MV5-AR

Compact, Ruggedized Attitude Reference and IMU

LORD SENSING
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1.   Sensor Overview

The LORD Sensing MV5-AR brings a new level of precision to measurements of dynamic inclination, acceleration, and angular rate in challenging environments such as those encountered in heavy-duty construction, off-highway, agriculture, and trucking industries.

The MV5-AR utilizes the power of a sophisticated Auto-Adaptive Extended Kalman Filter (EKF) to remove errors associated with vibration, sudden linear motions, and quake, resulting in a true reading of inclination under all conditions. The wide bandwidth, high-range, low noise 20g accelerometer and 1000dps gyroscope allow accurate IMU measurements of the most extreme events, making it ideal for monitoring shock and vibration fatigue.

LORD Sensing's state-of-the-art temperature compensation and calibration assures error-free performance over the full operational temperature range.

The compact size, wide 4.5 to 36 V power range, IP68 / IP69K rating, and CAN J1939 or CANopen communications interface options make the MV5-AR a single part solution for a full range of vehicle sizes and applications.

2.   Basic Setup and Operation

2.1   Installation

The sensor has three mounting holes and three socket head cap screws for fastening; M8 or equivalent. The sensor can be mounted in any orientation, as required for the application. The axes are labeled on the face of the sensor for reference, and the sensor measurement origin is shown in the sensor dimensional drawing (see Dimensions on page 11). When mounting requires the device to be rotated with respect to the vehicle or implement reference frame, the slope outputs may be adjusted into optimum measurement range using the device configuration commands in section 7.
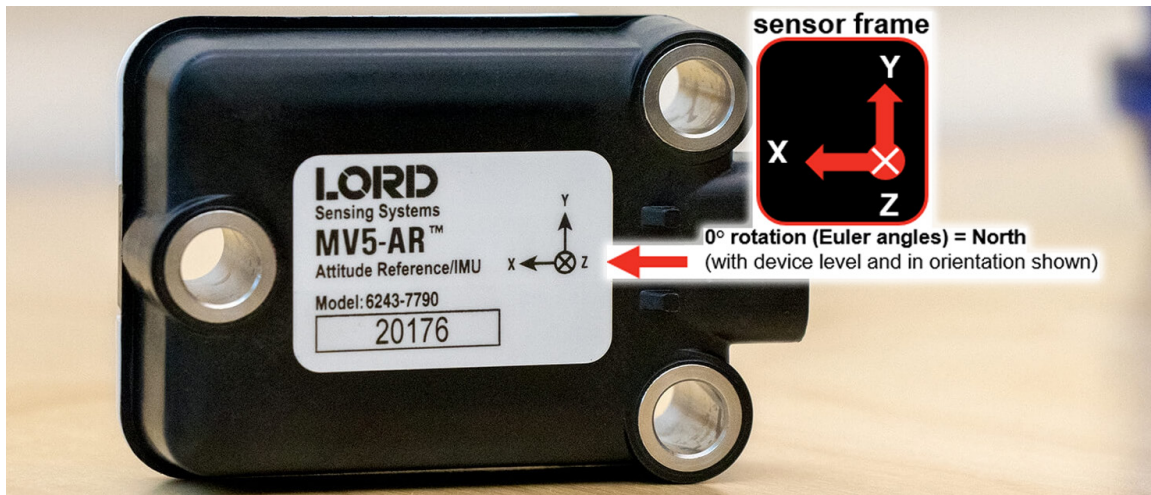
- Mating connector: AMPSEAL 16 Series gold plated 4 pin
- Mounting direction: +Z

2.2   Sensor Calibration

All internal sensors in the MV5-AR are calibrated when the device is manufactured, and the calibration values are saved in the device memory. Recalibration is not required unless the device has been under conditions that exceed the operating specifications. For example, if the sensor has been exposed to excessive shock beyond the rated g-force, performance may be compromised. Indications of internal sensor damage may be observed as excessive measurement offsets or drift when the sensor is in a neutral motionless position.

2.3   Temperature Calibration

All sensor conversion and calibration formulas include temperature compensation. All computed outputs and IMU sensor outputs are automatically adjusted for local temperature.

2.4 Cabling and Termination
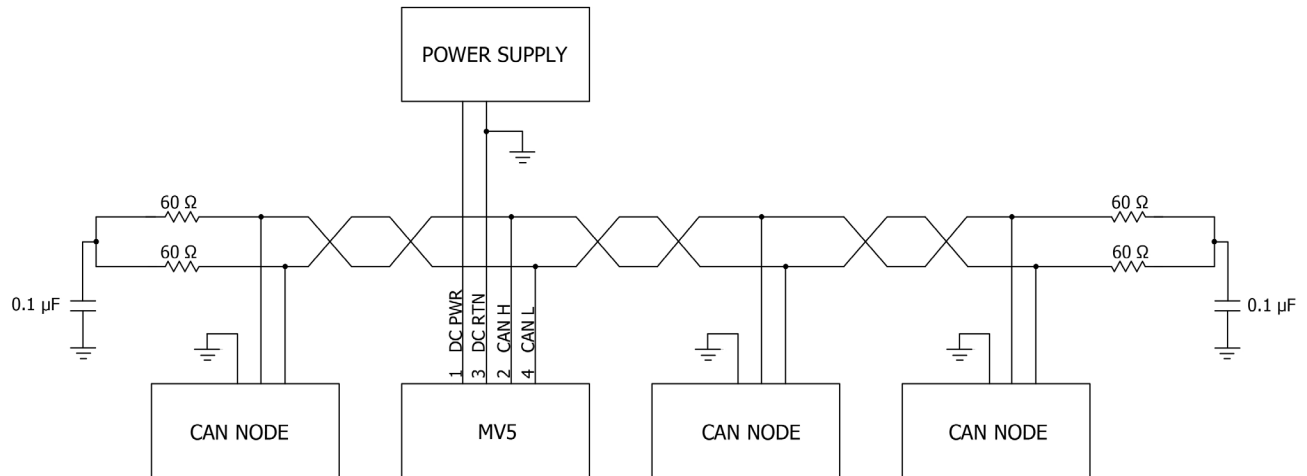
LORD recommends split termination on both ends of the cable for optimum EMC performance.

