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Engine Operation, Emissions and DTC Monitoring using J1939

SmartVue can monitor and log virtually all parameters in the J1939 standard and can also be configured to read manufacturer specific parameters that are not part of the standard. In this example we will monitor common parameters like Engine Speed, Oil Pressure and Coolant Temperature and a couple emissions parameters available in engines that meet the EPA Tier 4 Emissions Standard.

Connecting to the J1939 Data Bus

The SmartVue connects to the J1939 bus as shown in the diagram below. Standard J1939 Deutsch connectors and terminators are readily available for this purpose.



Note: 120 ohm terminating resistors must used on the first and last nodes.

Enabling J1939 Communications

First we will configure the SmartVue to receive J1939 data by selecting "Monitor only" mode with the standard set to "J1939-11". More advanced features for example obtaining the device list (ECU list), PGN Requests, and arbitrary address management require bi-directional communication and can be turned on by selecting "Send & Receive" mode.

Ra	te *•	Main Menu	44 a	Communications 🕶
		Configure I/O	Set Outputs	
		Processes	Communications	Ethernet Settings
		Control Processes	SmartVue	J1939 Menu
		Meters	File System	
MENU		Run / Stop	Exit	Exit
J1939 - Menu	# .	J1939 - Configuration	* .	J1939 - Configuration 1/2 #
J1939 - Menu Configuration	Active Device List	J1939 - Configuration Mode: Disat	₽ ∎ oled	J1939 - Configuration 1/2 #
J1939 - Menu Configuration SPN List	Active Device List	J1939 - Configuration Mode: Disat	₽	J1939 - Configuration 1/2 Mode: Monitor Only Standard: J1939-11
J1939 - Menu Configuration SPN List User Device List	Active Device List SPN(Data) Monitor PGN Request List	J1939 - Configuration Mode: Disat	#∎	J1939 - Configuration 1/2 Mode: Monitor Only Standard: J1939-11
J1939 - Menu Configuration SPN List User Device List Diagnostics Config	Active Device List SPN(Data) Monitor PGN Request List Diagnostics Display	J1939 - Configuration Mode: Disat	#∎	J1939 - Configuration 1/2 Mode: Monitor Only Standard: J1939-11

Adding J1939 Suspect Parameter Numbers

Now that the SmartVue is configured to receive J1939 messages it is time to add the Suspect Parameter Numbers (SPN's) that we want to monitor to the "SPN List". If you know the SPN's they can be added manually or we can pick from the list of SPN's that are actively being transmitted on the J1939 bus.



Connecting to a single ECU

If connecting to a single ECU "Send and Receive" mode must be selected to acknowledge the ECU's CAN message frames. "Monitor Only" mode does not acknowledge CAN message frames and can only be used if there is already active communications between multiple ECU's.

First we will add "Engine Speed" to the SPN list and label it "RPM".

J1939 - Menu	45 🗖	J,	1939 - SPN List			₽ 🖬	J1939 - SPN Configuration 😤
Configuration	Active Device List	<u>#</u>	Label	SPN	Device(ECU)		Label: RPM PGN: 61444 SPN: 190 Units: rpm
		2	2				Description: Engine Speed
SPN List	SPN(Data) Monitor	3				Add	Addressing: Fixed (By Address)
User Device List	PGN Request List	5				Delete	Address: 0 Active List
Diagnostics Config	Diagnostics Display	7					Timeout: 0 s (0 = No Timeout)
J1939 Status	Exit			<	Cancel		OK Cancel

Next we can select the ECU address that we want to receive the SPN data from which is useful in systems that contain multiple ECU's that transmit the same information. In this case the Engine #1 ECU is located at a fixed address of 0.

At this point we can also choose a timeout value to produce an error if data is not received within the specified period. If the timeout is set to zero (no timeout) and there is a loss of communications no error will be generated and the last SPN data value successfully received will be used indefinitely. For this example let's set the timeout to 10 seconds.

J1939 - SPN Configuration ₽ □ Label: RPM PGN: 0 SPN: 0 Units:	J1939 - SPN Configuration
Description:	Description:
Addressing: Fixed (By Address) 🤤	Addressing: Fixed (By Address)
Address: 0 Active List	Address: 0 Active List
Timeout: 0 s (0 = No Timeout)	Timeout: 10 s (0 = No Timeout)
Search Define States Advanced OK Cancel	Search Define States Advanced OK Cancel



Arbitrary Addressing Mode

Arbitrary addressing is also supported for advanced J1939 implementations where the ECU addresses can change dynamically. This is accomplished by tracking the ECU by its device name attributes.

