Multiplexed Rearfed Fuse and Relay Module

mRFRM

Software User Manual

Revision 2.0

Table of Contents

1 mRFRM J1939 CAN Configuration & Monitoring

The mRFRM communicates with other devices on the vehicle's CAN bus using the SAE J1939 protocol, and can be part of a multiplexing system that eliminates the need for individual connections between switches and loads. The mRFRM works by receiving messages to turn its relays "on" and "off", and by sending messages indicating the state of its monitored components.

The mRFRM's CAN control board is protected against over-voltage transients and reverse-voltage conditions and its relay coil drivers are protected from short-circuits.

Following is a list of CAN messages that mRFRM can handle. These messages are discussed in more details in their respective sections.

Configuration Messages (PGN: $00EF00_{16}$)			
Message Title	**View / Change**	**Command ID**	**Response ID**
Loss of Communication Relay States	View	0x62	0x63
	Change	0x73	0x01
CAN Message Count Threshold, CAN Timeout Source Address, CAN Source Address Offset (Cable Select) – *view only*, & Operating Mode - *view only*	View	0x70	0x71
	Change	0x72	0x01
Population Table	View	0x74	0x75
	Change	0x76	0x01
Default Relay State	View	0x77	0x78
	Change	0x79	0x01
Startup Delay Time, PGN Base, & PGN Broadcast Rate	View	0x7A	0x7B
	Change	0x7C	0x01
Device Error Reporting Flags	View	0x7D	0x7E
	Change	0x7F	0x01

Control and Status Messages	
Message Title	**PGN**
Switched Power Outputs Command	008600_{16}
Switched Power Outputs Status	$00FCB4_{16}$
Fused Power Output Status	$00FCB5_{16}$

Miscellaneous J1939 Messages	
Message Title	**PGN**
Address Claim	$00EE00_{16}$
Commanded Address	$00FED8_{16}$
DM1	$00FECA_{16}$
DM13	$00DF00_{16}$
Transport Protocol	$00EB00_{16}$ / $00EC00_{16}$
Request for PGN	$00EA00_{16}$

2 Configuration Messages

A number of mRFRM software parameters can be configured using J1939 messages. These parameters are shown in 'Configuration Messages' table above. The PGN used for all these messages is $00EF00_{16}$. Each message has a unique ID in the first data byte that differentiates individual commands and responses. Following is the description of the CAN message used for configuring parameters:

Configuration Message	
Transmission Repetition Rate	As needed
Data Length	8 bytes
Data Page	0
PDU Format	239
PDU Specific	Destination Address (address of node that sends the message)
Default Priority	6
Parameter Group Number	61184 ($00EF00_{16}$)

2.1 Loss of Communication Relay States

The loss of communication relay states are the relay states the mRFRM assumes if the CAN message count threshold, if enabled, is breached. Loss of communication relay states can be selected to On, Off or No Action. When the mRFRM is shipped, all loss of communication relay states are set to No Action. The following sections show how to view and change the loss of communication relay states.

Message Title	View / Change	Command ID	Response ID
Loss of Communication Relay States	View	0x62	0x63
	Change	0x73	0x01

2.1.1 View

In order to view the status of loss of communication relay states, set byte 1 to 0x62 and send the command to mRFRM unit. The unit responds with message ID 0x63.

2.1.1.1 Command (0x62)

Send command to mRFRM with command ID in byte 1.

Byte 1	Message ID (0x62)
Byte 2	
Byte 3	
Byte 4	
Byte 5	
Byte 6	
Byte 7	
Byte 8	

2.1.1.2 Response (0x63)

Note: Each loss-of-communication relay state is represented by two bits as follows:
00: Off
01: On
10: No action

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Message ID (0x63)							
Byte 2	Relay 1		Relay 2		Relay 3		Relay 4	
Byte 3	Relay 5		Relay 6		Relay 7		Relay 8	
Byte 4	Relay 9		Relay 10		Relay 11		Relay 12	
Byte 5	Relay 13		Relay 14		0x00			
Byte 6	0x00							
Byte 7	0x00							
Byte 8	0x00							

2.1.2 Change

Message ID 0x73 is used to change the loss of communication relay states. The mRFRM responds to this message with reply message ID 0x01.

2.1.2.1 Command (0x73)

Send command to mRFRM with command ID in byte 1.

