

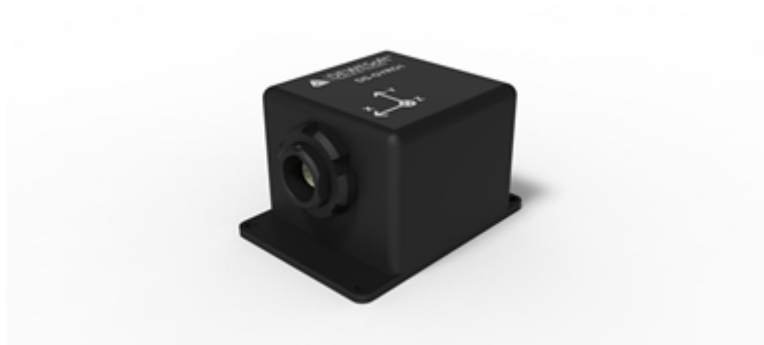


Image 21: DS-GYRO1

4.5.1. Scope of supply

DS-GYRO1 is supplied in a kit that contains everything required to get started operating the system right away. It's supplied in a carry case to protect the equipment during the shipment.



Image 22: DS-GYRO1 supply kit

4.5.1.1. Kit contents

- DS-GYRO1
- Interface cable harness (with USB and Power)

4.5.1.2. Quick start

- Position the DS-GYRO1 in the vehicle.
- Plug the interface cable into DS-GYRO1.
- Plug the USB cable into your computer
- Download DewesoftX® software and the plugin from www.dewesoft.com.
- Install the driver for RS232 converter
- Run DewesoftX® software --> go to Settings --> Devices --> Click on the plus button and under Plugins you will find the DS-IMU option.

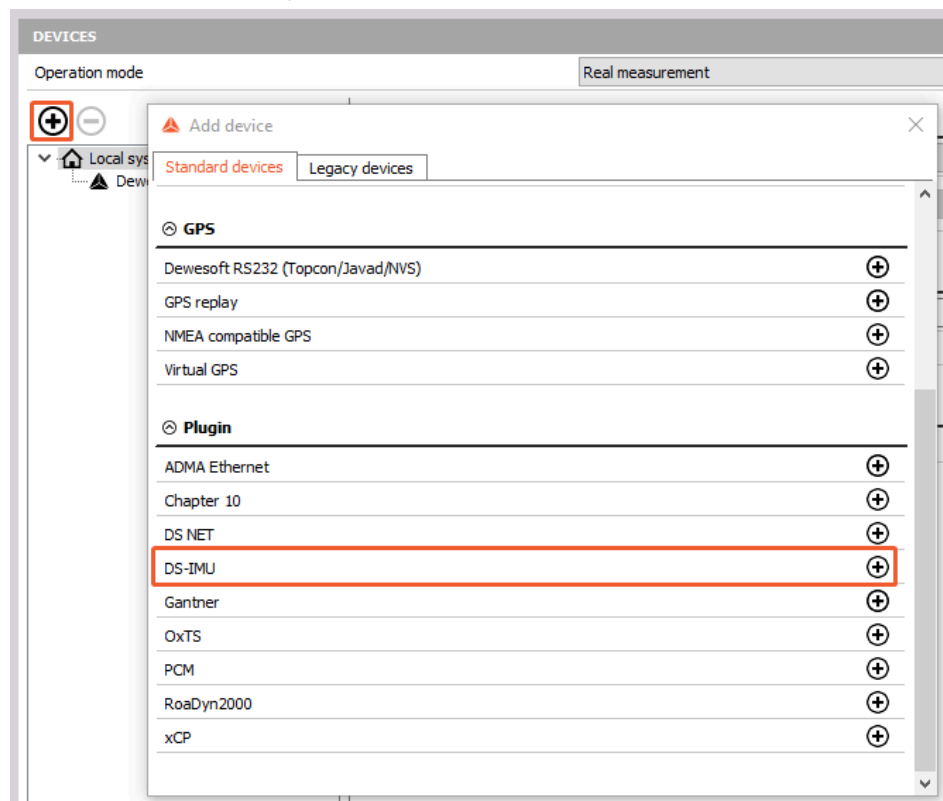


Image 23: Add DS-IMU device inside settings

- The device should be automatically recognized, if not press the Rescan device.

