OPERATION AND TECHNICAL SERVICE BULLETIN FOR WRV

This document overviews the operation and functions of the electronics system. The first part will cover system operation from VDC functions to Icon and instrument operation. The second part of the document will show pin out information, voltage at various points, and other system design parameters. The third part will cover troubleshooting the system, should you have trouble, and a guide of various failures and how to diagnose them.

OPERATION

Initial power on

When the ignition key is first turned to the first position the following will happen. All of the lights on the Annunciator will come on. The Icons will light up for one second to perform a bulb check signifying they all work. After one second all the Icons will go out except the Low Oil, Park brake, and Check engine Icons. These will go off after the engine is started. The park brake Icon will stay on as long as the park brake is applied.

Also at initial key on the gauge pointers will move counter clockwise to the zero position and vibrate for a brief period. This period is our zero calibration period so the gauge has a zero reference for normal operation. This is a normal function and will happen whenever the system is first powered up.

The high beam Icon will function anytime the high beams are used. Even when the vehicle is not powered up the operator can pull the high beam switch for high beams and the Icon will illuminate.

Engine running

When the engine is first started the oil pressure light and warning buzzer will be on until the engine senses oil pressure.

The buzzer is programmed to come on for any of the following conditions:

Low oil pressure, Low coolant level, High coolant temperature. The buzzer will stay on until all the conditions are in normal ranges.

Note: During starting operation with weak batteries the instrument panel may not function properly until the system voltage is above 9.6 volts. This can take up to 50 seconds after start up.

Odometer and Trip Odometer Operation

The dash panel in the driver's station is equipped with a stand-alone trip/odometer. Located in the instrument is a digital display that is capable of displaying either the odometer or the trip mileage, which will be explained below. Both functions can be displayed in English or Metric scaling (miles and kilometers, resp.) The scaling is driver selectable (miles and km, resp.) via a reset switch located on the dash panel labeled TRIP RESET.

Display Operation

1. A short press of the trip reset (<3sec.) will toggle LCD between trip mode and odometer mode
2. A long press of the trip reset (>3sec.) while in trip mode will reset the trip odometer
3. A long press of the trip reset (>3sec.) while in odometer mode will toggle the units of measure between English and Metric

Odometer **Trip Odometer**

J1587/J1708 Note:

We have found an issue with the J1587/J1708 databus that needs to be explained to eliminate any confusion that may arise. The trip odometer can appear to skip tenths of a mile at high speeds. This is normal operation of the J1587/J1708 databus and not a defective stand-alone gauge. A more thorough explanation follows:

Cause of Skipping

- J1587 specifies that a message for total vehicle distance traveled (PID 245) be sent out every 10 seconds on the databus. Therefore if you go less than tenth of a mile in more than 10 seconds, the databus will update for every tenth of a mile. However, at speeds that exceed a tenth of a mile in 10 seconds or less, the update for the trip meter/odometer will not have been sent on the databus, therefore the trip meter will appear as if is skipping.

Mathematical Example

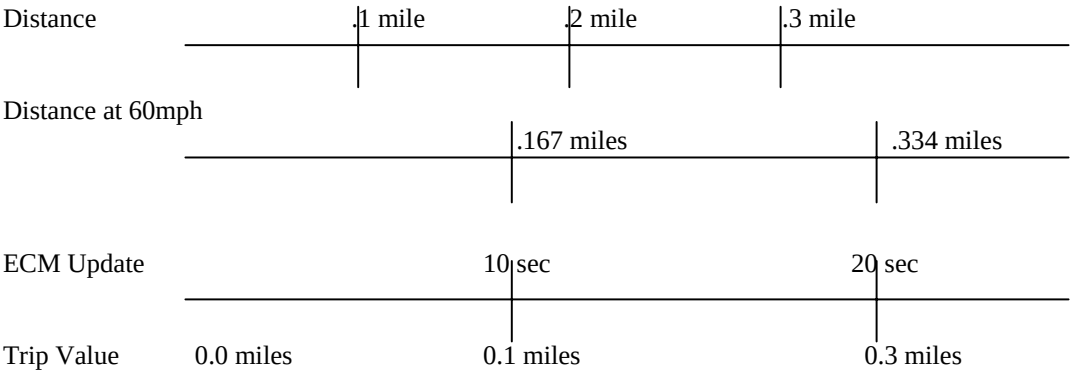
- 60mph/ 3600= .0167 * 10 = .167

```
|       |       |       \----------      .167 (total miles traveled in 10 sec)
|       |       \------------------  10 (to get distance traveled in 10 sec.)
|       \--------------------------      .0167 (miles traveled in 1 sec)
\---------------------------------      3600 (seconds per hour)
```