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Message ID (0x73)							
Byte 2	Relay	1	Relay	2	Relay	3	Relay	4
Byte 3	Relay	5	Relay	6	Relay	7	Relay	8
Byte 4	Relay	9	Relay	10	Relay	11	Relay	12
Byte 5	Relay	13	Relay	14				
Byte 6								
Byte 7								
Byte 8								

Each relay status value will have one of the following bit settings:

Bit Value	Hex Value	Action
0 0	0	Relay off
0 1	1	Relay on
1 0	2	No action
1 1	3	Reserved

2.1.2.2 Response (0x01)

Message ID 0x01 is a diagnostic message that indicates success or failure. The following table shows the format of the data bytes of message ID 0x01:

Byte 1	Message ID (0x01)	
Byte 2	ID of the message responded to	
Byte 3	0x00:	Failure
	0x01:	Success
Byte 4	Error description	
	0x00:	Default (look to other error flags)
	0xE0:	Message is too short
	0xE1:	Invalid offset
	0xE2:	Invalid command parameter
Byte 5	Reserved	
Byte 6	Reserved	
Byte 7	Reserved	
Byte 8	Reserved	

2.2 Message Count Threshold / Timeout Source Address / Cable Select / Operating Mode

CAN Message Count Threshold

The CAN message count threshold refers to the minimum number of messages that must be received by the mRFRM every two seconds.

- If the CAN message count threshold is set to zero (the default value), this feature is disabled.
- If the CAN message count threshold is set to any other value, this feature is enabled.

If the feature is enabled and the mRFRM does not receive the configured number of messages over two seconds, it switches all relays to their loss-of-communication state. The relays will remain in this state until the mRFRM again receives messages at the proper rate, or receives an AUXIO2 message with different relay state information, or until ignition power is cycled.

When the mRFRM again receives messages at the proper rate, the relays are set to the state they were in before the timeout occurred.

There are two ways you can use the CAN message count threshold:

- The same CAN message count threshold can be applied to all modules communicating with the mRFRM by setting CAN timeout source address to 0xFF.
- A specific CAN message count threshold can be applied to one module communicating with the mRFRM by using a specific CAN timeout source address. If this is used, the mRFRM will only count messages from the indicated module.

CAN Timeout Source Address

CAN Timeout Source Address specifies how to process CAN Message Count Threshold.

- If CAN Timeout Source Address is set to 0xFF, count all messages sent to all source addresses. This includes global broadcasts, etc.
- If CAN Timeout Source Address is set to CAN Source Address, count only those messages that are specific to the receiving node.

CAN Source Address Offset (Cable Select)

Please refer to the section, 'CAN Harness Address Pin Connections' in **mRFRM Hardware User Manual**.

Operating Mode

mRFRM runs only in one of the two modes, that is Run mode or Test mode.

- Run mode: Normal operation
- Test mode: reserved for factory use only

Message Title	View / Change	Command ID	Response ID
CAN Message Count Threshold, CAN Timeout Source Address, CAN Source Address Offset (Cable Select) – *view only*, & Operating Mode - *view only*	View	0x70	0x71
	Change	0x72	0x01

2.2.1 View

2.2.1.1 Command (0x70)

Send command to mRFRM with command ID in byte 1.

Byte 1	Message ID (0x70)
Byte 2	
Byte 3	
Byte 4	
Byte 5	
Byte 6	
Byte 7	
Byte 8	

2.2.1.2 Response (0x71)

mRFRM responds with ID 0x71 with information shown in the table below.

Byte 1	Message ID (0x71)
Byte 2	CAN Message Count Threshold (LSB)
Byte 3	CAN Message Count Threshold (MSB)
Byte 4	CAN Timeout Source Address
Byte 5	CAN Source Address Offset (Cable Select)
Byte 6	Operating Mode 0: Run 1: Reserved 2: Test Mode
Byte 7	0xFF
Byte 8	0xFF

2.2.2 Change

Message ID 0x72 is used to change following parameters:

- CAN Message Count Threshold
- CAN Timeout Source Address

2.2.2.1 Command (0x72)

Send command to mRFRM with command ID in byte 1.

Byte 1	Message ID (0x72)
Byte 2	CAN Message Count Threshold (LSB)
Byte 3	CAN Message Count Threshold (MSB)
Byte 4	CAN Timeout Source Address
Byte 5	
Byte 6	
Byte 7	
Byte 8	

2.2.2.2 Response (0x01)

Please refer to the table in section, Response (0x01).

2.3 Fuse and Relay Population Tables

The fuse and relay configuration of the mRFRM is fixed, but the user may choose to omit some devices. Population tables (stored in FLASH memory) indicate whether or not the devices are actually installed in the mRFRM. If a device is not installed (but should be according to the population table), the mRFRM will generate an error in the corresponding Output Status message.

To avoid errors from a missing device, you must send the mRFRM a message telling it to stop controlling or monitoring the device. This is done by adjusting the population table with message ID 0x76.

Message Title	View / Change	Command ID	Response ID
Population Table	View	0x74	0x75
	Change	0x76	0x01

2.3.1 View

2.3.1.1 Command (0x74)

Send command to mRFRM with command ID in byte 1.