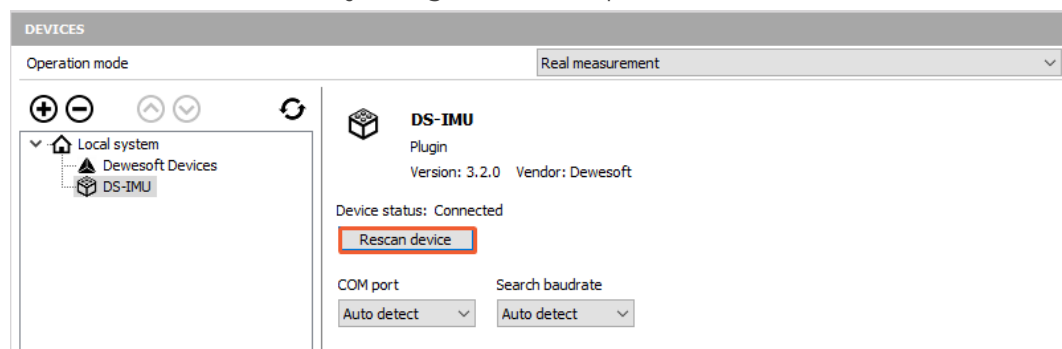


Image 24: Click on Rescan device button if the device is not automatically recognized

- After recognizing the device press OK.

- Device will send the data all the time, so you can watch them already in the Channel setup.

Device setup equals this setup.

Connected Healthy Upload to device Download from device Restart device Disconnect

Data Mounting Configuration

Channel rate: 100 Hz Speed unit: m/s Acceleration unit: m/s² ☐ Reset distance on measurement start ☐ Store raw data log

+	Used	C	Channel name	Units	Min	Values	Max	Scale	Offset	Zero
--- System state channels ---										
Unused			Time	-	-INF	1.1.70 00:00:47	INF	1.00	0.00	Zero
Unused			System_status	-	-INF	10.000 (-)	INF	1.00	0.00	Zero
Unused			Roll	deg	-90.00	-0.551 (deg)	90.00	1.00	0.00	Zero
Unused			Pitch	deg	-90.00	0.328 (deg)	90.00	1.00	0.00	Zero
Unused			Heading	deg	0.00	1.839 (deg)	360.00	1.00	0.00	Zero
Unused			Angular_velocity_X	deg/s	0.00	0.016 (deg/s)	2000...	1.00	0.00	Zero
Unused			Angular_velocity_Y	deg/s	0.00	-0.023 (deg/s)	2000...	1.00	0.00	Zero
Unused			Angular_velocity_Z	deg/s	0.00	0.079 (deg/s)	2000...	1.00	0.00	Zero
--- Raw sensors channels ---										
Unused			Accelerometer_X	m/s²	-160.00	0.078 (m/s²)	160.00	1.00	0.00	Zero
Unused			Accelerometer_Y	m/s²	-160.00	0.109 (m/s²)	160.00	1.00	0.00	Zero
Unused			Accelerometer_Z	m/s²	-160.00	-9.864 (m/s²)	160.00	1.00	0.00	Zero
Unused			Gyroscope_X	deg/s	0.00	0.008 (deg/s)	2000...	1.00	0.00	Zero
Unused			Gyroscope_Y	deg/s	0.00	0.010 (deg/s)	2000...	1.00	0.00	Zero
Unused			Gyroscope_Z	deg/s	0.00	0.174 (deg/s)	2000...	1.00	0.00	Zero
Unused			Magnetometer_X	mG	0.00	371.067 (mG)	8.00	1.00	0.00	Zero
Unused			Magnetometer_Y	mG	0.00	395.600 (mG)	8.00	1.00	0.00	Zero
Unused			Magnetometer_Z	mG	0.00	1044.813 (mG)	8.00	1.00	0.00	Zero
Unused			IMU_Temperature	deg C	0.00	32.004 (deg C)	100.00	1.00	0.00	Zero
--- Euler orientation standard deviati...										
Unused			Roll_standard_deviation	deg	-90.00	0.318 (deg)	90.00	1.00	0.00	Zero
Unused			Pitch_standard_deviation	deg	-90.00	0.318 (deg)	90.00	1.00	0.00	Zero
Unused			Heading_standard_deviation	deg	0.00	19.984 (deg)	360.00	1.00	0.00	Zero
--- Event channels ---										
Unused			Event_1	-	0.00	0.000 (-)	1.00	1.00	0.00	Zero
Unused			Event_2	-	0.00	0.000 (-)	1.00	1.00	0.00	Zero