Recommended mating connector shell: TE Connectivity 776487-1 or equivalent

Figure 1. MV5-AR Cabling and Termination

3. Technical Data

3.1 IMU Accelerometer Specifications (3 Axis)

Characteristic	Min.	Typ.	Max.	Unit
Measurement range	-20		+20	g
Accel output range (PGN 61485)	-200		+200	m/s²
Non-linearity		±0.04		% fs
Resolution		0.05		mg
Bias instability		±0.08		mg
Initial bias error		±0.004		g
Scale factor stability		±0.05		%
Noise density		85		µg/√Hz
Alignment error		±0.05		%
Bandwidth	1	40	225	Hz
Offset error over temperature		0.2		%
Gain error over temperature		0.05		%
Scale factor non-linearity (@ 25°C)		0.04	0.2	%
IMU data output rate	1	100	500	Hz

3.2 IMU Gyroscope Specifications (3 Axis)

Characteristic	Min.	Typ.	Max.	Unit
Measurement range	-1000		+1000	°/sec
Gyro output range (PGN 61482)	-250		+250	
Non-linearity		±0.06		% fs
Resolution		<0.003		°/sec
Bias instability		8		°/hr
Initial bias error		±0.1		°/sec
Scale factor stability		±0.05		%
Noise density		0.0075		°/sec√Hz
Alignment error		±0.05		%
Bandwidth	1	40	500	Hz
Offset error over temperature		0.1		%
Gain error over temperature		0.1	0.4	%
Scale factor non-linearity (@ 25°C)		0.04	0.15	%
IMU data output rate	1	100	500	Hz

3.3 Inclinometer Specifications (2 Axis)

Characteristic	Min.	Typ.	Max.	Unit
Slope Output range	-85	-	+85	deg
Measurement range (3 axis)	-180	-	+180	deg
Attitude resolution		0.05		deg
Static Inclination Error (-40°C to 85°C)		±0.2		deg
Translational acceleration error		±0.44		deg
Settling time		5	200	mSec
Attitude repeatability		0.2		deg
Data output rate	1	100	500	Hz

3.4 System Interface

Characteristic	Parameter
Communication	CAN 250 kb/s
Protocols	J1939 (Standard) CAN-open (Optional)
Connector	AMPSEAL 16 recpetacle, 4 Position, gold plated pins
CANH/CANL Operating Common-Mode Range	-7V to +12V
CANH/CANL Absolute Maximum Rating	±36V
Short Circuit Protection	All pins, automatic restart
Start-up time: IMU	1 second
Start-up time: Slope (EKF)	5 seconds

3.5 Power Supply

Characteristic	Min.	Nominal	Max.
Operating Supply Voltage Range	4.5V	5V (regulated), or 12V or 24V (vehicle power)	36V
Power consumption (all voltages)		625mW	
Reverse Voltage Limits	**-60V absolute max steady-state** -15mA max clamped steady-state current if exceeding -60V -15.5A max clamped brief surge current if exceeding -60V		
Overvoltage Limits	**+40V absolute max steady-state** +50mA max clamped steady-state current if exceeding +40V +114A max clamped brief surge current if exceeding +40V		

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3.6 Environmental

Characteristic	Parameter
Operating temperature	-40°C to +85°C
Storage temperature	-40°C to +125°C
Vibration (Random)	MIL-STD-202G, Test E, 24 hrs/axis
Vibration (Sweep)	J1455 Appendix A 10-2000Hz, 10 g Peak, 10hr/octave/axis
Ingress protection	IP68 (Immersion), IP69K (Pressure Wash)
Thermal shock	100X @ J1455
Salt spray	MIL-STD-202G, Method 101E Condition A (96 hours)
Hot dunk	5X, 30 mins @ 85C, 30 mins @ ice bath, operating
UV rating	1m on to concrete surface 3x, J1455
Mechanical shock (Drop)	50g, 11ms 1/2sine, 3X direction, 18 total, MIL STD 202, M213
Mechanical shock (Operating)	50g, 11ms 1/2sine, 3X direction, 18 total, MIL STD 202, M213

3.7 EMC & Electrical Compliance Standards

Characteristic	Standard	Test Levels
Radiated Immunity: ALSE	ISO 11452-5:2004	200 V/m 200 MHz to 3.2 GHz
Radiated Immunity: Bulk Current Injection	ISO 11452-5:2002	200mA 1 to 400 MHz
Radiated Immunity: Strip line	ISO 11452-5:2002	200mA 10 kHz to 400 MHz
Radiated emissions	CISPR 25 ED. 4.0: 2016	150 kHz to 2.5 GHz, Class 3 and 5
Conducted emissions	CISPR 25 ED. 4.0: 2016	150 kHz to 88 MHz, Class 5
Mutual coupling	ISO 7637-2: 2011 Section 5.6.3	Pulses 3a and 3b
ESD direct contact discharge	ISO 10605	8kV
ESD air discharge	ISO 10605	15KV
Superimposed AC Voltage	ISO 16750-2: 2010, Section 4.4	12V, 4Vp-p 24V, 10V p-p
Starting Profile	ISO 16750-2: 2010	12V, Table3, I-IV 24V, Table 4, I-III
Inducted EM Noise on Signal lines	ISO 7637-3:2016	CCC/ICC/DCC methods

3.8 Physical Specifications

Characteristic	Parameter
Dimensions	L 80 mm x W 55 mm x H 24 mm
Weight	120 grams
Enclosure material	PBT Thermoplastic, Reinforced
Ingress protection	IP68, IP69K
Mounting	3 x M8, installation torque 20 Nm ±2 Nm
Regulatory compliance	RoHS, REACH, CE

