EF00
Description	This message is used for module configuration.				
PGN	61184				
Priority	5				
Destination	Keypad				
Data Length	8				
Direction	Receive				
Update Rate	N/A				
Start	Bits	Name	Value	Notes	
1.1	8	Function Code	0x20	J1939 Source Address	
2.1	8	Action Code	R/W	<-- 0x10 Read; 0x11 Write	
3.1	8	Reserved	0xFF		
4.1	8	New Source Address	##	valid J1939 address	
5.1	32	Reserved	0xFF...		
1.1	8	Function Code	0x23	J1939 NAME (ECU Instance)	
2.1	8	Action Code	R/W	<-- 0x10 Read; 0x11 Write	
3.1	8	Reserved	0xFF		
4.1	8	ECU Instance	##	valid range 0-7	
5.1	32	Reserved	0xFF...		
1.1	8	Function Code	0x24	J1939 NAME (Function Instance)	
2.1	8	Action Code	R/W	<-- 0x10 Read; 0x11 Write	
3.1	8	Reserved	0xFF		
4.1	6	Function Instance	##	valid range 0-31	
5.1	32	Reserved	0xFF...		
1.1	8	Function Code	0x25	J1939 NAME (Function)	
2.1	8	Action Code	R/W	<-- 0x10 Read; 0x11 Write	
3.1	8	Reserved	0xFF		
4.1	8	Function	##	valid range 0-255	
5.1	32	Reserved	0xFF...		
1.1	8	Function Code	0x26	Transmission Priority	
2.1	8	Action Code	R/W	<-- 0x10 Read; 0x11 Write	
3.1	8	Reserved	0xFF		
4.1	8	Priority	##	valid range 0-7	
8.1	32	Reserved	0xFF...		

Proprietary-A (continued)					PGN: 61184
					hex: 0EF00
Description	This message is used for module configuration.				
PGN	61184				
Priority	5				
Destination	Keypad				
Data Length	8				
Direction	Receive				
Update Rate	N/A				
Start	Bits	Name	Value	Notes	
1.1	8	Function Code	0x27	J1939 NAME (Vehicle System)	
2.1	8	Action Code	R/W	<-- 0x10 Read; 0x11 Write	
3.1	8	Reserved	0xFF		
4.1	8	Vehicle System	##	valid range 0-127	
5.1	32	Reserved	0xFF...		
1.1	8	Function Code	0x28	J1939 NAME (Vehicle System Instance)	
2.1	8	Action Code	R/W	<-- 0x10 Read; 0x11 Write	
3.1	8	Reserved	0xFF		
4.1	8	Vehicle System Instance	##	valid range 0-15	
5.1	32	Reserved	0xFF...		
1.1	8	Function Code	0x29	J1939 NAME (Industry Group)	
2.1	8	Action Code	R/W	<-- 0x10 Read; 0x11 Write	
3.1	8	Reserved	0xFF		
4.1	8	Industry Group	##	valid range 0-7	
5.1	32	Reserved	0xFF...		
1.1	8	Function Code	0x2A	J1939 NAME (Arbitrary Address Capable)	
2.1	8	Action Code	R/W	<-- 0x10 Read; 0x11 Write	
3.1	8	Reserved	0xFF		
4.1	8	Arbitrary Address Capable	##	valid range 0-1	
5.1	32	Reserved	0xFF...		
1.1	8	Function Code	0x2B	Alternate Address Count	
2.1	8	Action Code	R/W	<-- 0x10 Read; 0x11 Write	
3.1	8	Reserved	0xFF		
4.1	6	Alternate Address Count	##	valid range 0-15	
5.1	32	Reserved	0xFF...		
1.1	8	Function Code	0x2C	Alternate Address List	
2.1	8	Action Code	R/W	<-- 0x10 Read; 0x11 Write	
3.1	8	Reserved	0xFF		
4.1	8	Index into list	##	valid range 1-15	
5.1	8	Alternate Address Count	##	valid J1939 address	
6.1	24	Reserved	0xFF...		
1.1	8	Function Code	0x34	CAN Transmission Rates	
2.1	8	Action Code	R/W	<-- 0x10 Read; 0x11 Write	
3.1	16	PGN number	##	Note 1	
5.1	16	Transmit Rate (1 mS/bit)	##	Note 2	
7.1	16	Transmit Offset (1 mS/bit)	##	Note 3	

## Notes:

1. Must be a valid PGN
2. Valid range is 10-60000 milliseconds. Use 0xFFFF for no change. Use 0 to disable periodic transmissions.
3. Valid range is 0-3000 milliseconds. This value will delay the initial transmission. Used to stagger messages having the same transmit rate.