Since we are connected to an active J1939 network let's choose the SPN we want to monitor by searching active SPN's. Navigate through the pages and select SPN 190 "Engine Speed".

J1939 - SPN Configuration *	J1939 - SPN Search Active: # J1939 - Active SPN Search	45 <mark>-</mark>
Label: RPM PGN: 0 SPN: 0	SPN: PGN: PGN SPN Description	
Description	No matched SBN or BCN found	r En
Description:	1675 - Engine Starter Mode	
Addressing: Fixed (By Address)	2432 - Engine Demand - Percent Torque	
	190 - Engine Speed	
Address: 0 Active List	975 - Estimated Percent Fan Speed	
	977 - Fan Drive State	
Timeout: 10 s (0 = No Timeout)	4212 - Fan Drive Bypass Command Status	
	1639 - Fan Speed	
Search Define States Advanced	4211 - Hydraulic Fan Motor Pressure	
OK Cancel	OK Cancel OK Cancel	\geq

Once SPN 190 "Engine Speed" is selected more detailed information about the SPN is displayed including the standard scaling information and units. Press "Ok" twice to view the "SPN List".

J1939 - SPN Search Active:	J1939 - SPN Configuration 🍄	J1939 - SPN List 🕫
SPN: 190 PGN: 61444 PGN SPN	Label: RPM PGN: 61444 SPN: 190	# Label SPN Device(ECU)
Labely Electronic Engine Controller 1 (EEC1)	Units: rpm	1 RPM 190 0
Laber: Electronic Engine Controller 1 (EECI)	Description: Engine Speed	2
Name: Engine Speed	Addressing: Fixed (By Address)	3 Edit
Size: 16 Bits		4
Start Location: 4.1	Address: 0 Active List	Delete
Offset: 0	Address of the second s	6
Scale: 0.125	Timeout: 10 s (0 - No Timeout)	7
Min: 0	Timeout. To s (o = No Timeout)	/
Max: 8032	Search Define States Advanced	8
Unit: rpm	Search Denne States Advanced	9
OK Cancel	OK Cancel	

The SPN list now contains the SPN 190 from device address 0. Let's repeat the steps above and add SPN 100 "Engine Oil Pressure", SPN 110 "Engine Coolant Temperature" and SPN 1761 "Diesel Exhaust Fluid Tank Level". The "SPN List" should now look like the one below.

J19	39 - SPN List			₽
#	Label	SPN	Device(ECU)	
1	RPM	190	0	
2	Oil Pressure	100	0	
3	Engine Temp	110	0	Eart
4	DEF Level	1761	0	Delete
5				Delete
6				
7				
8				
9				
	Ок		Cancel	

SPN/PGN Active Search

The active search function shows all active SPN's/PGN's currently being transmitted from all ECU's

Manufacturer Specific SPN's

SPN's that are not part of the standard can be configured using the "Advanced" settings option.

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Now let's add SPN 3697 which is used to control the "Diesel Particulate Lamp" that illuminates when active regeneration is required.

The "Define States" option is available for all SPN's that relay state information and can be used to label each state. In this case we will label the following three states:

0x0 = "OFF" 0x1 = "ON" 0x4 = "BLINK"

If an SPN with state data is displayed on the meter screen the state labels or hexadecimal value can be displayed.



Now there should be 5 SPN's configured and displayed in the "SPN List". Each SPN configured can be used in processes so they can be displayed on the meter screen and/or used to directly control outputs.

Up to 16 SPN's can be added and directly monitored on the "J1939 Data Monitor" screen, logged to a .csv file and streamed to a remote PC via Ethernet.





SPN/PGN Active Search

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Manufacturer Specific SPN's

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Linking SPN Data to a Process

If we want SPN data to be displayed on a meter screen or used to control an output it must first be linked to a process. From the "Main Menu" enter the "Processes" menu and select "Process 1". Change the name to "Engine RPM" change the "Type" to "J1939 SPN" and press the "Input" button to bring up the SPN list. From the SPN list select SPN 1 "RPM".

Pro	cesses 1/2	47 🖥	Proc	cess 1	₽	J19	39 - SPN List			# * 🖬
	Process 1	Process 2		Name: Engine RPM	- 1	#	Label	SPN	Device(ECU)	
1.1	THOUGH I			5	- 1	1	RPM	190	0	
	Process 1 Total/Rate	Disabled		Type: J1939 SPN 🖒	- 1	2	Oil Pressure	100	0	
	Totainate				- 1	3	Engine Temp	110	0	
	Drocoss 2	Drocoss 4		Input: SPN01: RPM	- 1	4	DEF Level	1761	0	
1.1	Process 5	Process 4			- 1	5	DPF Lamp	3697	0	
	Disabled	Disabled			- 1	6				
					- 1	7				
					- 1	8				
_					- 1	9				
	✓ Ex	it D		OK Cancel			Sele	ct	Cancel	

Press "OK" to save "Process 1" and configure four more processes for the remaining four SPN's. The "Processes" screens should look like the ones below.