3.9 Dimensions
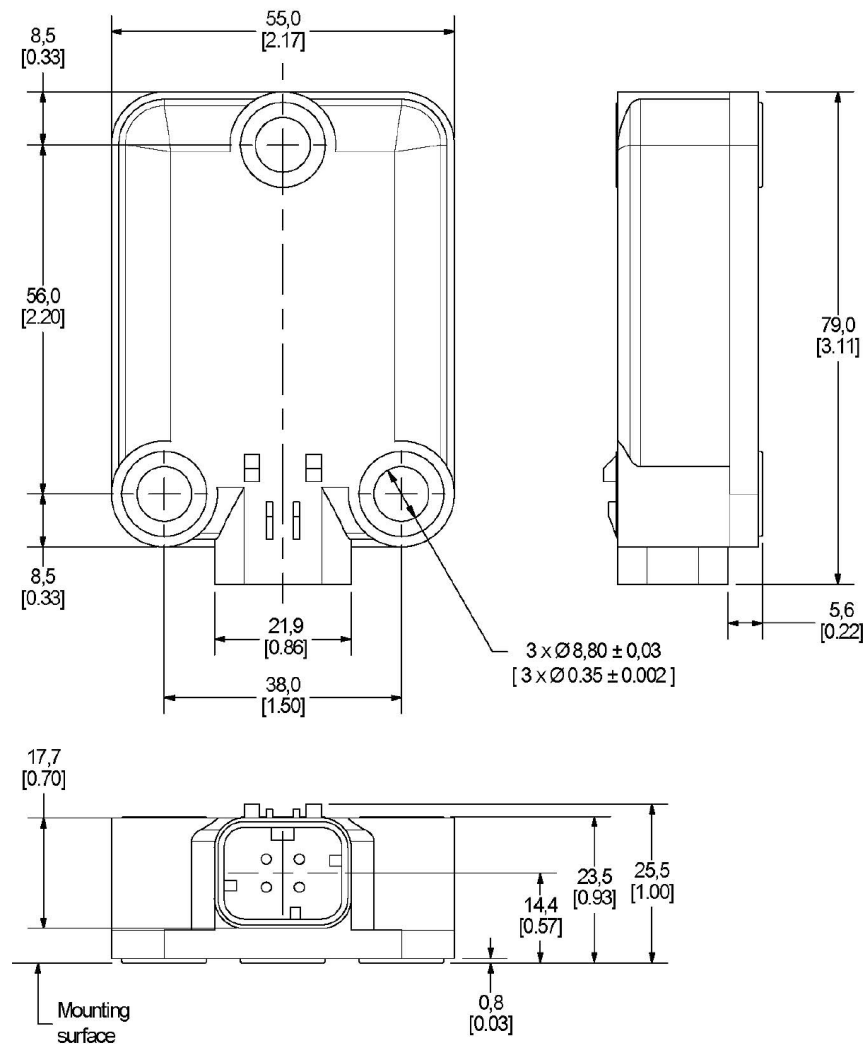
Figure 2. MV5-AR Dimensions

3.10 Mounting & Pinout

MV5 Mounting Hole Dimensions $\frac{mm}{[in]}$
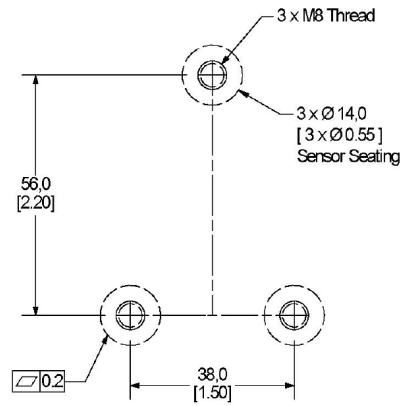
MV5 Pin Output and Configuration

Connector Termination

Pin	Descriptor
1	DC Power
2	CAN High
3	DC Return
4	CAN Low
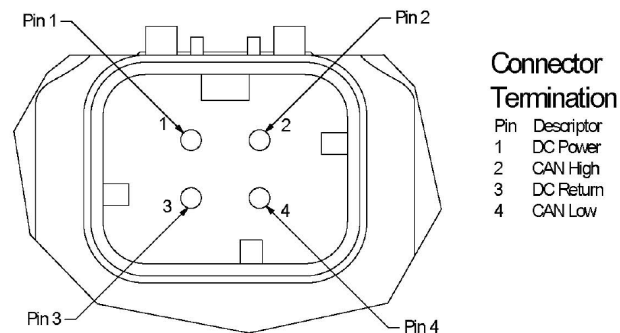
Figure 3. MV5-AR Mounting Dimensions

4. CAN Messages and Communication

4.1 Standard Broadcast Data

These PGNs are standard default data broadcast by device at 100Hz (interval 10 ms). The channels may be disabled individually. The broadcast intervals are programmable individually from 2 to 500 ms. To decode a given field, extract the relevant bits, multiply by the resolution, and add the offset. The ranges given are protocol limitations only and do not necessarily reflect the true sensor ranges, which may exceed the protocol range.

Many of these PGNs contain figures of merit, as specified by the J1939 standard. The values are as follows:

Value	Definition
0	Output is functioning normally.
1	Output quality may be degraded.
2	Error condition.
3	Figure of merit information is not available.

4.2 CAN J1939 Device Information

Data supplied by the MV5-AR is communicated through the CAN J1939 communications interface. To learn more about SAE J1939 communication standards, go to: SAE J1393 Standards.