Image 25: DS-IMU tab preview in channel setup

4.5.2. Specifications

4.5.2.1. Mechanical drawings

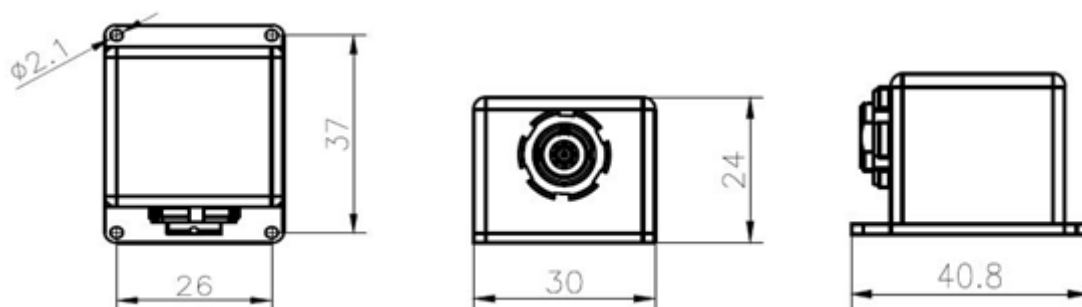


Image 25: Mechanical drawing for DS-GYRO1

4.5.2.2. Navigation specifications

Parameter	Value
Roll & Pitch accuracy (static)	0.2 °
Heading accuracy (static)	0.5 °
Roll & Pitch accuracy (dynamic)	0.6 °
Heading accuracy (dynamic)	1.0 °
Orientation range	Unlimited
Hot start time	500 ms
Internal filter rate	1000 Hz
Output data rate	Up to 500 Hz

4.5.2.3. Sensor specifications

Parameter	Accelerometers	Gyroscopes	Magnetometers
Range (dynamic)	2 g 4 g 16 g	250 °/s 500 °/s 2000 °/s	2 G 4 G 8 G
Noise density	400 µg/√Hz	0.005 °/s/√Hz	210 µg/√Hz
Non-linearity	< 0.05 %	0.005 °/s/√Hz	< 0.05 %
Bias stability	5 mg	18 °/hr	-
Scale factor stability	< 0.05 %	< 0.05 %	< 0.05 %

Cross-axis alignment error	< 0.05 °	< 0.05 °	< 0.05 °
Bandwidth	256 Hz	256 Hz	110 Hz

4.5.2.4. Hardware specifications

Parameter	Value
Operating voltage	4 to 36 V
Input protection	± 40 V
Power consumption	65 mA @ 5 V (typical)
Operating temperature	- 40 °C to 85 °C
Environmental sealing	IP 68
Shock limit	2000 g
Dimensions	30 x 40.6 x 24 mm
Weight	25 grams
Interface	USB

4.5.2.5. Electrical specifications

Parameter	Minimum	Typical	Maximum
Power supply			
Input supply voltage	4 V		36 V
Input protection range	- 40V		40 V