- As shown above, traveling at 60mph is in excess of a tenth mile, and will lead to trip meter skipping.
- Greater than 36mph will eventually accumulate a value that will cause the trip meter to skip.

  36mph/3600= .01 * 10 = .1

- The skipping is usually not noticed until higher speeds, due to the increase of distance traveled versus time.



- The above chart shows roughly how this symptom occurs.

Conclusion

- This is a normal function of the trip meter. The trip meter is good; the problem is within the J1587/J1708 update rate.

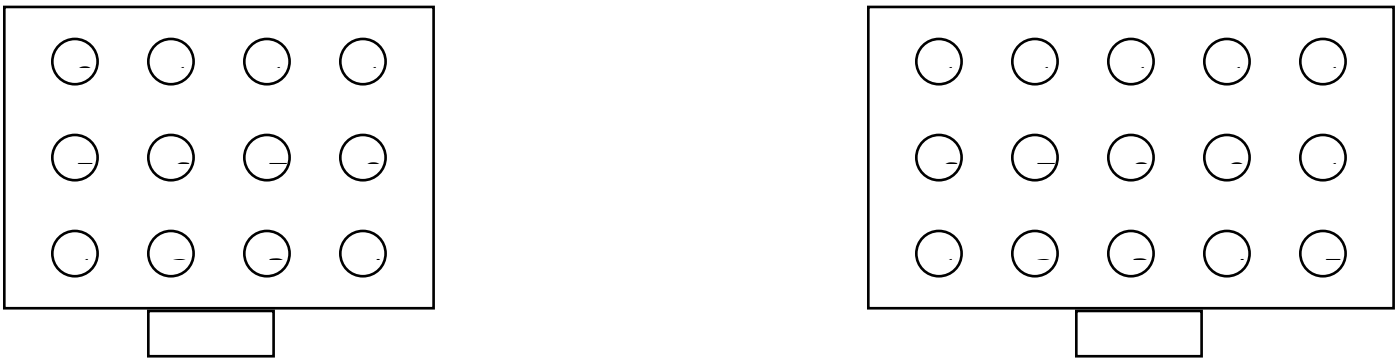
ANNUNCIATOR

Below is the diagram for the Annunciator connectors and there is also an illustration for the Annunciator Icon positions. The Annunciator is located on the dash panel it contains the Icons or warning indicators, which light up telling status of a function on the chassis. The Annunciator has a built in diagnostic function, which will tell you if the Annunciator is receiving data from the VDC. If data is lost from the VDC to Annunciator for more than 45 seconds, the Annunciator icons will begin to dance or begin a chase pattern. The VDC sends data to the Annunciator and then the data is passed through to the gauges.

The high beam indicator is wired directly to the high beam circuit and will work at any time the high beam lights are on even when the key is off. The hazard flashers or left and right turn signal are also wired directly and will flash when the hazards are on even with the key off. All other indicators require ignition to be on.