4.2.1 CAN J1939 Device Information			
29 BIT IDENTIFIER			
Name	**Bits**	**Bit position**	**Description**
Priority	3	29..27	0 through 7, lower is higher priority.
R	1	26	Reserved (default 0)
DP	1	25	Data Page (default 0)
PDU Format	8	24..17	PDU1 format if < 0xF0 (240). Otherwise PDU2 format.
PDU Specific	8	16..9	Used for PDU2 format PGNs. Destination is always broadcast (0xFF).
Source	8	8..1	Source address of MV5

8 BYTE DATA FIELD			
Name	**Bits**	**Bit position**	**Description**
BYTE 8	8	8..1	Data (PDU specific)
BYTE 7	8	8..1	Data (PDU specific)
BYTE 6	8	8..1	Data (PDU specific)
BYTE 5	8	8..1	Data (PDU specific)
BYTE 4	8	8..1	Data (PDU specific)
BYTE 3	8	8..1	Data (PDU specific)
BYTE 2	8	8..1	Data (PDU specific)
BYTE 1	8	8..1	Data (PDU specific)

4.2.2 Angular Rate 61482 (PGN 0xF02A)

Description	Transmit Angular Rate Sensor Data (3 axis 360°) Right-handed axis system, Z axis points down. The range and resolution given below is the theoretical range and resolution allowed by the format. See the device specifications for the actual measurement range and resolution. Note that the internal measurement range may exceed the range available from this message format.
Example	Pitch rate = Payload [0..1] * (1/128.0) -250

SPN	**Bit position (Byte.bit)**	**Length**	**Resolution**	**Offset**	**Range**
Pitch Rate	Bytes 1-2	2 Bytes	1/128 °/s/bit	-250 °/s	-250 to 250.992°
Roll Rate	Bytes 3-4	2 Bytes	1/128 °/s/bit	-250 °/s	-250 to 250.992°
Yaw Rate	Bytes 5-6	2 Bytes	1/128 °/s/bit	-250 °/s	-250 to 250.992°
Pitch Rate figure of merit1	7.1-7.2	2 bits	0 = Functional 1 = Degraded 2 = Error 3 = Not available		
Roll Rate figure of merit1	7.3-7.4	2 bits			
Yaw Rate figure of merit1	7.5-7.6	2 bits			
Not Implemented	Byte 8	1 Byte	N/A		

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4.2.3 Acceleration 61485 (PGN 0xF02D)

Description	Transmit Acceleration Sensor Data (2 axis -pitch, roll, status). Right-handed axis system, Z axis points up. The range and resolution given below is the theoretical range and resolution allowed by the format. See the device specifications for the actual measurement range and resolution.				
Example	Pitch rate = Payload [0..1] * (1/100) -320				
SPN	Bit position (Byte.bit)	Length	Resolution	Offset	Range
Lateral Accel. (Y)	Bytes 1-2	2 Bytes	0.01 m/s2/bit	-320 m/s2	-320 to +322.55 m/s^2
Longitudinal Accel. (X)	Bytes 3-4	2 Bytes	0.01 m/s2/bit	-320 m/s2	-320 to +322.55 m/s^2
Vertical Accel. (Z)	Bytes 5-6	2 Bytes	0.01 m/s2/bit	-320 m/s2	-320 to +322.55 m/s^2
Lateral Accel. figure of merit1	7.1-7.2	2 bits	0 = Functional 1 = Degraded 2 = Error 3 = Not available		
Longitudinal Accel. figure of merit1	7.3-7.4	2 bits			
Vertical Accel. figure of merit1	7.5-7.6	2 bits			
Not Implemented	7.7-7.8	10 bits	N/A		

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4.2.4 Slope Sensor 61481 (0xF029)

Description	Transmit Extended Slope Sensor Data (3 axis 60°) Right-handed axis system, Z axis points down. The range and resolution given below is the theoretical range and resolution allowed by the format. See the device specifications for the actual measurement range and resolution.
Example	

SPN	Bit position (Byte.bit)	Length	Resolution	Offset	Range
Pitch Angle	Bytes 1-3	3 Bytes	1/32768 °/bit	-250°	-250 to 250.992°
Roll Angle	Bytes 4-6	3 Bytes	1/32768 °/bit	-250°	-250 to 250.992°
Pitch Compensated2	Bytes 7.1-7.2	2 bits	0=Uncompensated 1=Compensated		
Pitch Angle figure of merit1	7.3-7.4	2 bits	0 = Functional 1 = Degraded 2 = Error 3 = Not available		
Roll Compensated2	7.5 -7.6	2 bits	0=Uncompensated 1=Compensated		
Roll Angle figure of merit1	7.7 -7.8	2 bits	0 = Functional 1 = Degraded 2 = Error 3 = Not available		
Not Implemented	Byte 8	1 Byte	N/A		

4.3   Standard Commands

The PGNs in this section are standard commands that may be issued to the device as defined in the SAE J1939 standard documents.

Note: Examples assume a source ID of 0x99 and a target ID of 0xFC.

4.3.1 Request Information 59904 (PGN 0xEA00)

Description	Request the specified PGN be transmitted by the device. The PGN's that may be requested with this PGN are: **39680**, **65234**, **65242**, **64965**, **60928**, **65259**, **45312**, **45568**, **45824**, **46592**, **49152**. All others will be Nacked with a **59392** message.
Example	0x18 EA FC 99 00 B6 00 (requests packet 0xB600 (PGN 46592))

SPN	Bit position (Byte.bit)	Length	Resolution	Offset	Range
PGN Requested	1	3 Bytes	N/A	N/A	N/A

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4.3.2 ACKM 59392 (PGN 0xE800)

Description	Sent by device in response to PGN 59904 Request and the settings PGNs in Section 7. Ack type will be NACK if requested PGN is not recognized or unable to send, or ACK if successful.		
Example	0x00 FF FF FF 99 00 B6 00 (ACK)		
SPN	Bit position (Byte.bit)	Length	Notes
Ack type	1	1 Byte	0=ACK, 1=NACK, 2=Access Denied, 3=Device Busy
Group Function	2	1 Byte	Unused, always 0xFF
Reserved	3	1 Byte	
Reserved	4	1 Byte	
Destination	5	1 Byte	Destination address
PGN	6	3 Bytes	PGN of command being ACK'd.