4.5.2.6. Power consumption

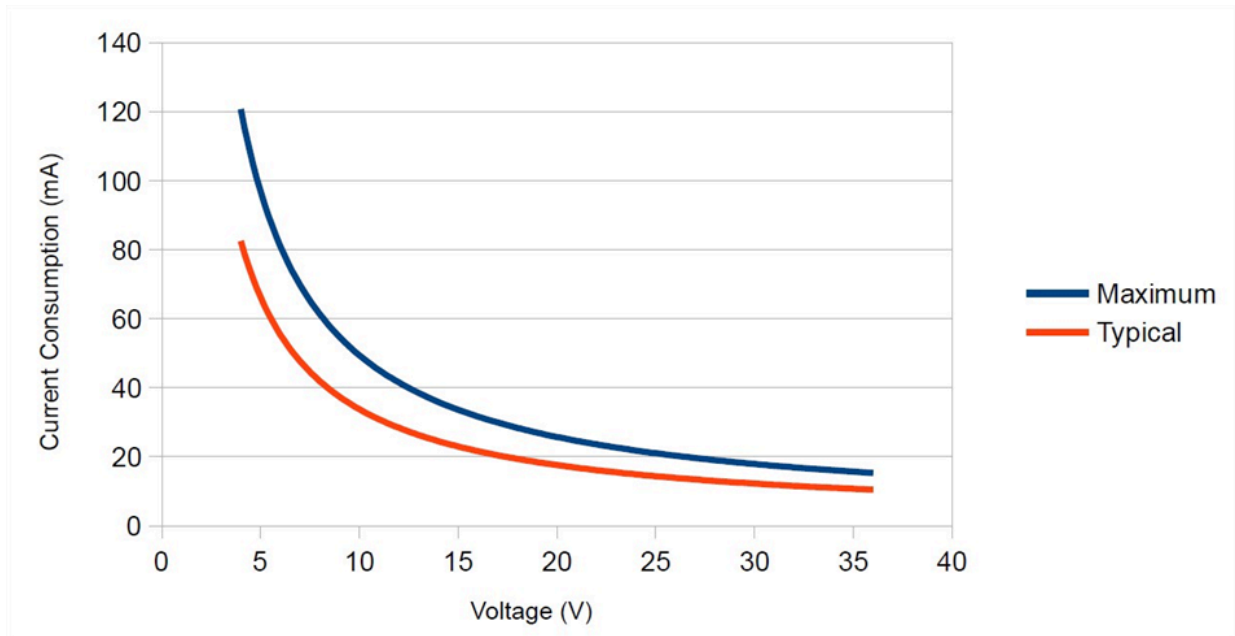
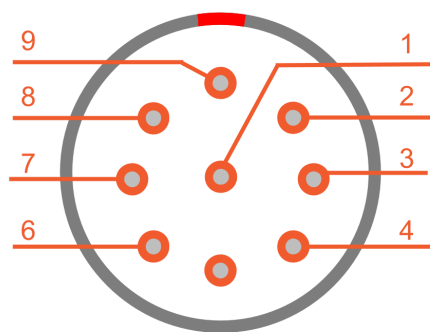


Image 26: Power consumption specifications

4.5. Connector pin-out

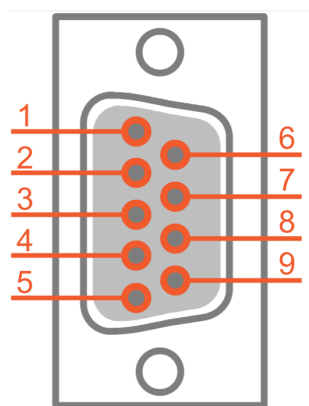
Power supply and signal connections are made through a ODU Mini-Snap Series B 9 pin connector, which provides a reliable and rugged connection to all the instruments under demanding conditions and is rated to IP68 in the mated condition. Plugs are supplied with 2 meters of unterminated shielded TPE cable.



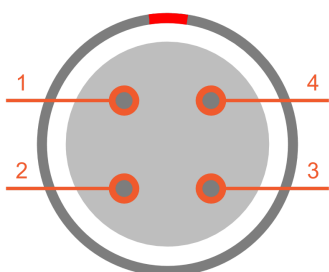
Pin	Colour	Function
1	BLack	Signal ground
2	Brown	Power supply
3	White	GPIO
4	Green	PPS
5	Red	Primary RS232 Tx
6	Orange	Primary RS232 Rx
7	Yellow	Auxiliary RS232 Tx
8	Blue	Auxiliary RS232 Rx
9	Pink	Power ground

4.7. Cable harness

4.7.1. DS-IMU2 cable



PIN	Description
1	+5V (USB)
2	TX AUX
3	RX AUX
4	PPS FLT
5	GND
6	PPS RADIO
7	Not Connected
8	GPI01 FLT
9	+15V (Ext power)



Sync connector: pin-out (4-pin LEMO female)

Pin	Name	Description
1	CLK	Clock
2	Trigg	Trigger
3	GPS-PPS	GPS - PPS
4	DGND	Digital Ground

Interface connector: EEG.00.304.CLL

Mating connector: FGG.00.304.CLAD27Z

The DS-IMU-2 needs additional Power-supply.