Byte 1	Message ID (0x74)
Byte 2	0x00: Fuses 0x01: Relays
Byte 3	
Byte 4	
Byte 5	
Byte 6	
Byte 7	
Byte 8	

2.3.1.2 Response (0x75)

Message ID 0x75 is sent by the mRFRM after receiving command message ID 0x74. The number in the 2nd byte is used to indicate either fuses or relays. The following table shows the format of the data bytes of message ID 0x75:

Note: In bytes 3 through 6 in the table below, a 1 indicates that the position was populated.

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Message ID (0x75)							
Byte 2	0x00: Fuses							
Byte 3	Fuse 8	Fuse 7	Fuse 6	Fuse 5	Fuse 4	Fuse 3	Fuse 2	Fuse 1
Byte 4	Fuse 16	Fuse 15	Fuse 14	Fuse 13	Fuse 12	Fuse 11	Fuse 10	Fuse 9
Byte 5	Fuse 24	Fuse 23	Fuse 22	Fuse 21	Fuse 20	Fuse 19	Fuse 18	Fuse 17
Byte 6	0x0				Fuse 28	Fuse 27	Fuse 26	Fuse 25
Byte 7	0x00							
Byte 8	0x00							

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Message ID (0x75)							
Byte 2	0x01 : Relays							
Byte 3	Relay 8	Relay 7	Relay 6	Relay 5	Relay 4	Relay 3	Relay 2	Relay 1
Byte 4	0	0	Relay 14	Relay 13	Relay 12	Relay 11	Relay 10	Relay 9
Byte 5	0x00							
Byte 6	0x00							
Byte 7	0x00							
Byte 8	0x00							

2.3.2 Change

Message ID 0x76 is used to change the population table settings. The number in the 2nd byte is used to select either fuses or relays.

2.3.2.1 Command (0x76)

Send command to mRFRM with command ID in byte 1.

Note: 1 = populated
0 = unpopulated

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Message ID (0x76)							
Byte 2	0x00: Fuses							
Byte 3	Fuse 8	Fuse 7	Fuse 6	Fuse 5	Fuse 4	Fuse 3	Fuse 2	Fuse 1
Byte 4	Fuse 16	Fuse 15	Fuse 14	Fuse 13	Fuse 12	Fuse 11	Fuse 10	Fuse 9
Byte 5	Fuse 24	Fuse 23	Fuse 22	Fuse 21	Fuse 20	Fuse 19	Fuse 18	Fuse 17
Byte 6					Fuse 28	Fuse 27	Fuse 26	Fuse 25
Byte 7								
Byte 8								

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Message ID (0x76)							
Byte 2	0x01 : Relays							
Byte 3	Relay 8	Relay 7	Relay 6	Relay 5	Relay 4	Relay 3	Relay 2	Relay 1
Byte 4			Relay 14	Relay 13	Relay 12	Relay 11	Relay 10	Relay 9
Byte 5								
Byte 6								
Byte 7								
Byte 8								

2.3.2.2 Response (0x01)

Please refer to the table in section, Response (0x01).

2.4 Default Relay States

The default relay states are the “safe” relay states the mRFRM assumes at power-up. When the mRFRM is shipped, all default relay states are set to “off” (0). The following sections show how to view and change the default relay states.

Message Title	View / Change	Command ID	Response ID
Default Relay State	View	0x77	0x78
	Change	0x79	0x01

2.4.1 View

2.4.1.1 Command (0x77)

Send command to mRFRM with command ID in byte 1.

Byte 1	Message ID (0x77)
Byte 2	
Byte 3	
Byte 4	
Byte 5	
Byte 6	
Byte 7	
Byte 8	

2.4.1.2 Response (0x78)

The following table shows the format of the data bytes.

Note: 0 = Default relay state is ‘Off’
1 = Default relay state is ‘On’

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Message ID (0x78)							
Byte 2	Relay 8	Relay 7	Relay 6	Relay 5	Relay 4	Relay 3	Relay 2	Relay 1
Byte 3	0x00		Relay 14	Relay 13	Relay 12	Relay 11	Relay 10	Relay 9
Byte 4	0x00							
Byte 5	0x00							
Byte 6	0x00							
Byte 7	0x00							
Byte 8	0x00							

2.4.2 Change

Message ID 0x79 is used to change the default relay states.

2.4.2.1 Command (0x79)

Send command to mRFRM with command ID in byte 1.

Note: 0 = Set the default relay state to 'Off'
1 = Set the default relay state to 'On'

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Message ID (0x79)							
Byte 2	Relay 8	Relay 7	Relay 6	Relay 5	Relay 4	Relay 3	Relay 2	Relay 1
Byte 3			Relay 14	Relay 13	Relay 12	Relay 11	Relay 10	Relay 9
Byte 4								
Byte 5								
Byte 6								
Byte 7								
Byte 8								

2.4.2.2 Response (0x01)

Please refer to the table in section, Response (0x01).