Processes 1/2	₽	Processes 2/2	# .
Process 1 Process 2	~	Process 5 Process 6	- 1
Engine RPM SPN SPN		DPF Lamp Disabled	
Process 3 Process 4		Process 7 Process 8	
Temperature DEF Level SPN SPN		Disabled Disabled	
Exit	•	Exit D	

Configuring the Meter Display

Now that we have a process linked to each SPN we can display the process data on the meter screen and/or control outputs based on the processes SPN value.

Let's configure four meters to display RPM, oil pressure, temperature, and diesel exhaust fluid level.

Select "Meters" from the "Main Menu" and navigate right to the "Meters – Layout" screen and select the four meter layout box. Now when you navigate back there will be four meter configuration buttons.

Press "Meter 1" and configure it to display data from "Process 1". Repeat for meters 2,3 and 4 selecting "Process 2", "Process 3" and "Process 4" respectively.



Now that all four meters are configured exit the "Main Menu" to view the meter screen. You should now see the RPM, Oil Pressure, Engine Temperature and DEF Level. If the communications is interrupted for more than the configured timeout of 10 seconds the meter screen will display "TIMEOUT" in red.





Additional Meter Options

The meters can be configured as graphs and can display averaged values. See Users Manual.

Controlling an Output using J1939 Data

Now that we have the meter configured to display the first four engine parameters let's configure a digital output to switch low whenever the active regeneration lamp is signaled to illuminate. This can be done by linking "Process 5" (DPF Lamp) to a digital output.

We start by configuring the Multipurpose I/O channel #1 as an output. From the "Main Menu" select "Configure I/O", "Multipurpose I/O" then "DIO/VIN 1".

Main Menu	4 ∎	Configure I/O	47 🗖	Configure I/O - Multipur	pose I/O ₽₽
Configure I/O	Set Outputs	Current Loop I/O	Multipurpose I/O		
Processes	Communications	Total/Rate Counters	Temperature	DIO/VIN 1 (DIN)	DIO/VIN 4 (DIN)
Control Processes	SmartVue	Voltage Outputs		DIO/VIN 2 (DIN)	DIO/VIN 5 (DIN)
				DIO/VIN 3 (DIN)	DIO/VIN 6 (DIN)
Meters	File System	4-20mA Calibration	Logic Thresholds		
Run / Stop	Exit	Ex	it	Ex	it

Change the "I/O Type" to "Digital Output" and fill in the text fields as shown below.

Configure I/O - DIO/VIN 1 🕫	Configure I/O - DIO/VIN 1	Configure I/O - Multipurpose I/O 🛛 🕫
I/O Type: Digital Output 🤤	I/O Type: Digital Output	
Label:	Label: AR Required	DIO/VIN 1 (DOUT) DIO/VIN 4 (DIN)
Low State: LOW	Low State: AR REQ	
HiZ State: HIGH	HiZ State: OK	
Pull-up: On 🗳	Pull-up: On 🗳	DIO/VIN 3 (DIN) DIO/VIN 6 (DIN)
OK Cancel	OK Cancel	Exit

Now let's link digital output #1 to "Process 5" (DPF Lamp). From the "Main Menu" select "Set Outputs" navigate to the right and select "DOUT 1". Set "Enabled" to "Yes" and select "P5: DPF Lamp" then navigate right to configure the output mode.