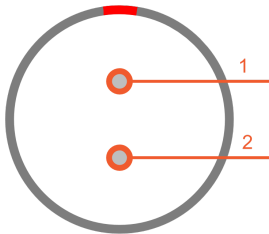
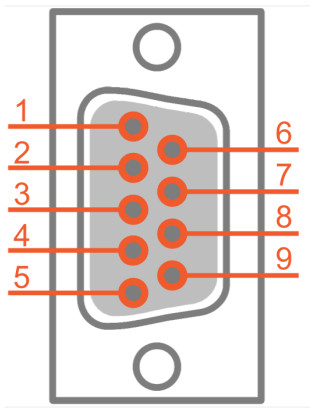


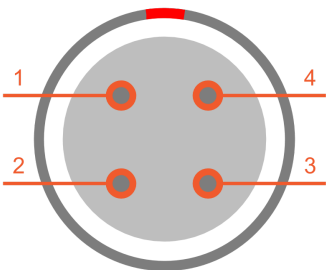
Image 10: Power supply connector (2-pin LEMO male)
EXJ.1B.302.HLD

Pin	Description
1	+9 to +36 VDC power supply
2	GND power supply

4.7.2. DS-IMU1 cable and DS-GYRO1 cable



PIN	Function
1	+5V (USB)
2	TX AUX
3	RX AUX
4	PPS FLT
5	GND
6	PPS RADIO
7	Not Connected
8	GPIO1 FLT
9	Not Connected



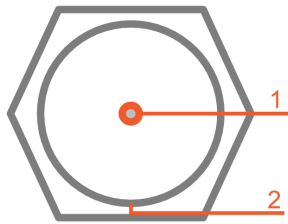
Sync connector: pin-out (4-pin LEMO female)

Pin	Name	Description
1	CLK	Clock
2	Trigg	Trigger
3	GPS-PPS	GPS - PPS
4	DGND	Digital Ground

Interface connector: EEG.00.304.CLL
Mating connector: FGG.00.304.CLAD27Z

4.8. Antenna connection

- DS-IMU-2 has two Antenna connectors
- DS-IMU-1 has one Antenna connector
- DS-GYRO1 does not have Antenna connector



Pin	Description
1	Hot
2	shield

Interface connector: SMA female
Mating connector: SMA male

5. Installations

5.1. Position and alignment

When installing DS-IMU and DS-GYRO1 products into a vehicle, correct positioning and alignment are essential to achieve good performance. There are a number of goals in selecting a mounting site in your application, these are:

- The unit should be mounted in an area that is not going to exceed its temperature range.
- The unit should be mounted away from high levels of vibration where possible.
- The unit should be mounted within several meters of the GNSS antennas where possible.
- If atmospheric altitude is going to be used, the two vents on the sides of DS-IMU products should not be obstructed.
- The unit should be mounted close to the center of gravity of the vehicle where possible.
- For best performance during GNSS outages, DS-IMU products should be mounted at least 10 cm away from sources of dynamic magnetic interference i.e. high current wiring, large motors,...

5.1.1. Alignment of device

The easiest way to align DS-IMU and DS-GYRO1 is by installing it with the sensor axes aligned with the vehicle axes. This means that the X axis points forward towards the front of the vehicle and the Z axis points down towards the ground. See the Illustration below.