4.3.3 Commanded Test 58112 (PGN 0xE300)

Description	Initiates the built-in test (J1939 diagnostic message "DM7"). The response will come in PGN 65232 (J1939 diagnostic message "DM8")		
Example	0x18 E3 FC 99 01 FF FF FF FF FF FF FF (requests packet 0xFED0 (PGN 65232))		
SPN	Bit position (Byte.bit)	Length	Notes
Test ID	1	1 Byte	Test Identifier, must be 1
SPN Low	2	2 Bytes	Unused, set to 0xFF
FMI	4.1	5 Bits	Unused, set to 0x1F
SPN High	4.6	3 Bits	Unused, set to 0x7
Reserved	5	4 Bytes	Unused, set to 0xFFFFFFFF

4.3.4 Commanded Test Result 65232 (PGN 0xFED0)

Description	Returns the test pass/fail status (J1939 diagnostic message "DM8") requested using 58112 (J1939 diagnostic message "DM7").			
Example	0x18 FE D2 FC 01 FF 00 00 00 00 00 00			
SPN	Bit position (Byte.bit)	Length	Range	Notes
Test ID	1	1 Byte	N/A	Always 1
Component ID	2	1 Byte	N/A	Always 0xFF
Test Result	3	2 Bytes	0 - 65535	Pass if this is between min and max values (0 is passing)
Maximum	5	2 Bytes	0- 65535	Always 0
Minimum	7	2 Bytes	0- 65535	Always 0

4.3.5 Supported Tests 65234 (PGN 0xFED2)

Description	Reports 1 test supported (the BIT test) (J1939 diagnostic message "DM10"). This PGN is transmitted by the device upon request (use PGN 0xEA00 to request).		
Example	0x18 FE D2 FC 80 00 00 00 00 00 00 00		
SPN	Bit position (Byte.bit)	Length	Notes
Tests	1	8 Bytes	Bitfield of supported tests. Least-significant bit comes first in each byte. Always 0x0000000000000080 (i.e. test #1 is supported)

4.3.6 Commanded Address 65240 (PGN 0xFED8)

Description	Restart address claim procedure using the specified address. Saved to non-volatile memory. Must be sent using 9-Byte BAM (Broadcast announcement message).		
Example			
SPN	Bit position (Byte.bit)	Length	Notes
Name	1	8 Bytes	J1939 Device NAME
Address	8	1 Byte	New source address. Cannot be 0xFF (broadcast address) or 0xFE (NULL address).

4.3.7 Address Claim 60928 (PGN 0xEE00)

| Description	Transmitted by J1939 ECUs including the MV5 after: • Every power on • A request for Address Claimed command • A re-claim situation when receiving an Address Claimed message with the same Source Address • Programming a new Source Address • Programming a new NAME The PGN is used to compare NAME priority with devices with same address to facilitate address claiming (See Address Claim Logic diagram).	
Example	0x18 EE FF FC 00 00 20 47 00 91 00 20	
SPN	Length	Notes
J1939 NAME	8 Bytes	J1939 NAME value stored on device. Lower valued names have higher priority.

