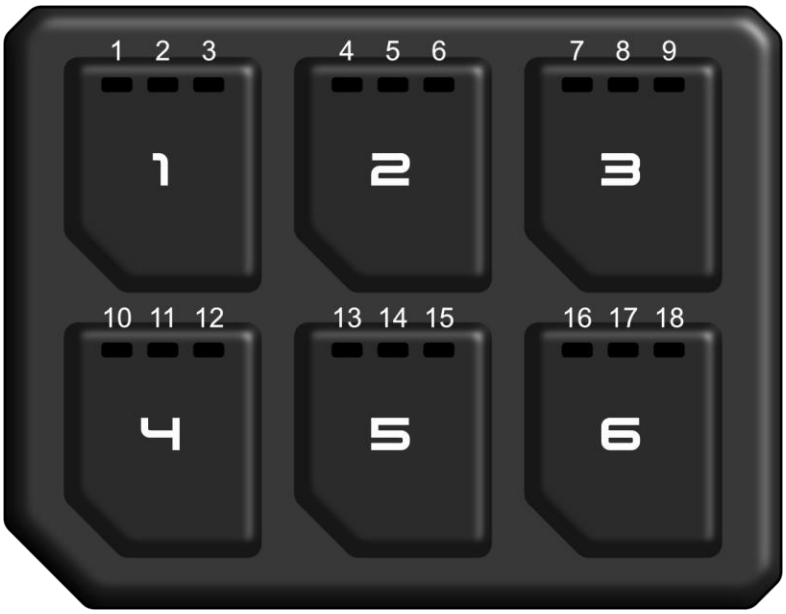
Marlin Keypad Module Slave Protocol

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 6, beginning with the upper left key.
LEDs are numbered consecutively from 1 to 18 beginning with the left most LED of KEY 1.

See diagram below:



CREATED	E. FIERST	DATE	08/25/23
CHECKED	J. COOPER	DATE	10/22/24
APPROVED	J. COOPER	DATE	10/22/24
ECN	14177E	DATE	6/22/22

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.

Aux. I/O Status #1				PGN: 65241 hex: FED9
Description	This message is broadcast periodically or on change of state to indicate the status of the keypad buttons			
PGN	65241			
Priority	6			
Destination	Global			
Data Length	8			
Direction	Transmit			
Update Rate	250ms periodic and upon change of state (configurable, no faster than 20ms)			
Start	**Bits**	**Name**	**SPN**	**Notes**
1.7	2	Button #1	701	00_2 - Button is not pressed
1.5	2	Button #2	702	01_2 - Button is pressed
1.3	2	Button #3	703	10_2 - Error
1.1	2	Button #4	704	11_2 - Not Available
2.7	1	Button #5	705	
2.5	1	Button #6	706	
2.3	1	Not Used		All bits set to 1
2.1	1	Not Used		
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		

Indicator LED Command Messages

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

Aux. I/O Status #2				PGN: 42752 hex: A7xx
Description	This message will set the state of the LED indicators			
PGN	42752			
Priority	6			
Destination	Keypad (xx = Keypad Source Address)			
Data Length	8			
Direction	Receive			
Update Rate	N/A			
Start	**Bits**	**Name**	**SPN**	**Notes**
1.7	2	LED #1	3840	00_2 - Indicator OFF
1.5	2	LED #2	3841	01_2 - Indicator ON
1.3	2	LED #3	3842	10_2 - Indicator Blink 2Hz
1.1	2	LED #4	3843	11_2 - No Change
2.7	2	LED #5	3844	
2.5	2	LED #6	3845	
2.3	2	LED #7	3846	
2.1	2	LED #8	3847	
3.7	2	LED #9	3848	
3.5	2	LED #10	3849	
3.3	2	LED #11	3850	
3.1	2	LED #12	3851	
4.7	2	LED #13	3852	
4.5	2	LED #14	3853	
4.3	2	LED #15	3854	
4.1	2	LED #16	3855	
5.7	2	LED #17	3856	
5.5	2	LED #18	3857	
5.3	2	Not Used		All bits set to 1
5.1	2	Not Used		
6.1	8	Not Used		
7.1	8	Not Used		
8.1	8	Not Used		

Backlight Intensity

The Keypad module uses the J1939 Cab Illumination message to control the intensity of keypad icon backlight intensity and keypad indicator intensity. The message Data Field contains the desired intensity of each type of LEDs. Values between 1(0x01) and 250(0xFA) are valid with values above and below are constrained to this range with the exception the value 0(0x00). A value of 0(0x00) in the Indicator LED data field will result in full intensity 250(0xFA).