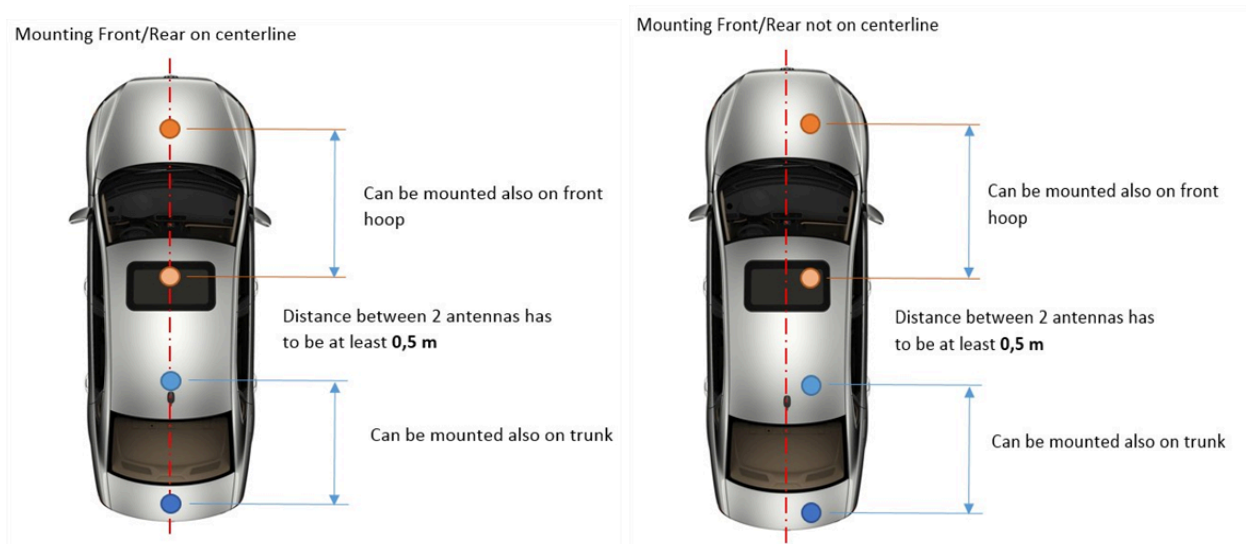
Image 30: Alignment of device

If aligning the units with the vehicle's axes is not possible or not optimal, it may be mounted in a different alignment and the alignment offset should be configured using DewesoftX® software package, which is described in 6.2.2 section.

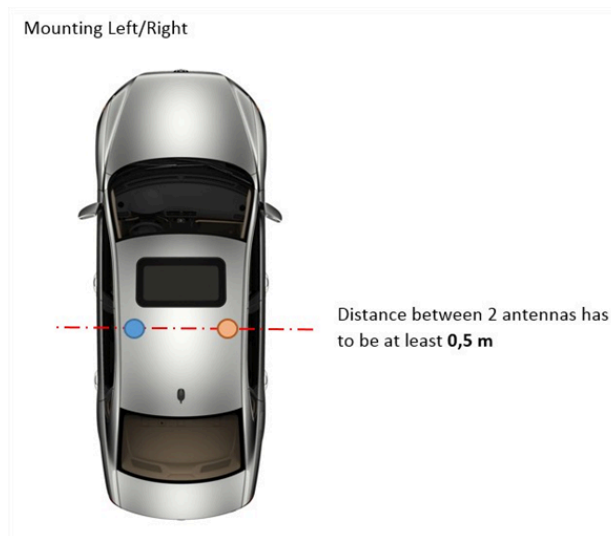
5.1.2. Alignment of Dual antenna

Since DS-IMU2 is dual antenna system, both antennas has to be aligned in one of the 4 possibilities:

1. Primary antenna front – Secondary antenna rear
2. Secondary antenna front – Primary antenna rear



3. Primary antenna left – Secondary antenna right
4. Secondary antenna left – Primary antenna right



How to set up DS-IMU2 with Antenna alignment is written in 6.2.2.

5.2. GNSS antennas

The GNSS antennas should be installed level with a clear unobstructed view of the sky and close to the DS-IMU unit where possible. The antennas should be mounted away from any RF emitters. It is important to have a ground plane (flat conductive surface such as a piece of plate aluminum) under the antenna with a minimum radius of 60mm. Correct antenna positioning is very important for DS-IMU2 heading to function correctly.

The primary antenna position offset should be configured in the DS-IMU products by using the alignment dialogue in the DS-IMU plugin, see section. The antenna offset is measured from the center of the DS-IMU unit to the central base of the antenna in the body frame. It is very important to set the antenna offset accurately as DS-IMU2 corrects for lever arm velocities. Incorrect GNSS antenna offset will lead to performance degradation under turning and angular rotations.

The secondary antenna should be mounted directly behind the primary antenna with as much separation as possible. The higher the separation the better the orientation accuracy. Both antennas should be mounted at exactly the same vertical height on the vehicle, if used with automatic offset settings. See Illustration for example mounting on a car. If it is impractical to mount the secondary antenna directly behind the primary antenna, it can be mounted in another position. In this case the secondary antenna offset must be accurately measured and entered using the secondary antenna configuration dialogue in the DS-IMU plugin, see section.

The standard antenna supplied in the DS-IMU2 evaluation kit is the Antcom G5Ant-53A4T1. It is an L1/L2/L5 RTK antenna that supports GPS, GLONASS, BeiDou, Galileo, Omnistar and SBAS. It is environmentally sealed to the IP68 standard.

If you are sourcing your own antenna, please note the following antenna guidelines:

- The antenna should be capable of receiving both L1 and L2. Heading performance will be significantly degraded with an L1 only antenna.

- The antenna needs to have an accurate phase center to be RTK capable. This is required for the dual antenna heading to function correctly. Low performance (cheap) antennas are typically not able to achieve good heading performance.
- The antenna should have an LNA gain of at least 35dB.
- The antenna should support both GPS and GLONASS.
- The antenna should be environmentally sealed, including connectors.