ANNUNCIATOR CONNECTORS WESTERN RV

A2 VIEW FROM TOP OF CONNECTOR A1



1	Fuel Sender (Low)
2	RIGHT TURN SIGNAL (High)
3	LEFT TURN SIGNAL (High)
4	HIGH BEAM (High)
5	Rear Air (Low)
6	Do Not Shift (Low)
7	Brake (Low)
8	ABS (Low)
9	Front Extend (Low)
10	Fasten Seat Belt (Low)
11	Front Air (Low)
12	Jacks Down (Low)

1	DATA BUS +
2	GND
3	7V DC OUT
4	GROUND (from J2-H)
5	BATTERY
6	NC
7	NC
8	ON/OFF (from J2-G)
9	GAUGE DATA
10	DATA BUS -
11	Buzzer (OUT1)
12	Chime (OUT2)
13	NC (OUT3)
14	NC (OUT4)
15	NC

Vehicle Data Computer (VDC)

The VDC is the heart of the instrument system. For most applications it is mounted near the engine compartment and has direct communications with the engine ECM through the J1587 Databus. It is also in direct communication with the Annunciator located in the dash panel. This communication is accomplished through a set of wires, which *must* be a twisted pair. See below for pin locations.

The VDC is constructed in a rugged case, which is splash and spray resistant. Below is the pin out diagram showing wire locations and there is also a list of requirements for properly mounting the VDC to insure reliable service.

WRV VDC I/O Connections

Pin	Name	Type	Schematic
J1-1	Not Used		OUT4
J1-2	Not Used		OUT3
J1-3	Not Used		ANLG2(AD8)
J1-4	Engine Maintenance	Switch/Active Low (Sink to Grd)	ANLG9(AD1)
J1-5	Not Used		ANLG7(AD3)
J1-6	Not Used		ANLG5(AD5)
J1-7	Not Used		OUT2
J1-8	Not Used		FIN1
J1-9	Not Used		FIN2
J1-10	Not Used		DIN4
J1-11	Stop Engine	Switch/Active Low (Sink to Grd)	DIN3
J1-12	Not Used		OUT1
J1-13	Not used	Internal Pressure/Flexible Hose	ANLG0(AD10)
J1-14	Not Used	N/A (internal pressure spare)	ANLG3(AD7)
J1-15	Not Used	Internal Pressure/Flexible Hose	ANLG1(AD9)
J1-16	Not Used		ANLG8(AD2)
J1-17	Not Used		ANLG6(AD4)
J1-18	ABS	Switch/Active high	ANLG4(AD6)
J1-19	Low Coolant	Switch/Active Low (Sink to Grd)	DIN8
J1-20	Park Brake	Switch/Active Low (Sink to Grd)	DIN6
J1-21	Water in Fuel	Switch/Active Low (Sink to Grd)	DIN7
J1-22	Mikm - Odo/Trip – Trip reset	Switch/Active Low (Sink to Ground)	DIN5
J1-23	Engine Protect	Switch/Active Low (Sink to Ground)	DIN2
J1-24	Wait to Start	Switch/Active Low (Sink to Ground)	DIN1
J2-A	Vehicle Data Bus +	J1708/J1587	DB1+
J2-B	Vehicle Data Bus -	J1708/J1587	DB1-
J2-C	Instrument Data Bus +	RS-485	DB2+
J2-D	Instrument Data Bus -	RS-485	DB2-
J2-E	Ignition	Switched 12 V	IGNITION
J2-F	Battery	12V Nominal	BATTERY
J2-G	Annunciator power control	sink to ground	Switch Ground
J2-H	Annunciator Ground	Annunciator Return	GND
J2-J	Module Ground	To Chassis Ground	GND
J2-K	Not Used	Not Used	SWDATA

View is from PCB bottom or from housing

VDC Installation Guidelines

To insure proper operation and reliability of the Vehicle Data Computer there are some guidelines, which must be followed:

1) The VDC is designed to operate in an environment that is exposed to water spray or splash. It should not be submerged for any period of time or exposed to flying debris. Do not mount the VDC in a wheel well or near the engine exhaust.

2) The VDC is equipped with 4 rubber boots, one at each corner mounting point. **CAUTION:** When mounting the VDC do not tighten the mounting bolts to the point that the boots are squeezed out from under the VDC housing. This may cause damage to the internal electronics due to excessive vibration.