Cab Illumination			PGN: 53248 hex: D0xx	
Description	This message will set the brightness of the LED indicators and backlight			
PGN	53248			
Priority	6			
Destination	Keypad (xx = Keypad Source Address)			
Data Length	8			
Direction	Receive			
Update Rate	N/A			
Start	**Bits**	**Name**	**SPN**	**Notes**
1.1	8	Backlight Illumination %	N/A	0-100 percent (0.4% per bit) Range: (0x00-0xFA)
2.1	8	Indicator Illumination %	N/A	0.4-100 percent (0.4% per bit) Range: (0x01-0xFA)
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		

Sleep Mode

The Keypad module can be put into a low-power sleep mode to reduce total system power consumption. Sleep mode is disabled by default and must be enabled via the Module Configuration procedure detailed in this document. Additionally, "wake on CAN" may be disabled via the Module Configuration procedure. If "wake on CAN" is disabled while sleep mode is enabled, it is imperative that key wake up is configured via the Module Configuration procedure, or else the module will not wake up from sleep mode and will require a power reset to resume normal functionality.

Sleep Mode			PGN: 65320 hex: FF28	
Description	This message is used to put the module into a low-power sleep mode as well as wake it up			
PGN	65320			
Priority	6			
Destination	Keypad			
Data Length	8			
Direction	Receive			
Update Rate	N/A			
Start	**Bits**	**Name**	**SPN**	**Notes**
1.1	8	Destination Address	N/A	Must match either keypad source address or broadcast address (0xFF)
2.1	8	Sleep Command	N/A	0 - Wake up (if enabled) 1 - Go to sleep
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: FF60
Description	This message is broadcast periodically or upon request to indicate the module status			
PGN	65376			
Priority	6			
Destination	Global			
Data Length	8			
Direction	Transmit			
Update Rate	5000ms periodic (configurable) and upon request			
Start	**Bits**	**Name**	**SPN**	**Notes**
1.1	8	Supply Voltage	N/A	Resolution 1 mV/bit
3.1	16	Core Temperature	N/A	Resolution 1 °C/bit
5.1	8	Not Used		
6.1	8	Not Used		
7.1	8	Not Used		
8.1	8	Not Used		

Indicator Color

The color of the indicators can be changed using the below message. Indicators can be changed individually, per-button, and for the whole keypad.

LED Indicator Color				PGN: 65519 hex: FFEF
Description	This message is used to change the colors of the indicator LEDs on the keypad			
PGN	65519			
Priority	6			
Destination	Global			
Data Length	8			
Direction	Receive			
Update Rate	N/A			
Start	**Bits**	**Name**	**SPN**	**Notes**
1.1	8	Destination Address	N/A	Must match either keypad source address or broadcast address (0xFF)
2.1	8	LED Command	N/A	1 - Set single LED 2 - Set all LEDS for single button 3 - Set all LEDS for all buttons
3.1	8	LED/Button Specifier	N/A	LED or Button number (ignored if LED command is 3)
4.1	8	R (Red)	N/A	LED RGB Values Range 0x00 - 0xFF
5.1	8	G (Green)	N/A	
6.1	8	B (Blue)	N/A	
7.1	8	Not Used		
8.1	8	Not Used		

Colors set using this message are only persistent while the keypad is powered on. If the module is reset, it will default to the colors set via the Module Configuration procedure.

Module Configuration

All module configuration is performed either by using the Proprietary-A CAN message, PGN 61184 (0xEF00) or with the XML-based configuration **17544S**.

If using the CAN message-based configuration, 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), and the second byte of the PGN must match the keypad source address.

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.

To put the module into configuration mode, the user must send the specific Proprietary-A CAN message as detailed below with a function code of 0x10 indicating configuration mode entry. Once in configuration mode, the user can change one or more parameters detailed by the SPN chart in Appendix 1. After changing parameters, or to exit configuration mode, the user can send a Proprietary-A message to save their changes, cancel their changes, or restore all factory default values.