If you are sourcing your own antenna cables it is important to ensure that the antenna has enough gain to support the loss over the cable. DS-IMU2 requires a minimum of 33dB of gain at the connector. With the standard 5 meter LMR240 antenna cables supplied by Dewesoft, the minimum antenna gain is 34.5dB.L1HV

5.2.1. GNSS antenna cables

The antenna cables should be routed away from powerful RF emitters, high current wiring, high temperatures and any rotating or reciprocating machinery. It is very important not to bend the antenna cable beyond its maximum bend radius. It is recommended to use wide cable ties and be careful not to do them up too tight. Dewesoft recommends using either RG58 low loss or LMR240 coaxial cable combined with high quality connectors. LMR300 and LMR400 can also be used to minimize loss for very long antenna cables.

Cable type	Minimum bend radius	Signal loss
RG-58/U low loss	20 mm	~0.92 dB/m
LMR240	20 mm	~0.33 dB/m
LMR300	22.2 mm	~0.26 dB/m
LMR400	25.4 mm	~0.17 dB/m

5.3. Power supply

A high level of power supply filtering has been built into DS-IMU products, however it is still recommended that the power supply is free of significant noise. DS-IMU products contain a fully isolated power supply and have separate grounds for power and signal to ensure that power supply noise does not corrupt communications or cause ground loops with other equipment. When wiring the system, the signal ground should be routed with the primary RS232, auxiliary RS232 and GPIO pins. The power ground should be routed with the power supply to the power source.

A power supply should be selected that can provide at least the maximum current calculated from the graph mentioned above.

DS-IMU2 contains an active protection circuit on the power supply input that protects the unit from under-voltage, over-voltage and reverse polarity events. The protection circuit shuts off power and automatically recovers the unit to full operation once the fault is removed. Take care when running the unit close to its under-voltage lockout of 8.5 V because small voltage drops can engage the

under-voltage shutdown and potentially oscillate between the on and off state. It is recommended that the unit is always run at 9.5 V or more to avoid issues associated with this.

6. Operation

6.1. Filter

DS-IMU products contain a very sophisticated filter which it uses to fuse all its sensors into a state estimation. The filter is a set of custom algorithms that have similar principles to a kalman filter, but operate differently. DS-IMU's custom filter makes decisions based upon context and history which greatly improves performance and makes it more resilient to error sources than a standard kalman filter.

Under rare conditions, when there are large errors present that DS-IMU's filter cannot compensate for, it can become unstable. If DS-IMU's filter does become unstable a monitoring process will immediately reset the filter to the last known good state. The filter initialized flag will remain reset until the filter stabilizes again. In real time control applications it is very important to monitor DS-IMU's filter status, so that data can be ignored if a situation occurs causing the filter to reset.

6.2. Initialisation

When DS-IMU2 starts up, it assumes that it can be in any orientation. To determine its orientation it uses the accelerometers to detect the gravity vector. Whilst this is occurring, if there are random accelerations present, these can cause an incorrect orientation to be detected. To prevent this, DS-IMU2 monitors the accelerometers and gyroscopes and restarts the orientation detection if there are sudden movements. It is however still possible under some circumstances for it to miss movements and start with a small orientation error. In this scenario DS-IMU2 will progressively correct the orientation error over a period of several seconds.

After orientation detection, DS-IMU's filter takes several minutes to achieve its full accuracy. It is recommended to wait two minutes after power on for applications requiring high accuracy.

6.3. Hot start

DS-IMU products are the first GNSS/INS on the market with hot start functionality. This allows it to start inertial navigation within 500 milliseconds and obtain a GNSS fix in as little as 3 seconds. This hot start is always on and fully automatic.

A next generation backup battery system within DS-IMU2 provides the hot start ability for more than 24 hours without power. When DS-IMU2 hot starts it assumes that it is in the same position it was when it lost power and begins navigating from that position. The hot start also provides ephemeris, almanac and time information to the GNSS receiver which allows it to achieve a fix far more quickly than it otherwise would. When the GNSS achieves its first fix, if this position deviates from the hot start position, DS-IMU2 will jump to the new position without causing any side effects to the filter.

Whilst DS-IMU products are without power it keeps track of the time accurately to within 1 second so that the time is immediately valid on a hot start.