2.5 Startup Delay Time / PGN Base / PGN Broadcast Rate

Startup Delay Time

The start-up delay is the number of milliseconds the mRFRM waits after start-up before receiving commands, or sending messages. This delay is in addition to the 250ms delay required by the J1939 Address Claim actions (the Address Claim delay is not adjustable).

- The start-up delay range is 0 milliseconds to 65,534 milliseconds (65.5 seconds), which is 000000_{16} to $00FFFE_{16}$.

Note: The default start-up delay time is 1,000 ms (1 second).

PGN Base

The use of PGN Base has been reserved for factory use only.

Caution: The use of PGN Base has been deprecated for the end user!
Do not change PGN Base. Always set to 0xFF.

PGN Broadcast Rate

PGN Broadcast Rate sets the rate at which fuse and relay status messages are broadcast. The range for this value is between 1000 and 10000. The default value is 1000.

- If an out of range value is set, it will automatically be changed to the closest limit. For example, a value of 11000 will be changed to 10000.
- If a value between two acceptable values is set, it will automatically be changed to the nearest lower acceptable value. For example, any value between 2001 and 2999 will be set to 2000.

Caution: Please read the above conditions before modifying this value.

Message Title	View / Change	Command ID	Response ID
Startup Delay Time, PGN Base, & PGN Broadcast Rate	View	0x7A	0x7B
	Change	0x7C	0x01

2.5.1 View

2.5.1.1 Command (0x7A)

Send command to mRFRM with command ID in byte 1.

Byte 1	Message ID (0x7A)
Byte 2	
Byte 3	
Byte 4	
Byte 5	
Byte 6	
Byte 7	
Byte 8	

2.5.1.2 Response (0x7B)

mRFRM responds with information shown in the table below.

Byte 1	Message ID (0x7B)
Byte 2	Startup Delay (LSB)
Byte 3	Startup Delay (MSB)
Byte 4	PGN Base *(reserved for factory use)*
Byte 5	PGN Broadcast Rate (LSB)
Byte 6	PGN Broadcast Rate (MSB)
Byte 7	0xFF
Byte 8	0xFF

2.5.2 Change

Message ID 0x7C is used to change following parameters:

- Startup Delay
- PGN Broadcast Rate

2.5.2.1 Command (0x7C)

Send command to mRFRM with command ID in byte 1.

Byte 1	Message ID (0x7C)
Byte 2	Startup Delay (LSB)
Byte 3	Startup Delay (MSB)
Byte 4	**0xFF**
Byte 5	PGN Broadcast Rate (LSB)
Byte 6	PGN Broadcast Rate (MSB)
Byte 7	
Byte 8	

2.5.2.2 Response (0x01)

Please refer to the table in section, Response (0x01).

2.6 Device Error Reporting

The fuse and relay configuration of the mRFRM is fixed, but some components might not be powered at times in the vehicle. If a component is installed but not powered, the mRFRM will generate an error in the corresponding Output Status message, indicating the component is not powered.

To avoid errors from an unpowered component, you must send the mRFRM a message telling it to disable 'not powered' errors for the component. This is done with message ID 0x7F.

Message Title	View / Change	Command ID	Response ID
Device Error Reporting Flags	View	0x7D	0x7E
	Change	0x7F	0x01

2.6.1 View

2.6.1.1 Command (0x7D)

Send command to mRFRM with command ID in byte 1.

Byte 1	Message ID (0x7D)
Byte 2	0x00: Fuses 0x01: Relays
Byte 3	
Byte 4	
Byte 5	
Byte 6	
Byte 7	
Byte 8	

2.6.1.2 Response (0x7E)

mRFRM responds with information shown in the table below. The number in the 2nd byte is used to indicate either fuses or relays.

Note: 0 = 'not power' error reporting is enabled
1 = 'not powered' error reporting disabled

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Message ID (0x75)							
Byte 2	0x00: Fuses							
Byte 3	Fuse 8	Fuse 7	Fuse 6	Fuse 5	Fuse 4	Fuse 3	Fuse 2	Fuse 1
Byte 4	Fuse 16	Fuse 15	Fuse 14	Fuse 13	Fuse 12	Fuse 11	Fuse 10	Fuse 9
Byte 5	Fuse 24	Fuse 23	Fuse 22	Fuse 21	Fuse 20	Fuse 19	Fuse 18	Fuse 17
Byte 6	0x0				Fuse 28	Fuse 27	Fuse 26	Fuse 25
Byte 7	0x00							
Byte 8	0x00							

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Message ID (0x75)							
Byte 2	0x01 : Relays							
Byte 3	Relay 8	Relay 7	Relay 6	Relay 5	Relay 4	Relay 3	Relay 2	Relay 1
Byte 4	0	0	Relay 14	Relay 13	Relay 12	Relay 11	Relay 10	Relay 9
Byte 5	0x00							
Byte 6	0x00							
Byte 7	0x00							
Byte 8	0x00							

2.6.2 Change

Message ID 0x7F is used to change the device error reporting flags. The number in the 2nd byte is used to select either fuses or relays.