Configure I/O	₩.	Main Menu	⇔ ∎	Set Outputs - Page 1 of 2	2 ≁∎
Current Loop I/O	Multipurpose I/O	Configure I/O	Set Outputs		
Total/Rate Counters	Temperature	Processes	Communications	0-10V OUT 1	0-10V OUT 2
Voltage Outputs	Frequency Outputs	Control Processes	SmartVue	4-20mA OUT 1	4-20mA OUT 2
4-20mA Calibration	Logic Thresholds	Meters	File System	Frequency OUT 1	Frequency OUT 2
Ex	it	Run / Stop	Exit		it 💽
Set Outputs - Page 2 of 3	2 ≠∎	Set Outputs p1 - DOUT 1	- AR Required #	Set Outputs p1 - DOUT 1	- AR Required 관 🖬
Set Outputs - Page 2 of 2	2 ** •	Set Outputs p1 - DOUT 1 Enabled:	- AR Required #	Set Outputs p1 - DOUT 1 Enabled:	- AR Required 🕫
Set Outputs - Page 2 of 2 DOUT 1 DIN 2	2 #	Set Outputs p1 - DOUT 1 Enabled:	- AR Required # Yes	Set Outputs p1 - DOUT 1 Enabled:	- AR Required PS: DPF Lamp
Set Outputs - Page 2 of 2 DOUT 1 DIN 2 DIN 3	2 ** DIN 4 DIN 5 DIN 6	Set Outputs p1 - DOUT 1 Enabled: Process/Control: Data Point:	AR Required P	Set Outputs p1 - DOUT 1 Enabled: Process/Control: Data Point:	AR Required PS: DPF Lamp

In this case there are three possible output modes to choose from "Compare", "Threshold" and "Latching. We will use the "Compare" mode to set the output "Low" when the DPF Lamp is ">=" "0x00000001". You can either type the hexadecimal compare value in manually or choose it from the "State List".

Set Outputs p2 - DOUT 1 - AR Required ** Source - P5: DPF Lamp (SPN:DPF Lamp)	Set Outputs p2 - DOUT 1 - AR Required *	Set Outputs p2 - DOUT 1 - AR Required FOUT Source - P5: DPF Lamp (SPN:DPF Lamp)
Mode: Threshold	Mode: Compare	Mode: Compare
HiZ Threshold: 0x00000000 << State List	Set Output: Low 🔷 when DPF Lamp	Set Output: Low when DPF Lamp
Low Threshold: 0x00000000 << State List	is <= 🛞 0x00000000 << State List	is >= 🔗 0x00000000 << State List
SPN Fault Action: No Change	SPN Fault Action: No Change	SPN Fault Action: No Change
OK Cancel	OK Cancel	OK Cancel
Set Outputs p2 - DOUT 1 - AR Required ** Source - P5: DPF Lamp (SPN:DPF Lamp)	J1939 - Define SPN States 🗸 🛱	Set Outputs p2 - DOUT 1 - AR Required # Source - P5: DPF Lamp (SPN:DPF Lamp)
Set Outputs p2 - DOUT 1 - AR Required ** Source - P5: DPF Lamp (SPN:DPF Lamp) Mode: Compare	J1939 - Define SPN States #□ # State State Label 1 00000000 OFF	Set Outputs p2 - DOUT 1 - AR Required #* Source - P5: DPF Lamp (SPN:DPF Lamp) Mode:
Set Outputs p2 - DOUT 1 - AR Required Source - P5: DPF Lamp (SPN:DPF Lamp) Mode: Compare Set Output: Low when DPF Lamp	J1939 - Define SPN States # 0 # State State Label 1 0000000 OFF 2 0X00001 ON 3 0X00004 BLINK	Set Outputs p2 - DOUT 1 - AR Required Source - P5: DPF Lamp (SPN:DPF Lamp) Mode: Compare Set Output: Low when DPF Lamp
Set Outputs p2 - DOUT 1 - AR Required ** Source - P5: DPF Lamp (SPN:DPF Lamp) Mode: Mode: Compare Set Output: Low when DPF Lamp is is >= 0x00000000 << State List	J1939 - Define SPN States # # State State Label 1 00000000 OFF 2 0X000001 ON 3 0X000004 BLINK 4 Disabled 5 5 Disabled 5	Set Outputs p2 - DOUT 1 - AR Required #■ Source - P5: DPF Lamp (SPN:DPF Lamp) Mode: Compare Mode: Compare Set Output: Low when DPF Lamp is >= 0x00000001 << State List
Set Outputs p2 - DOUT 1 - AR Required *■ Source - P5: DPF Lamp (SPN:DPF Lamp) Mode: Mode: Compare Set Output: Low when DPF Lamp is is >= Ox00000000 << State List	J1939 - Define SPN States # # State State Label 1 00000000 OFF 2 0X000001 ON 3 0X000004 BLINK 4 Disabled 5 5 Disabled 6 6 Disabled 8 7 Disabled 8	Set Outputs p2 - DOUT 1 - AR Required #■ Source - P5: DPF Lamp (SPN:DPF Lamp) Mode: Compare Mode: Compare Ø Set Output: Low Ø when DPF Lamp is is >= Ø 0x00000001 << State List

The output will now switch low whenever active regeneration is required.

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SPN Fault Action If the SPN that is connected to an output is not received in the time specified a fault will be generated. Use "SPN Fault Action" to specify the outputs prefered state during fault conditions.