INSTRUMENTS

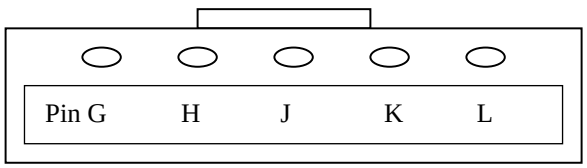
The instruments get their operating information from various points on the vehicle. This data is either received directly from the engine ECM or through discrete sensors mounted on the vehicle. All the data is fed into the VDC and Annunciator and then sent to the instruments through a single wire data bus from the Annunciator.
The instrument are listed below and what type of data they each receive:

Speedometer	Engine ECM (J1587 databus) PID 84
Tachometer	Engine ECM (J1587 databus) PID 190
Odometer	Engine ECM (J1587 databus) PID 245
Trip Odometer	Calculated from PID 245
Engine Coolant Temperature	Engine ECM (J1587 databus) PID 110
Engine Oil Pressure	Engine ECM (J1587 databus) PID 100
Voltage	Engine ECM (J1587 databus) PID 168
Transmission Oil Temperature	Transmission ECM (J1587 databus) PID 177
Fuel Level	Sender in Fuel tank

Instrument (pin out & voltage)

	G	H	J	K	L
Information	Lighting	Databus	Ground	Power	NA
DC Voltage	12 vdc*	3 to 7 vdc		7+/-.5 vdc	
*When Lights On					

View from wire insertion end.



The BorgWarner instrumentation system is a Microprocessor based system utilizing both sensor and data bus information to display both gauge and warning information. With a microprocessor system the need for a good clean ground is very important. Whenever the system is giving erratic behavior please check the grounds between the VDC (pin J), Annunciator (pin 4 or 2), and battery (ground post). Knowing that the ground is good as well as the battery and ignition voltages are within the OEM parameters will save a lot of trouble shooting time.

Gauge troubleshooting

All of the gauges are built the same way. They all have a Microprocessor, stepper motor, and LED backlighting. Knowing this will aid in trouble shooting for a faulty gauge. The gauge gets its information by a single data line (pin 9) on the Annunciator to (pin H) on all of the gauges. This is important because the gauge harness is a universal harness. This means you can plug any connector into any gauge and it should work assuming that the information is coming across that data line. You can perform the following tests to determine if you have a harness or gauge failure.

1. As you turn on the key switch watch the gauges. All of the gauges should reset or zero (when they reach the zero point they should vibrate or hum slightly).
2. At this point the vehicle is not running and the key is on. The gauges that have information will start working (fuel, air pressure, volt, etc.).
3. If any of the gauges do not reset (vibrate), swap gauge connectors with a gauge that did reset and repeat the process.
4. If the same gauge still fails to reset and the other gauges do reset, then the gauge is bad but, if it now does reset, the harness or the connector may be bad. See the gauge section for the gauge connector pinout.
5. If all gauges reset and seem to work properly start the engine and follow the chart below to test the inputs that drive each gauge.

Gauge	Input	Test
Volt	Battery	Use voltmeter to insure gauge matches battery.
Fuel	Sender	Pin 1 of 12-pin Annunciator connector should read between 240 and 33 ohms. If you ground this pin the fuel gauge will go to Full. See attachment A.
Engine Temp.	Engine ECM	Use engine OEM diagnostic tool to compare reading with engine ECM.
Oil Pressure	Engine ECM	Use engine OEM diagnostic tool to compare reading with engine ECM.
Speedometer	Engine ECM	Use engine OEM diagnostic tool to compare reading with engine ECM.
Tachometer	Engine ECM	Use engine OEM diagnostic tool to compare reading with engine ECM
Transmission Oil Temp.	Engine ECM	Use engine OEM diagnostic tool to compare reading with engine ECM

Troubleshooting the BorgWarner VDC and Annunciator

The VDC and ANN are the brains of the system. The VDC was designed to take the inputs, some digital some analog and convert them into an all-digital signal that the ANN can use to turn on the warning lights and drive the gauges. A good portion of the information that the VDC uses is directly from the engine data bus. If for any reason the data bus is lost at the VDC for 18 Seconds the odometer will start flashing. After and 25 seconds the gauges will return to 0 (reset) and at 45 seconds the ANN will start scrolling or the lights will start a chase routine. After the data bus is reestablished the system will return to normal.