2.6.2.1 Command (0x7F)

Send command to mRFRM with command ID in byte 1.

Note:
0 = Enable 'not power' error reporting
1 = Disable 'not powered' error reporting

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Message ID (0x7F)							
Byte 2	0x00: Fuses							
Byte 3	Fuse 8	Fuse 7	Fuse 6	Fuse 5	Fuse 4	Fuse 3	Fuse 2	Fuse 1
Byte 4	Fuse 16	Fuse 15	Fuse 14	Fuse 13	Fuse 12	Fuse 11	Fuse 10	Fuse 9
Byte 5	Fuse 24	Fuse 23	Fuse 22	Fuse 21	Fuse 20	Fuse 19	Fuse 18	Fuse 17
Byte 6					Fuse 28	Fuse 27	Fuse 26	Fuse 25
Byte 7								
Byte 8								

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Message ID (0x7F)							
Byte 2	0x01 : Relays							
Byte 3	Relay 8	Relay 7	Relay 6	Relay 5	Relay 4	Relay 3	Relay 2	Relay 1
Byte 4			Relay 14	Relay 13	Relay 12	Relay 11	Relay 10	Relay 9
Byte 5								
Byte 6								
Byte 7								
Byte 8								

2.6.2.2 Response (0x01)

Please refer to the table in section, Response (0x01).

3 Control & Status Messages

Control and status messages provide information regarding the current status of fuses and relays. The user is also provided with the option to turn relays on or off.

3.1 Switched Power Outputs Command

Each relay can be individually turned on or off using this command.

Switched Power Outputs Status	
Transmission Repetition Rate	As required, in response to command messages
Data Length	8 bytes
Data Page	0
PDU Format	134
PDU Specific	0
Default Priority	6
Parameter Group Number	34304 (008600_{16})

Note: If a shorted relay coil is detected when a relay is switched “on”, the mRFRM turns that relay coil driver “off” to protect the circuit and reports the “fault” error. The relay will remain “off” until the mRFRM receives a command to turn it “off” and then back “on”.

The individual 2-bit field definitions are mapped into mRFRM relays as shown below:

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Relay	1	Relay	2	Relay	3	Relay	4
Byte 2	Relay	5	Relay	6	Relay	7	Relay	8
Byte 3	Relay	9	Relay	10	Relay	11	Relay	12
Byte 4	Relay	13	Relay	14				
Byte 5								
Byte 6								
Byte 7								
Byte 8								

Each relay state value will have one of the following bit settings:

Bit Value	Hex Value	Action
0 0	0	Turn relay off
0 1	1	Turn relay on
1 0	2	Reserved
1 1	3	Do not change relay state

3.2 Switched Power Outputs Status

The mRFRM uses this message to report Switched Power Output Status. The status message is sent once every 1000 ms, or every time the state of a relay changes (but no faster than once every 25 ms). The message rate may be changed by using Message ID 7C.

Switched Power Outputs Status	
Transmission Repetition Rate	default 1000ms and on change of any fused power output status but no faster than once every 25ms
Data Length	8 bytes
Data Page	0
PDU Format	252
PDU Specific	180
Default Priority	6
Parameter Group Number	64692 ($00FCB4_{16}$)

The individual 2-bit field definitions are mapped into mRFRM relays as shown below:

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Relay	1	Relay	2	Relay	3	Relay	4
Byte 2	Relay	5	Relay	6	Relay	7	Relay	8
Byte 3	Relay	9	Relay	10	Relay	11	Relay	12
Byte 4	Relay	13	Relay	14	0xF			
Byte 5	0xFF							
Byte 6	0xFF							
Byte 7	0xFF							
Byte 8	0xFF							

Each relay state value will have one of the following bit settings:

Bit Value	Hex Value	Action
0 0	0	Relay off
0 1	1	Relay on
1 0	2	Reserved
1 1	3	Not installed

3.3 Fused Power Outputs Status

The mRFRM uses this message to report Fused Power Output Status. The status message is sent once every 1000 ms, or every time the state of a relay changes (but no faster than once every 25 ms). The message rate may be changed by using Message ID 7C.