4.3.8 Address Claim Procedure
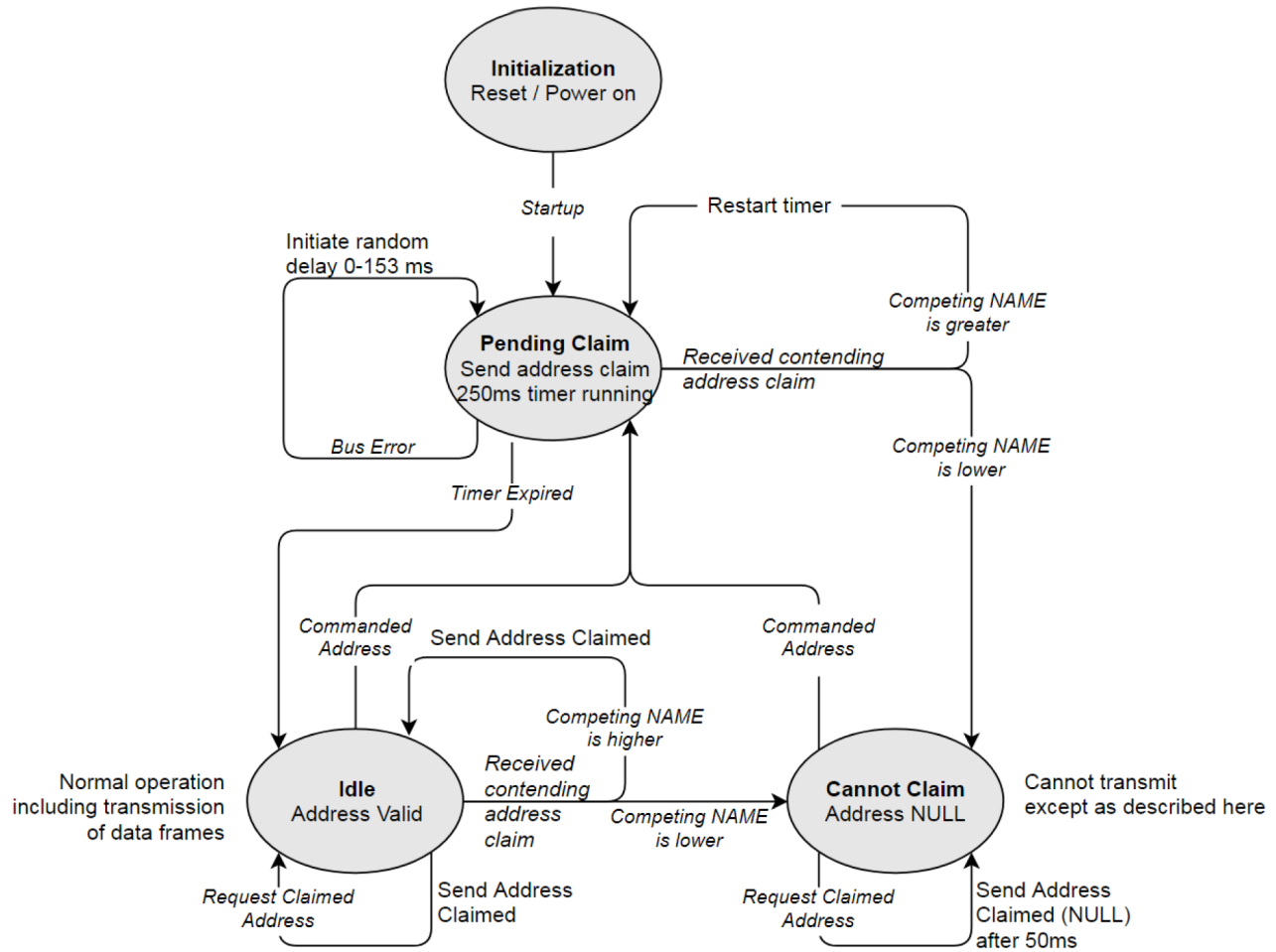
Figure 4. MV5-AR Address Claim Logic

4.3.9 Stop/Start Broadcast 57088 (PGN 0xDF00)				
Description	Suspends or resumes transmission of data.			
Example	0x18 DF FC 99 3F FF FF FF 00 00 FF FF FF (stop indefinitely) 0x18 DF FC 99 7F FF FF FF FF FF FF FF FF (start immediately) 0x18 DF FC 99 3F FF FF FF FF 00 08 FF FF (Stop for 2 seconds) 0x18 DF FC 99 FF FF FF FF 0F 00 10 FF FF (Set stop duration to 4 seconds)			
SPN	Bit position (Byte.bit)	Length	Resolution	Notes
J1939 #1	1.1	2 Bits	0=STOP 1=START 2=Reserved 3=No Change	Interpreted
J1922	1.3	2 Bits		Ignored
J1587	1.5	2 Bits		Ignored
Current Link	1.7	2 Bits		Interpreted
Other	2.1	2 Bits		Ignored
J1850	2.3	2 Bits		Ignored
ISO 9141	2.5	2 Bits		Ignored
J1939 #2	2.7	2 Bits		Ignored
J1939 #4	3.1	2 Bits		Ignored
Proprietary #2	3.3	2 Bits		Ignored
Proprietary #1	3.5	2 Bits		Ignored
J1939 #3	3.7	2 Bits		Ignored
Suspend	4.1	4 Bits	0x0=All 0x1=Some 0x2=All (temporary) 0x3=Some (temporary) 0x4-0xD=Reserved 0xE=Resume 0xF=N/A	Not currently implemented. For future compatibility use 0xF.
Hold	4.5	4 Bits	0x0=Hold All Devices 0x1=Hold Modified Devices 0x2-0xE=Reserved 0xF=N/A	Ignored unless set to 0x0 and the device was already stopped. In this case the suspend duration is updated even if No Change was specified for the current link.
Duration	5	2 Bytes	Duration of effect in ms.	Not currently implemented (always indefinite). Use 0xFFFF for future compatibility.
Reserved	7	2 Bytes	Reserved	Set to 0xFFFF.

4.3.10 Proprietary Messaging Information 39680 (PGN 0x9B00)				
Description	Indicates devices usage of the PropA, PropA2, and PropB messages. Allows ECUs to determine if they know this device lingo or not. Vendor ID 11 bits, Protocol 21 bits = "ue" (LORD internal protocol). This PGN can be requested from the device (use PGN 0xEA00 to request).			
Example	0x18 9B 99 FC 39 02 65 75 00 00 00 00			
SPN	Bit position (Byte.bit)	Length	Value	Notes
Manufacturer	1.1	11 Bits	Always 569 (0x0239)	LORD Sensing ID
Protocol	2.3	21 Bits	Manufacturer-specific protocol ID	Split into version and ID fields below
Protocol.version	2.3	6 Bits	0x00	LORD Internal Protocol v0
Protocol.id	4.1	2 Bytes	0x7565	LORD Internal Protocol

4.4   Device Information

These are standard device information PGNs that are sent from the device to the ECU and may be requested individually from the device by sending the 0xEA00 (59904) command.

4.4.1 Software Identification 65242 (PGN 0xFEDA)	
Description	BAM message containing LORD firmware revision number/s. Data is in the form of a single ASCII string with three fields, each field separated by an ASCII "*". The first byte of the response is the count (3) of fields. This PGN can be requested from the device (use PGN 0xEA00 to request).
Example	0x18 EC FF FC 20 33 00 08 FF DA FE 00 (BAM 8 pkt response header) 0x1C EB FF FC 01 03 36 32 34 33 2D 37 (3 fields, first six chars "6243-7") 0x1C EB FF FC 02 37 39 30 23 31 2E 30 (next seven chars "790#1.0") 0x1C EB FF FC 03 2E 31 34 2A 36 32 35 (next seven chars ".14*625") 0x1C EB FF FC 04 38 2D 37 37 36 30 23 (next seven chars "8-7760#") 0x1C EB FF FC 05 31 2E 31 2E 36 38 2A (next seven chars "1.1.68*") 0x1C EB FF FC 06 36 32 35 39 2D 37 37 (next seven chars "6259-77") 0x1C EB FF FC 07 33 30 23 31 2E 30 2E (next seven chars "30#1.0.") 0x1C EB FF FC 08 35 30 FF FF FF FF FF (last seven chars "50"…..)
Byte 1	Number of string fields to follow.
Value 1	MV5 model number, '#', firmware version
Value 2	VRU model number, '#', firmware version
Value 3	IMU model number, '#', firmware version