If for any reason the gauges and the ANN fail to power up you can ground Pin 8 of the ANN and the gauges and the lights should go through the power up

Sequence. This is a very helpful hint to help eliminate half of the system when trying to diagnose a dead system. For further assistance in troubleshooting the system please see the section below.

SERVICE PROBLEM GUIDE

The Guide below is provided to aid in solving a problem when the following symptoms are experienced.
If the following symptoms are seen, then perform the corresponding diagnostics. This is broken down into 3 sections. Section 1 deal with system problems. Section 2 deals with individual or multiple gauge problems. Section 3 deals with Annunciator problems.

Section 1 System Problems

Symptom

The instrumentation system will not turn on, meaning that neither the Annunciator nor gauges will not power up with key on.

Diagnostic Check	**Corrective Action**
1.Measure for battery voltage at VDC pin F and then at ANN pin 5	If battery voltage not found at VDC pin F or ANN pin 5 then locate bad connection in the harness or connector and repair.
2.Measure ignition voltage at VDC Pin E with the key on.	If ignition voltage is not found, then locate bad connection in harness or connector and repair.
3.Check connection at ANN pin J1-8 and VDC pin G. Should read GND with key on at ANN and ground at VDC.	If GND not found at ANN or ground at VDC check continuity of harness. If good then then verify step 4.
4.Check connection at ANN pin J1-pin8 and VDC Pin G. Should read 12v with Key off.	If 12v not found at VDC Pin G then replace VDC. If 12v at VDC and not at ANN, check continuity of harness.
5.Check ANN pin J1-pin8 for short. Disconnect harness at ANN to check.	If short found at J1-Pin8 then repair harness.
6.Check VDC pin J & H for ground continuity.	If Pin J & H not grounded repair harness
7.Ground ANN J1-pin4 to test for ground to ANN.	If ground J1-pin4 and system works then repair harness from VDC pin H To ANN J1-pin4. If system still doesn't work then replace ANN.

Symptom

The instrumentation/Annunciator system will not turn OFF. This is after the key has been switched off.

Diagnostic Check	**Corrective Action**
1.Disconnect VDC pin E with system on.	If system shuts down then repair harness for short to battery. If system still won't shut down replace VDC.
2.Disconnect ANN J1-pin8 to check if system will shut down.	If system shuts down then repair harness from J1-pin8 ground at VDC. If system will still not turn off then replace ANN.

SECTION 2. Individual or Multiple Gauge Problems

Symptom

The ANN is on but the gauges will not come on.

Diagnostic Check	**Corrective Action**
1.Check and measure voltage at gauge Pin K.	If 7V not seen at Pin K repair harness, If 7V measured then replace the Gauge.
2. Ground Pin J of gauge to test.	If gauges come on, then repair harness.
3.Disconnect all the instruments and then connect back one at a time.	As you connect each gauge back they should work until The shorted instrument is connected and the gauges shut down replace that gauge.

Symptom

No gauge backlighting.

Diagnostic Check	**Corrective Action**
Check for 12v at gauge Pin G with headlights on and Ground at pin J.	If no voltage found then repair harness. If 12v found at Pin G and ground at pin J, then replace gauge.

Symptom

Erratic gauge operation.

Diagnostic Check	**Corrective Action**
1.Swap connectors on gauges to find faulty connector or harness.	When bad connector found repair harness.
2.Check continuity from ANN pin 9 to gauge Pin H.	If continuity is bad then repair harness or connector.
3.Measure voltage at gauge Pin K, their should be 7V with key on.	If 7v not found then repair harness.
4.Check gauge Pin J for continuity To ground.	If Pin J not grounded properly then repair harness.

See instrument section for more troubleshooting guidelines to check gauges.

Symptom
No Instrument Data. The gauges will reset at power on, but will not display data.

Diagnostic Check	**Corrective Action**
1.Swap connectors between gauge(s) that work and one(s) that do not.	If gauge starts to work with different connector Note which connector is bad and repair. If gauge still doesn't work, use service software and laptop To determine if data being transmitted by VDC, if data is on Databus then replace the gauge.