Fused Power Outputs Status	
Transmission Repetition Rate	default 1000ms and on change of any fused power output status but no faster than once every 25ms
Data Length	8 bytes
Data Page	0
PDU Format	252
PDU Specific	181
Default Priority	6
Parameter Group Number	64693 ($00FCB5_{16}$)

The individual 2-bit field definitions are mapped into mRFRM relays as shown below:

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 1	Fuse	1	Fuse	2	Fuse	3	Fuse	4
Byte 2	Fuse	5	Fuse	6	Fuse	7	Fuse	8
Byte 3	Fuse	9	Fuse	10	Fuse	11	Fuse	12
Byte 4	Fuse	13	Fuse	14	Fuse	15	Fuse	16
Byte 5	Fuse	17	Fuse	18	Fuse	19	Fuse	20
Byte 6	Fuse	21	Fuse	22	Fuse	23	Fuse	24
Byte 7	Fuse	25	Fuse	26	Fuse	27	Fuse	28
Byte 8	0xFF							

Each relay state value will have one of the following bit settings:

Bit Value	Hex Value	Action
0 0	0	Fuse not powered
0 1	1	Fuse Powered
1 0	2	Fault
1 1	3	Not installed

4 Miscellaneous J1939 Messages

4.1 Request for PGN

Request for PGN message is used to receive specific information through other PGNs. For example, a request for PGN message may be sent to receive information such as:

- Software Identification
- Component Identification

This request can be broadcast to all nodes or a specific node. If broadcast to a specific node, it must respond with the PGN requested or with a negative acknowledgement if it is not supported.

Request for PGN	
Transmission Repetition Rate	As needed
Data Length	3 bytes
Data Page	0
PDU Format	234
PDU Specific	Destination address or 255 (global broadcast)
Default Priority	6
Parameter Group Number	59904 ($00EA00_{16}$)

Example: A message 18EAB055 is broadcast to node B0 by node 55.

Following table shows the format of the data bytes for Request for PGN:

Byte	Size (Bits)	Description
1	8	LSB of the requested PGN
2	8	…
3	8	MSB of the requested PGN

4.1.1 Software Identification

Software Identification is a response that is provided when a request for PGN is sent.

Software Identification	
Transmission Repetition Rate	As needed
Data Length	8 bytes
Data Page	0
PDU Format	254
PDU Specific	218
Default Priority	6
Parameter Group Number	65242 ($00FEDA_{16}$)

The software identification information is provided with the format listed in the following table.

Bit Position	Field Name	ASCII Value	Hex Value
1.0	Product ID (MSB)	'4'	0x34
2.0	Product ID	'4'	0x34
3.0	Product ID (LSB)	'7'	0x37
4.0	SW Version Major (MSB)	'Z'	Year
5.0	SW Version Major (MSB)	'm'	Month
6.0	SW Version Minor (MSB)	'm'	Month
7.0	SW Version Minor (MSB)	'd'	Day
8.0	BAM Delimiter	"d"	Day

Where,

Y = 2015
Z = 2016
A = 2017
B = 2018
C = 2019
D = 2020

4.1.2 Component Identification

Component Identification is a response that is provided when a request for PGN is sent.

Component Identification	
Transmission Repetition Rate	As needed
Data Length	27 bytes
Data Page	0
PDU Format	254
PDU Specific	235
Default Priority	6
Parameter Group Number	65259 ($00FEEB_{16}$)

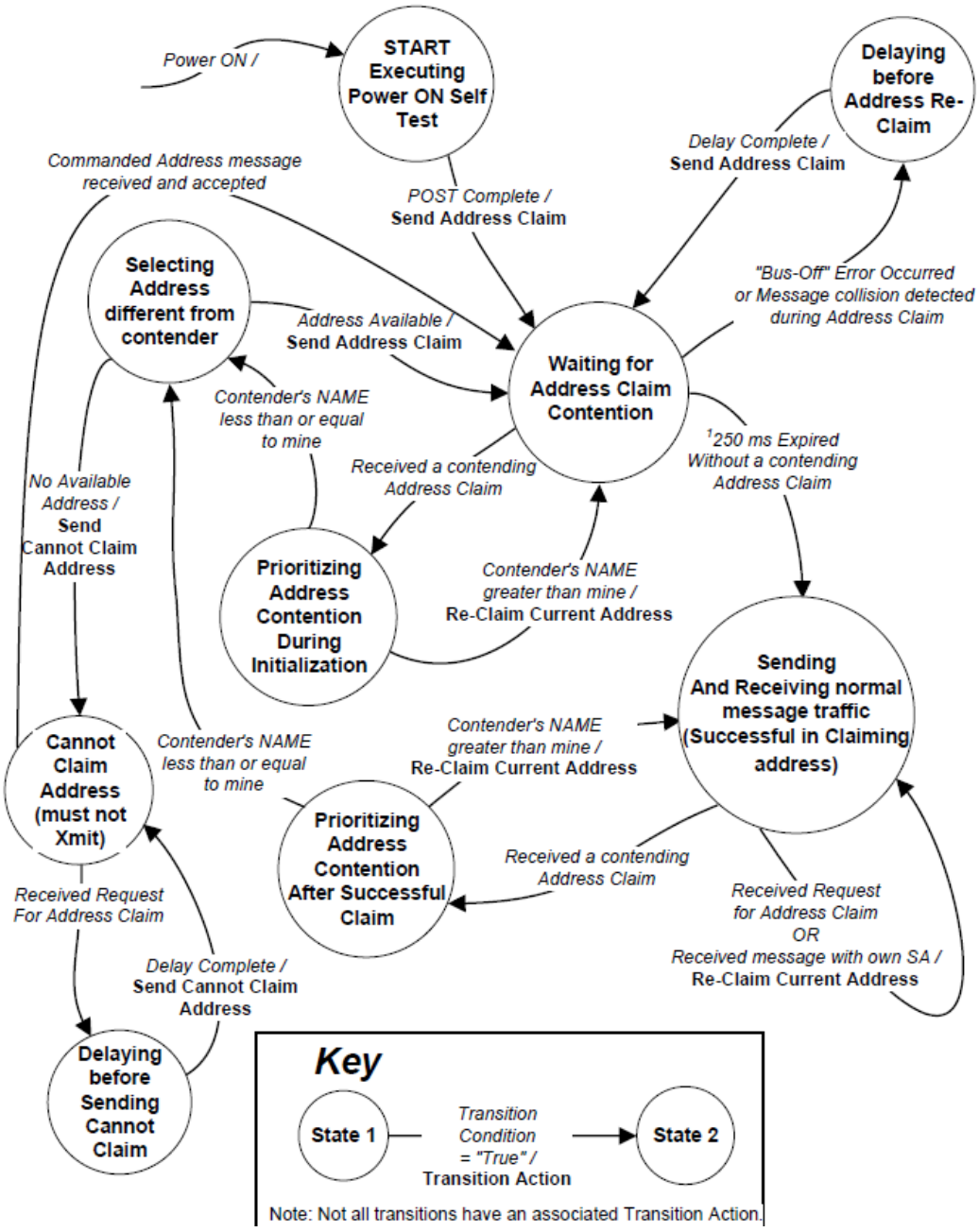
This response provides component identification information with the format listed in the following table. The component identification information is sent out using CAN Transport Protocol, which is explained in detail later in this document.