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4.4.2 ECU Identification Information 64965 (PGN 0xFDC5)

Description	BAM message containing ECU Identification Information. Data is in the form of a single ASCII string with multiple fields, each field separated by an ASCII "*". String fields contain Part #, Serial #, Location, ECU Type, manufacturer Name, and hardware revision. This is identification is for hardware rather than software and all the fields are predefined. This PGN can be requested from the device (use PGN 0xEA00 to request).
Example	0x18 EC FF FC 20 45 00 0A FF C5 FD 00 (BAM 10 pkt response header) 0x1C EB FF FC 01 36 32 34 33 2D 37 37 (first seven chars "6253-77") 0x1C EB FF FC 02 39 30 2A 36 32 34 33 (next seven chars "90*6243") 0x1C EB FF FC 03 2E 38 33 34 37 32 2A (next seven chars ".83472*") 0x1C EB FF FC 04 2A 33 44 4D 2D 4D 56 (next seven chars "*3DM-MV") 0x1C EB FF FC 05 35 2D 41 52 2A 4C 4F (next seven chars "5-AR*LO") 0x1C EB FF FC 06 52 44 20 53 65 6E 73 (next seven chars "RD Sens") 0x1C EB FF FC 07 69 6E 67 20 4D 69 63 (next seven chars "ing Mic") 0x1C EB FF FC 08 72 6F 53 74 72 61 69 (next seven chars "roStrai") 0x1C EB FF FC 09 6E 2A 32 30 67 2C 31 (next seven chars "n*20g1") 0x1C EB FF FC 0A 30 30 30 64 70 73 FF (last seven chars "000dps".)

J1939 Field Names		
String field 1	Model Number (MV5)	Part #
String field 2	Serial Number (MV5)	Serial #
String field 3	\<empty\>	Network Location
String field 4	Model Name	CU Type
String field 5	"LORD Sensing MicroStrain"	Manufacturer
String field 6	Device Options Field	HW Version

4.4.3 Component Identification 65259 (PGN 0xFEEB)

Description	BAM message containing the model and serial number Information. Data is in the form of a single ASCII string with multiple fields, each field separated by an ASCII "*". This PGN can be requested from the device (use PGN 0xEA00 to request).
Example	0x18 EC FF FC 20 18 00 04 FF EB FE 00 (BAM 4 pkt response header) 0x1C EB FF FC 01 2A 33 44 4D 2D 4D56 (first seven chars "*3DM-MV") 0x1C EB FF FC 02 35 2D 41 52 2A 36 32 (next seven chars "5-AR*62") 0x1C EB FF FC 03 34 33 2E 38 33 34 37 (next seven chars "43.8347") 0x1C EB FF FC 04 32 2A 2A FF FF FF FF (last seven chars "2**"….)

J1939 Field Names	
String field 1	\<empty\>
String field 2	Model Name
String field 3	Serial Number
String field 4	\<empty\>

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4.5   Configuration Commands

These utilize the Proprietarily Configurable Messaging PGNs. They comprise a set of configuration parameters and functional commands not covered by the J1939 spec. We use the Configurability Message PGNs in free form similar to other manufacturers and preferred by customers.

The Set/Get commands are all used in the same manner: The MV5 receives the message and immediately applies the new setting and stores it so that the setting is persistent across power cycles. If the parameter value is 0xFFFF (or maximum value or NaN) the CA will apply the default values instead (factory defaults). The MV5 will return a standard J1939 acknowledgement message for all the settings commands in this section to indicate that the command was received and whether was successful. The settings may be read back using the "Request Information (0xEA00)" command. These commands may be transmitted to the broadcast ID (0xFF), in which case all units which receive the message will be affected. No acknowledgement is returned in this case. Settings cannot be read out using the broadcast ID because they would be indistinguishable from broadcast commands.

Note that applying a setting utilizes non-volatile memory which has a finite durability of 32,000,000 settings changes. Writing a setting value that is the same as the previous value does not use up a setting change cycle. This should be considered when programming the ECU.

4.5.1 Set/Get MV5 J1939 NAME 45312 (PGN 0xB100)				
Description	Sets the various J1939 NAME fields. Arbitrary Address is not supported and must be 0 This PGN can be requested from the device (use PGN 0xEA00 for "get" request).			
Example	0x18 B1 FC 99 01 02 03 04 00 00 00 00 (set)			
SPN	Bit position (Byte.bit)	Range	Notes	Offset
Industry Group	1	0..7	See J1939 standard.	N/A
Vehicle System	2	0..127		N/A
Vehicle System Instance	3	0..15		N/A
Function	4	0..255		N/A
Function Instance	5	0..31		N/A
ECU Instance	6	0..7		N/A
Arbitrary Address Capability	7.1	0	Must be 0	N/A

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4.5.2 Set/Get Data Period (Rate) 45568 (PGN 0xB200)

Description	This command sets the output rate for a given data PGN. The default period is 10 ms. The specified PGN can be disabled by using a transmission period of 0. This PGN can be requested from the device (use PGN 0xEA00 for "get" request).					
Example	0x18 B2 FC 99 29 F0 00 64 00 (set)					
SPN	Bit position (Byte.bit)	Length	Resolution	Offset	Range	Default Range
Data PGN	1	3 Bytes	PGN of transmitted data			
Transmission Period	4	2 Bytes	1 ms	0	2 to 500. Use 0 to disable.	10ms (0xFFFF)

4.5.3 Set/Get Filter Bandwidth 45824 (PGN 0xB300)

Description	Sets the low pass filter bandwidth. This PGN can be requested from the device (use PGN 0xEA00 for "get" request).					
Example	0x18 B3 FC 99 2D F0 00 FA 00 (set)					
SPN	Bit position (Byte.bit)	Length	Resolution	Offset	Range	Default Value
Data PGN	1	3 Bytes	PGN of transmitted data			
Bandwidth	4	2 Bytes	1 Hz	0	1 to 250	40 Hz (0xFFFF)