Placing Indicators on a Meter

Now that we have the output configured we can display its state by placing an indicator on one of the meters. Let's place the "Active Regeneration Required" indicator on "Meter 4".

From the "Main Menu" select "Meters", "Meter 4". Each meter can display two indicators. Let's enable the right indicator by navigating right until the "Meter 4 – Right Indicator" page is displayed. Select "DOUT 1-Regen reqd" as the signal source and fill out the "Low" and "HiZ" text fields as shown below. The indicator colors can also be adjusted for each state.



An indicator is now displayed on the DEF Level meter showing the state of the active regeneration output. Press the indicator button to display a summary of the indicator and output compare settings.

^{крм}	oil Pressure ♥■	^{RPM}	oil Pressure ≄∎	Meter 4 - Right Indicator **•			
1015.63	44,00	1015.63	44.00				
rpm	kPa	rpm	kPa	State Label Compare State Color			
Engine Temp MENU	DEF Level	Engine Temp MENU	DEF Level	Low "AR REQ" >= 0x00000001			
90.00	72.40 *	90.00	72.40 Ar red	OK Cancel			



Indicator Buttons

The meter indicators buttons can be used to display digital input and output states and can also be used to directly switch outputs on and off, reset latched outputs, and adjust output threshold and compare values.

Adding active diagnostic information

The SmartVue is able to read active diagnostic trouble code (DTC) messages from multiple ECU's.

In the "Diagnostics Configuration" page press "Add" to add an ECU to monitor. Here we select the fixed addressing mode and set the address to 0 to receive DTC messages from the engine ECU. Once the ECU is added to the list the SmartVue will start receiving the active diagnostic codes. If a diagnostic code is received from any of the ECU's configured the small DTC icon will show up on the top right corner of the screen.

Use the "Diagnostics Display" feature to view detailed information for each DTC including the Malfunction indicator lamps, SPN, Failure Mode Identification (FMI) number, and Occurrence Count (OC).

The DTC codes can also be logged or streamed to a remote PC via Ethernet.

J1939 - Menu	44 <mark>8</mark>	J1939 Diagnostics Config	uration 🏾 🍽	J1939 Diagn	ostics Configu	uration 2	44 <mark>-</mark>
Configuration	Active Device List	# Device(ECU) 1	Status				
SPN List	SPN(Data) Monitor	2 3	Add	Addrossing	Eixed (Bu	Addross) A	h
User Device List	PGN Request List	5	Delete	Addressing:	Fixed (by	Address) 🛛	ļ
Diagnostics Config	Diagnostics Display	7		Address:	0	-	Active List
0 J1939 Status	Exit	9 ок	Cancel		ок	Cancel	
							-
J1939 Diagnostics Config # Device(ECU)	uration 😤 🖬	J1939 - Menu	≠ .	J1939 Active	DTC Monitor Combined L	amp States	49 <mark>016 -</mark>
J1939 Diagnostics Config # Device(ECU) 1 0	uration # Status OK	J1939 - Menu Configuration	≉œ∎ Active Device List	J1939 Active	DTC Monitor Combined L STOP	amp States WARNING	¥ [™] .
J1939 Diagnostics Config # Device(ECU) 1 0 2 3	uration # Status OK Edit	J1939 - Menu Configuration SPN List	ative Device List	J1939 Active	ECU A: 0 Status: DTC	amp States WARNING	₽ IIII
J1939 Diagnostics Config # Device(ECU) 1 0 2 3 4 5	OK Edit Delete	J1939 - Menu Configuration SPN List User Device List	مه هوسه المعالم الم	J1939 Active MIL #1 MIL SBN/DTC: 10	ECU A: 0 Status: DTC	amp States WARNING WARNING	PROTECT
J1939 Diagnostics Config # Device(ECU) 1 0 2 3 4 5 6 7 8	Uration # Status OK Edit Delete	J1939 - Menu Configuration SPN List User Device List Diagnostics Config	at Calibrian Active Device List SPN(Data) Monitor PGN Request List Diagnostics Display	J1939 Active MIL #1 MIL SPN/DTC: 19 FMI: 4 Voltage Br OC: 4	ECU A: 0 Status: DTC Status: DTC Status: DTC Stop eded	amp States WARNING WARNING	PROTECT PROTECT PROTECT Low Source

Dycor Technologies Ltd. 1851 – 94 Street NW Edmonton, Alberta Canada T6N 1E6

Bus: 780-486-0091 800-663-9267 Fax: 780-486-3535

sales@dycor.com www.dycor.com www.smartvue.ca

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