Bit Position	Field Name	Field Description	ASCII Value	Hex Value
1.0	Make (MSB)		'0'	0x34
2.0	Make		'7'	0x34
3.0	Make		'1'	0x37
4.0	Make (LSB)		'6'	0x30
5.0	BAM Delimiter		'*"	0x2A
6.0	Model (MSB)		'1'	0x31
7.0	Model		'5'	0x35
8.0	Model		'4'	0x34
9.0	Model		'M'	0x4D
10.0	Model	Base Mounting Threads[1]	X	
11.0	Model		'–'	0x2D
12.0	Model	Population[2]	X	
13.0	Model	Population	X	
14.0	Model	Population	X	
15.0	Model		'–'	0x2D
16.0	Model	Specific Version	X	
17.0	Model (LSB)	Private Label ID	X	
18.0	BAM Delimiter		'*"	0x2A
19.0	Serial Number (MSB)		X	
20.0	Serial Number		'–'	0x2D
21.0	Serial Number		X	
22.0	Serial Number		X	
23.0	Serial Number		X	
24.0	Serial Number		X	
25.0	Serial Number		X	
26.0	Serial Number (LSB)		X	
27.0	BAM Delimiter		'*"	0x2A

Where, 'X' is a variable character and may change from unit to unit.

[1] A single (1) character field, where 1: #10-32 and 2: M5 X 0.8
[2] A three (3) character field, where 100 : Unpopulated, 101: Fully populated.

5 Address Claiming Messages



5.1 Address Claimed

The mRFRM will start CAN (J1939) activity by issuing an Address Claim message for the configured Source Address. The mRFRM will then wait 250ms for any contending Address Claim messages. If no contending claims are made, the mRFRM will start normal operation.

If any contending Address Claims are made from a node with a higher priority, the mRFRM will issue a Cannot Claim message and remain offline.

If contending claims are made with a lower priority, the mRFRM will reissue the Address Claim message and start normal operation.

Address Claimed	
Transmission Repetition Rate	As needed
Data Length	8 bytes
Data Page	0
PDU Format	238
PDU Specific	255 (Global Address)
Default Priority	6
Parameter Group Number	60928 ($00EE00_{16}$)

The Address claim message will have the NAME identifier set as shown below:

Field	Value
Arbitrary Address Capable	0
Industry Group	0
Vehicle System Instance	0
Vehicle System	0
Function	67 (Electrical System Controller)
Function Instance	Set to the value of ADDR_0-2 at startup (Cable Select)
ECU Instance	0
Manufacturer Code	453
Identity Number	21 bits – derived from the microprocessor's "Unique Device ID" register

5.2 Request for Address Claimed

This is the 'Request for PGN[3]' specifically for source address claimed. The mRFRM unit may receive this command and respond with Address Claimed or Cannot Claim Address message.