## APPENDIX 1: Suspect Parameter Numbers (SPN)

### SPN 520192 – Function Byte

**Data Field position: Byte 1, 8 bits**

Used to define the configuration Function is to perform

#### Control Functions

0x10	Enter Configuration Mode – Run Mode Suspended, all outputs shut off
0x11	Save Changes and Exit Configuration Mode – Restart in Run Mode
0x12	Reset to Factory Default Settings – Restart in Run Mode
0x13	Cancel Changes and Exit Configuration – Restart in Run Mode

#### CAN J1939 Configuration

0x20	J1939 Source Address
0x21	reserved
0x22	reserved
0x23	J1939 NAME (ECU Instance)
0x24	J1939 NAME (Function Instance)
0x25	J1939 NAME (Function)
0x26	J1939 NAME (Reserved)
0x27	J1939 NAME (Vehicle System)
0x28	J1939 NAME (Vehicle System Instance)
0x29	J1939 NAME (Industry Group)
0x2A	J1939 NAME (Arbitrary Address Capable Bit)
0x2B	J1939 NAME (Alternate Address Count)
0x2C	J1939 NAME (Alternate Address List)

#### Module Configuration

0x34	Status CAN Transmit Rates (PGN, Rate, Offset)
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### SPN 520193 Action Byte

**Data Field position: Byte 2, 8 bits**

Used to define the action the Function is to perform

#### Tx: As a Command

0x10	Read Operation
0x11	Write Operation
0xFF	Not Applicable

#### Rx: As a Response

0x12	Operation completed successfully
0x13	Operation failed due to incorrect message format
0x14	Operation failed due to unsupported hardware

***SPN 520202 Module Status*****Data Field position: Byte 1, 16 bits**

Used to report Module supply voltage

Range: 0x0000-0x8CA0 (0-36000) expressed as 0.0-36000 mV 1 mV / bit

**Data Field position: Byte 3, 16 bits**

Used to report Module core temperature

Range: 0x0000-0x03E8 (0-1000) expressed as millivolts 0.1 °C / bit

***SPN 520207 16-bit Output CAN Timeout Parameters*****Data Field position: Byte 5, 16 bits**

Used to set the output timeout in the event of lost CAN command messages.

Range: 0x0001-0xFFDC (1-65500) expressed as 0.01-655 Sec 10 mS / bit

Range: 0x0000 Timeout Feature Disabled

Range: 0xFFFF Leaves value unchanged

**Data Field position: Byte 7, 16 bits**

Used to set the output state in the event of a timeout

0x00 = Turn OFF output, 0x01 = Turn ON output, 0xFF = Unchanged

***SPN 520208 16-bit CAN Transmission Parameters*****Data Field position: Byte 3, 16 bits**

Used to identify the PGN of the message

Range: 0xFF40-0xFF62 (PGN 65344-65378)

**Data Field position: Byte 5, 16 bits**

Used to set the transmission interval of the message

Range: 0x000A-0xEA60 (10-60000) 1 mS / bit

Range: 0x0000 Disables transmission

Range: 0xFFFF Leaves value unchanged

**Data Field position: Byte 7, 16 bits**

Used to set the offset or stagger for many messages with same interval.

Range: 0x0000-0x0BBF (0-3000) 1 mS / bit

Range: 0xFFFF Leaves value unchanged

## APPENDIX 2: Typical configuration Sequence

\* EXTENDED CAN ID - Assumes message priority = 0, module address = 0xC0. Command source address must be 0xF9.  
Tx = message sent from service tool to module, Rx = reply sent from module back to service tool.

### Tx: Command to Enter Configuration Mode

Ext ID *	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
0xEFC0F9	8	0x10	0xFF	0xF9	0xC0	0x44	0x55	0x66	0x77

Byte 1: 0x10 = Function (Enter Configuration Mode)  
 Byte 2: 0xFF = Sub-command (none)  
 Byte 3: 0xF9 = Service tool Address  
 Byte 4: 0xC0 = Module Address  
 Byte 5-8 0x77665544 = security key (low byte first)

### Rx: Reply

Ext ID *	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
0xEFF9C0	8	0x10	0x12	0xF9	0xC0	n/a	n/a	n/a	n/a

Byte 1: Function  
 Byte 2: Success = 0x12 (Three LEDs above Key 1 will light, center LED flashing)

### Tx: Command to Change Module Source Address

Ext ID *	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
0xEFC019	8	0x20	0x11	0xFF	0xC1	0xFF	0xFF	0xFF	0xFF

Byte 1: 0x20 = Function (J1939 Source Address)  
 Byte 2: 0x11 = Sub-command (Write)  
 Byte 3: 0xFF  
 Byte 4: 0xC1 = New Address (Desired Address)

### Rx: Reply

Ext ID *	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
0xEFF9C0	8	0x20	0x12	0xFF	0xC1	0xFF	0xFF	0xFF	0xFF

Byte 1: Function  
 Byte 2: Success = 0x12 (NOTE: New Address will not take effect until you save and exit configuration)

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Tx: Additional configuration commands

Rx: Reply

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### Tx: Command to Save Configuration and Exit to Run Mode

Ext ID *	DLC	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
0xEFC0F9	8	0x11	0xFF	0xF9	0xC0	0x44	0x55	0x66	0x77

Byte 1: 0x11 = Function (Exit Configuration Mode)  
 Byte 2: 0xFF = Sub-command (none)  
 Byte 3: 0xF9 = Service tool Address  
 Byte 4: 0xC0 = Current Module Address  
 Byte 5-8 0x77665544 = security key (low byte first)

Module will restart with all changes in effect.