Symptom
The trip Odometer Reset/Metric change does not work..

Diagnostic Check	**Corrective Action**
1.Check continuity between ANN pin J2-8 and trip reset switch.	If circuit open then repair wire harness.
2.Ground ANN pin J2-8.	If Trip reset works properly, then replace switch If Trip reset still doesn't work then replace ANN.

Symptom
Fuel gauge inaccurate.

Diagnostic Check	**Corrective Action**
1 Check resistance at connector Pin J2-1. Resistance should be between 33 and 240 ohms. 33 corresponds to full tank and 240 is empty.	If resistance is other than listed, the sender or harness is defective.
2. Check continuity from ANN Pin J2-1 to Fuel sender.	If continuity is greater than three ohms then repair harness.

If resistance values are within spec. and continuity is good. Check ANN ground. If this is good Then replace ANN.

SECTION 3. ANNUNCIATOR PROBLEMS

Symptom
The lights on the ANN begin to scroll or chase around in a circular pattern with Key ON.

Diagnostic Check	**Corrective Action**
1. Check to see that VDC pin C & D are not shorted by unplugging VDC and checking continuity on connector pins.	If VDC Pins shorted repair harness, If the pins and harness are good replace the VDC.
2. Then unplug ANN on pin J1-1 & J1-10 and check for short at ANN.	If ANN pins are not shorted then check harness for short on pins.

Symptom
The lights on the ANN begin to scroll or chase around in a circular pattern with Key OFF.

Diagnostic Check	**Corrective Action**
1. Check for 12v at ANN J1-Pin8.	If 12v found at ANN J1-pin8, then replace ANN. If 12v not found at ANN J1-Pin8, then wire is defective And harness needs repaired.

Symptom
One or more lights on ANN stay on.

Diagnostic Check	**Corrective Action**
1. To check if one specific light stays on. Disconnect the input Pin for that ANN light (see ANN connector for pin Of ANN light in question) .	If light goes out, then repair short in harness or connector.
2.The next step would be to test the sensor (refer to sensor supplier for troubleshooting information)	If the sensor tests bad then replace. If the sensor tests good, then replace the ANN.

Symptom
Icon on ANN will not come on.

Diagnostic Check	**Corrective Action**
1. Refer to VDC or ANN connector Diagram for Icon that is on as to what The pin location is, then either ground Or apply 12v to input pin depending on Appropriate signal to see if light comes On.	If the light comes on, check the connector or harness for a broken wire or connector.
2. If test 1. Fails then check the input's Sensor to see if sensor is bad. (refer to Sensor supplier for troubleshooting Information). If the sensor is good	If the sensor is bad then replace sensor. If the harness is bad repair as needed.
Check continuity of the harness wire for That input.	If all the above prove to be OK then replace ANN.

Symptom
Erratic ANN lights on

Diagnostic Check	**Corrective Action**
1. Refer to pin out diagrams above For VDC and ANN. Check the pin for Each light in question for Loose Connections.	If loose connection found then repair harness or connector.
2. Check for loose battery voltage Connection at VDC Pin J2-F	Repair harness at loose connection.
3. Check for loose Ignition voltage connection at VDC Pin J2-E	Repair harness at loose connection
4. Check continuity of connections at VDC Pins J2-C & D and ANN Pins J1-1 & 10 or connector If above tests show no problems then replace ANN.	If continuity not found at pins or harness, repair harness

Symptom
Buzzer will not activate.

Diagnostic Check	**Corrective Action**
1.Check ANN Pin J1– 11 to buzzer for continuity.	Repair buzzer connection or Pin at ANN.
2 Measure voltage at buzzer terminals. Should measure 12v nominal with	If 12v nominal not found then repair buzzer harness to power.

Key off.

3. Check for short to Ground on ANN pin J1-11 when buzzer should be on.	Repair harness

Symptom
Buzzer stays on.

Possible Cause	**Diagnostic Check**
1. Shorted connection	Check for short to GND on ANN pin1-11