Proprietary-A: Module Configuration				**PGN: 61184** **hex: EFxx**
Description	This message is used to configure the keypad			
PGN	61184			
Priority	5			
Destination	Keypad (xx = Keypad Source Address)			
Data Length	8			
Direction	Receive			
Update Rate	N/A			
Start	**Bits**	**Name**	**Value**	**Notes**
1.1	8	Function Code	⇨	0x10 - Enter Config. Mode 0x11 - Save and Exit Config. Mode 0x12 - Reset to Factory Defaults 0x13 - Cancel and Exit Config. Mode
2.1	8	Action Code	0xFF	
3.1	8	Service Tool Address	0xF9	
4.1	8	Module Address	⇨	Keypad Source Address
5.1	8	Security Key 1	0x44	
6.1	8	Security Key 2	0x55	
7.1	8	Security Key 3	0x66	
8.1	8	Security Key 4	0x77	

Proprietary-A: Module Configuration (continued)				PGN: 61184 hex: EFxx
Start	**Bits**	**Name**	**Value**	**Notes**
1.1	8	Function Code	0x20	**J1939 Source Address**
2.1	8	Action Code	⇨	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 ECU Instance**
2.1	8	Action Code	⇨	0x10 - Read 0x11 - Write
3.1	8	Reserved	0xFF	
4.1	8	**New ECU Instance**	⇨	Valid Range (0 - 7)
5.1	32	Reserved	0xFF	
1.1	8	Function Code	0x24	**J1939 Function Instance**
2.1	8	Action Code	⇨	0x10 - Read 0x11 - Write
3.1	8	Reserved	0xFF	
4.1	8	**New Function Instance**	⇨	Valid Range (0 - 31)
5.1	32	Reserved	0xFF	
1.1	8	Function Code	0x25	**J1939 Function**
2.1	8	Action Code	⇨	0x10 - Read 0x11 - Write
3.1	8	Reserved	0xFF	
4.1	8	**New Function**	⇨	Valid Range (0 - 255)
5.1	32	Reserved	0xFF	
1.1	8	Function Code	0x26	**J1939 Priority**
2.1	8	Action Code	⇨	0x10 - Read 0x11 - Write
3.1	8	Reserved	0xFF	
4.1	8	**New Priority**	⇨	Valid Range (0 - 7)
5.1	32	Reserved	0xFF	
1.1	8	Function Code	0x27	**J1939 Vehicle System**
2.1	8	Action Code	⇨	0x10 - Read 0x11 - Write
3.1	8	Reserved	0xFF	
4.1	8	**New Vehicle System**	⇨	Valid Range (0 - 127)
5.1	32	Reserved	0xFF	

Proprietary-A: Module Configuration (continued)			PGN: 61184 hex: EFxx	
Start	**Bits**	**Name**	**Value**	**Notes**
1.1	8	Function Code	0x28	**J1939 Vehicle System Instance**
2.1	8	Action Code	⇨	0x10 - Read 0x11 - Write
3.1	8	Reserved	0xFF	
4.1	8	**New Vehicle System Instance**	⇨	Valid Range (0 - 127)
5.1	32	Reserved	0xFF	
1.1	8	Function Code	0x29	**J1939 Industry Group**
2.1	8	Action Code	⇨	0x10 - Read 0x11 - Write
3.1	8	Reserved	0xFF	
4.1	8	**New Industry Group**	⇨	Valid Range (0 - 7)
5.1	32	Reserved	0xFF	
1.1	8	Function Code	0x2A	**J1939 Arbitrary Address Capable**
2.1	8	Action Code	⇨	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	**J1939 Alt. Address Count**
2.1	8	Action Code	⇨	0x10 - Read 0x11 - Write
3.1	8	Reserved	0xFF	
4.1	8	**Number of Alt. Addresses**	⇨	Valid Range (0 - 15)
5.1	32	Reserved	0xFF	
1.1	8	Function Code	0x2C	**J1939 Alt. Addresses**
2.1	8	Action Code	⇨	0x10 - Read 0x11 - Write
3.1	8	Reserved	0xFF	
4.1	8	**Index of Alt. Address**	⇨	Valid Range (0 - 15)
5.1	8	**Alternate Address**	⇨	Valid J1939 Address
6.1	24	Reserved	0xFF	