Following table shows the format of the data bytes:

Byte	Value
1	0x00
2	0xEE
3	0x00

[3] See section 4.1 for details on 'Request for PGN message

5.3 Cannot Claim Source Address

If mRFRM cannot successfully claim an address, it will respond with Cannot Claim Source Address message.

Cannot Claim Source Address	
Transmission Repetition Rate	As needed
Data Length	8 bytes
Data Page	0
PDU Format	238
PDU Specific	255 (Global Address)
Default Priority	6
Parameter Group Number	60928 ($00EE00_{16}$)

5.4 Commanded Address Claim

The mRFRM accepts changes to the J1939 Source Address via the J1939 Commanded Address mechanism. The new address is used immediately via the Address Claim mechanism.

Commanded Address Claim	
Transmission Repetition Rate	As needed
Data Length	9 bytes
Data Page	0
PDU Format	254
PDU Specific	216
Default Priority	6
Parameter Group Number	65240 ($00FED8_{16}$)

6 Diagnostic Messages

6.1 DM1

DM1 message is used to broadcast any error conditions. The SPN and FMI will be set to the highest priority active fault, as shown below, using SPN Conversion Method Version 4. Only one SPN will be sent in a DM1 message.

DM1	
Transmission Repetition Rate	As needed
Data Length	6 bytes
Data Page	0
PDU Format	254
PDU Specific	202
Default Priority	6
Parameter Group Number	65226 ($00FECA_{16}$)

	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1
Byte 1	Malfunction Indicator Lamp Status		Red Stop Lamp Status		Amber Warning Lamp Status		Protect Lamp Status	
Byte 2	Reserved							
Byte 3	SPN (LSB)							
Byte 4	SPN							
Byte 5	SPN (MS 3-bits)				Failure Mode Indication			
Byte 6	Conversion Method	Occurrence Count						

Fault	SPN	FMI	Description	Priority
CAN Message Timeout	639	9	The mRFRM failed to receive the number of CAN messages as per the timeout configuration.	Lowest
Corrupt Configuration	630	12	The mRFRM configuration is corrupt and cannot be recovered.	
Both IGNITION_LO and _HI asserted	158	2	The IGNITION_LO and IGNITION_HI signals are both asserted, which puts the mRFRM into a recovery mode running the original factory application image.	
Cable Select Changed	2839	2	The cable select inputs to the mRFRM (ADDR_0-ADDR_2) changed at run-time.	Highest

6.2 DM13

The mRFRM will stop broadcasting regular J1939 messages upon receipt of a DM13 Stop Broadcast request for "Current Data Link" or "J1939 Network #1", will stay quiet as long as DM13 Hold messages for "All Devices" or "Devices whose broadcast state has been modified" are received, and will restart regular broadcasts upon receipt of a DM13 Start Broadcast request for "Current Data Link" or "J1939 Network #1" or after six seconds from the last DM13 Hold request.

DM13	
Transmission Repetition Rate	As needed
Data Length	8 bytes
Data Page	0
PDU Format	223
PDU Specific	DA (Destination Address) or Global Address
Default Priority	6
Parameter Group Number	57088 ($00DF00_{16}$)

7 Transport Protocol

Transport Protocol is used when a message requires more than 8 bytes of data. This type of messaging is commonly referred to as “multi-packet message” and has a range of 9 to 1785 data bytes.

A multi-packet response consist of two types of messages:

a. Transport Protocol – Connection Management (TP.CM)
b. Transport Protocol – Data Transfer (TP.DT)

Transport Protocol – Connection Management

The first message in Transport Protocol is Broadcast Announce Message (BAM) which is part of the Connection Management function.

Transport Protocol – Connection Management	
Transmission Repetition Rate	As needed
Data Length	8 bytes
Data Page	0
PDU Format	236
PDU Specific	255 (Global Address)
Default Priority	7
Parameter Group Number	60416 ($00EC00_{16}$)

Data Format for Transport Protocol – Connection Management	
Byte 1	Control byte: 32
Byte 2	Message size (low byte)
Byte 3	Message size (high byte)
Byte 4	Total number of data packets
Byte 5	Reserved: 255
Byte 6	Parameter Group Number (low byte)
Byte 7	Parameter Group Number (mid byte)
Byte 8	Parameter Group Number (high byte)

Transport Protocol – Data Transfer
Each data packet after BAM is in the format as shown below:

Transport Protocol – Connection Management	
Transmission Repetition Rate	As needed
Data Length	8 bytes
Data Page	0
PDU Format	235
PDU Specific	255 (Global Address)
Default Priority	7
Parameter Group Number	60160 ($00EB00_{16}$)

Data Format for Transport Protocol – Connection Management	
Byte 1	Sequence Number (1 – 255)
Byte 2	Data
Byte 3	Data
Byte 4	Data
Byte 5	Data
Byte 6	Data
Byte 7	Data
Byte 8	Data

All unused data bytes in the last packet shall be set to 255.