4.5.4 RESET ATTITUDE 46080 (PGN 0xB400)

Description	Restarts the attitude measurement (May be used in the event of over-ranging). There are no data fields for this PGN.
Example	0x18 B4 FC 99 FF (set)

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4.4.5 Create Sensor to Vehicle Rotation 46336 (PGN 0xB500)

Description	Tares the sensor and treats the current orientation as the reference. The pitch and roll granularity parameters cause the sensor to round absolute orientation to the nearest multiple of the granularity before applying a tare translation. If the sensor is mounted with a +47° absolute pitch and a tare command is issued with a 5° pitch granularity, the sensor applies a -45° rotation transform on the pitch axis, and the resulting angle reported on the pitch axis is 2°. With a granularity of 0°, an exact-angle tare is performed. The yaw direction is treated as an offset value to the current absolute yaw. This allows sensors mounted in different directions to have yaw axes aligned in the vehicle reference frame.
Example	0x18 B5 FC 99 00 00 10 0E (set)

SPN	Bit position (Byte.bit)	Length	Resolution	Offset	Range	Default Values
Roll Granularity	1	1 Bytes	1° per bit	0°	0 to 90°	0°
Pitch Granularity	2	1 Bytes	1° per bit	0°	0 to 90°	0°
Yaw Direction	3	2 Bytes	0.1° per bit	0°	0° to 360°	0°

4.5.6 Set/Get Sensor to Vehicle Rotation 46592 (PGN 0xB600)

Description	The output of the device is rotated so that when the sensor is at the reference position (0° on all axes), the actual output corresponds to the rotation angles stored at this index. This can be used to adjust mounting orientation with respect to the vehicle or component orientation. For example, if the sensor is mounted +90° on the Y axis when the vehicle is actually at 0°, set the Y rotation below to -90°. That results in the sensor outputting 0° when the vehicle is at 0° rather than outputting 90°. To request this PGN from the device use PGN 0xEA00 for "get" request.
Example	0x18 B6 FC 99 10 0E 10 0E 10 0E (set)

SPN	Bit position (Byte.bit)	Length	Resolution	Offset	Range	Default
X Rotation	1	2 Bytes	.1° per bit	-180°	-180° to +180°	0°
Y Rotation	3	2 Bytes	.1° per bit	-180°	-180° to +180°	0°
Z Rotation	5	2 Bytes	.1° per bit	-180°	-180° to +180°	0°

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4.5.7 LOCK/UNLOCK Configuration Mode 49152 (PGN 0xC000)			
Description	Locks B100 to BF00 PGNs. When locked, those messages will be ignored by the device, however, the values of 0xB100, B200, B300, B600, and C000 may still be requested through the request information command (0xEA00).		
Example	0x18 C0 FC 99 50 49 4D 32 4E 41 43 01 (lock) 0x18 C0 FC 99 50 49 4D 32 4E 41 43 00 (unlock)		
SPN	Bit position (Byte.bit)	Length	Notes
Key Code	1	7 Bytes	Must be 0x43414E324D4950
Lock/Unlock	8	1 Bit	1 to lock, 0 to unlock

5. Repair and Support

5.1 Repair and Calibration

General Instructions

In order to return any LORD Sensing product, you must contact LORD Sensing Sales or Technical Support to obtain a Return Merchandise Authorization (RMA) number. All returned merchandise must be in the original packaging, including manuals, accessories, cables, etc. with the RMA number clearly printed on the outside of the package. Removable batteries should be removed and packaged in separate protective wrapping. Please include the LORD Sensing model number and serial number, as well as your name, organization, shipping address, telephone number, and email. Normal turnaround for RMA items is seven days from receipt of item by LORD Sensing.

Warranty Repairs

LORD Sensing warrants its products to be free from defective material and workmanship for a period of one (1) year from the original date of purchase. LORD Sensing will repair or replace, at its discretion, a defective product if returned to LORD Sensing within the warranty period. This warranty does not extend to any LORD Sensing products that have been subject to misuse, alteration, neglect, accident, incorrect wiring, mis-programming, or use in violation of operating instructions furnished by LORD Sensing. It also does not extend to any units altered or repaired for warranty defect by anyone other than LORD Sensing.

Non-Warranty Repairs

All non-warranty repairs/replacements include a minimum charge. If the repair/replacement charge exceeds the minimum, LORD Sensing will contact the customer for approval to proceed beyond the minimum with the repair/replacement.

5.2 Technical Support

There are many resources for product support found on the LORD Sensing website including technical notes, FAQs, and product manuals.

http://www.microstrain.com/support_overview.aspx

For further assistance our technical support engineers are available to help with technical and applications questions.

Technical Support sensing_support@LORD.com

Phone: 802-862-6629

Live Chat is available from the website during business hours: 9:00 AM to 5:00 PM (Eastern Time US & Canada)

5.3   Sales Support

Products can be ordered directly from the LORD Sensing website by navigating to the product page and using the Buy feature.

http://www.microstrain.com/inertial

For further assistance, our sales team is available to help with product selection, ordering options, and questions.

Sales Support sensing_sales@LORD.com

Phone: 802-862-6629

9:00 AM to 5:00 PM (Eastern Time US & Canada)

6.   Safety

⚠️ **WARNING**

PERSONAL INJURY

DO NOT USE these products as safety or emergency stop devices or in any other application where failure of the product could result in personal injury.

Failure to comply with these instructions could result in death or serious injury.

⚠️ **WARNING**

IMPROPER INSTALLATION

Consult with local safety agencies and their requirements when designing a machine-control link, interface, and all control elements that affect safety.

Strictly adhere to all installation instructions.

Failure to comply with these instructions could result in death or serious injury.