Proprietary-A: Module Configuration (continued)				**PGN: 61184** **hex: EFxx**
Start	**Bits**	**Name**	**Value**	**Notes**
1.1	8	Function Code	0x30	**Enable/Disable Sleep Mode**
2.1	8	Action Code	⇨	0x10 - Read 0x11 - Write
3.1	8	Reserved	0xFF	
4.1	8	**Sleep Enable**	⇨	0 - Sleep Disabled 1 - Sleep Enabled
5.1	32	Reserved	0xFF	
1.1	8	Function Code	0x31	**Wake on CAN**
2.1	8	Action Code	⇨	0x10 - Read 0x11 - Write
3.1	8	Reserved	0xFF	
4.1	8	**Enable Wake on CAN**	⇨	0 - Wake on CAN Disabled 1 - Wake on CAN Enabled
5.1	32	Reserved	0xFF	
1.1	8	Function Code	0x32	**Enable Wake on Button Press**
2.1	8	Action Code	⇨	0x10 - Read 0x11 - Write
3.1	8	Reserved	0xFF	
4.1	8	**Enable Wake on Button Press**	⇨	0 - Wake on Button Press Disabled 1 - Wake on Button Press Enabled
5.1	32	Reserved	0xFF	
1.1	8	Function Code	0x33	**Button Wake Mask**
2.1	8	Action Code	⇨	0x10 - Read 0x11 - Write
3.1	8	Reserved	0xFF	
4.1	16	**Mask Value**	⇨	Note 1
6.1	24	Reserved	0xFF	

Notes:

1. Bitmask sets which buttons can wake up the keypad. A '1' bit indicates the button in that position will wake the keypad. A '0' bit indicates the button in that position will not wake the keypad. For example:
   - *0b00000000 00000001* - Only button 1 will wake the keypad
   - *0b00000000 00111111* - All buttons will wake the keypad
   - *0b00000000 00000111* - Buttons 1, 2, and 3 will wake the keypad

WARNING: IF SLEEP MODE IS USED, EITHER WAKE ON CAN OR WAKE ON BUTTON PRESS (WITH NON-ZERO BUTTON WAKE MASK) MUST BE CONFIGURED. IF NEITHER WAKE OPTION IS ENABLED, THE KEYPAD WILL NOT WAKE FROM SLEEP AND MUST BE POWER CYCLED.

Proprietary-A: Module Configuration (continued)			PGN: 61184 hex: EFxx	
Start	**Bits**	**Name**	**Value**	**Notes**
1.1	8	Function Code	0x34	**Periodic CAN Transmit Rates**
2.1	8	Action Code	⇨	0x10 - Read 0x11 - Write
3.1	16	**PGN**	⇨	Note 1
5.1	16	**Transmit Rate (1ms/bit)**	⇨	Note 2
7.1	16	**Transmit Offset (1ms/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.

Proprietary-A: Module Configuration (continued)			PGN: 61184 hex: EFxx	
Start	**Bits**	**Name**	**Value**	**Notes**
1.1	8	Function Code	0x40	**LED COLOR**
2.1	8	Action Code	⇨	0x10 - Read 0x11 - Write
3.1	8	Reserved	0xFF	
4.1	8	**LED Number**	⇨	Which LED to change
5.1	8	R (Red)	⇨	Valid Range (0 - 255)
6.1	8	G (Green)	⇨	
7.1	8	B (Blue)	⇨	
8.1	8	Reserved	0xFF	

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

0x30	Enable Sleep Mode
0x31	Enable Wake on CAN message
0x32	Enable Wake on Button Press
0x33	Sleep Mode Button Wake Mask
0x34	Status CAN Transmit Rates (PGN, Rate, Offset)

LED Configuration

0x40	LED Colors

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 = 0xC1. 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
0xEFC1F9	8	0x10	0xFF	0xF9	0xC1	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: 0xC1 = 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
0xEFF9C1	8	0x10	**0x12**	0xF9	0xC1	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
0xEFC1F9	8	0x20	0x11	0xFF	0xC2	0xFF	0xFF	0xFF	0xFF

Byte 1: 0x20 = Function (J1939 Source Address)
Byte 2: 0x11 = Sub-command (Write)
Byte 3: 0xFF
Byte 4: 0xC2 = 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
0xEFF9C1	8	0x20	**0x12**	0xFF	0xC2	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
0xEFC1F9	8	0x11	0xFF	0xF9	0xC1	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: 0xC1 = Current Module Address
Byte 5-8 0x77665544 = security key (low byte first)

Module will restart with all changes in effect.