DS-IMU's hot start is of particular benefit to vehicle tracking and robotics applications. The primary benefits are immunity and fast recovery from power failure as well as fast startup time.

6.4. Time

DS-IMU products are designed to provide a highly accurate time reference. When a GNSS fix is available the time of instruments is accurate to within 50 nanoseconds. When a GNSS fix is lost this time accuracy typically remains within 10 microseconds over extended time periods. At hot start the time accuracy is typically within 1 second immediately on startup and corrected to within 50 nanoseconds as soon as a GNSS fix is achieved. To synchronize with DS-IMU products PPS and GPS time has to be used.

6.5. Correction data

6.5.1. Omnistar

DS-IMU2 internal GNSS receiver supports the Omnistar corrections service. The Omnistar corrections service allows the DS-IMU2 to achieve higher positional accuracy than standard GNSS, see section Omnistar is a satellite based service and the corrections are received using the same GNSS antenna used for positioning, this means that there is no additional infrastructure equipment required to use Omnistar. Omnistar is a paid subscription service with a yearly fee. Please contact your local Omnistar representative for pricing information. The current Omnistar subscription can be viewed in the Settings → Extensions → DS-IMU → Connected device.

6.5.2. RTK

DS-IMU2's internal GNSS receiver supports RTK GNSS which uses correction data from a base station to provide significantly higher positional accuracy than standard GNSS. RTK requires additional infrastructure equipment to receive corrections and is not practical for all applications. There are two different options for receiving RTK corrections. For applications that are within good cellular coverage we recommend cellular RTK corrections. For applications that have poor or no cellular coverage we recommend base station radio modem RTK corrections.

6.5.2.1. Cellular RTK corrections

For cellular RTK corrections, Dewesoft recommends the JAVAD Jlink GSM cellular corrections receiver. This unit can be plugged directly into DS-IMU2's RS232 port to receive cellular RTK correction. This solution is also supplied by Dewesoft as a package by request.

6.5.2.2. Base station radio modem RTK corrections

Base station radio modem RTK corrections require two additional pieces of hardware, these are the RTK base station and the radio modem receiver. The base station is set up at a fixed location and transmits corrections to the radio modem receiver that is connected to the mobile DS-IMU2 unit. The radio modem receiver and DS-IMU2 unit must remain within range of the base station to receive these corrections, typically this range is approximately 20 km, but it depends on the RF antenna which are used.

6.6. Environmental exposure

Whilst DS-IMU products are environmentally protected, there are clearly defined limits to this protection that must be adhered to for reliable operation. Products are only protected when connectors are mated and SMA GNSS antennas are attached to them. When any of these connections are not securely connected the unit offers no environmental protection. Spanners or tools should never be used to tighten the connectors. They should only ever be finger tight.

6.6.1. Temperature

DS-IMU products should not be subjected to temperature's outside of its operating range. If the temperature rises above 90 degrees Celsius, units will automatically shut off power to its sensors and GNSS in an attempt to prevent damage, this will also send the filters into reset. Subjecting DS-IMU products to temperature's outside of the storage range can affect the factory sensor calibration which will cause a permanent performance degradation.

6.6.2. Water

DS-IMU products are water-proof to the IP67 standard which means that it can be submerged in water to a depth of up to 1 meter only. Submersion to depths beyond 1 meter can cause water entry and destruction of the internal electronics.

6.6.3. Salt

DS-IMU products are made from marine grade aluminum which gives it reasonably good salt water corrosion resistance. However units cannot tolerate extended periods of time in salt water environments. After any contact with salt water environments, devices should be thoroughly rinsed with fresh water.

6.6.4. Dirt and dust

DS-IMU products are completely sealed against dirt and dust entry. It is important to note that this is only the case when the connectors are mated. When un-mating the connectors if the units are dirty or dusty, the dirt should be rinsed off with fresh water first and then dried off. This is to prevent dirt or dust entering the connectors which can cause them to fail.

6.6.5. pH level

Environments with a high or low pH level can cause the enclosure to corrode. If DS-IMU comes into contact with these environments it should be rinsed in fresh water as soon as possible. It is not recommended to operate devices in non neutral PH environments.

6.6.6. Shocks

DS-IMU products can tolerate shocks to 2000g, however continuous shocks of this severity are likely to cause premature failure. Shocks above 2000g can affect the factory sensor calibration and degrade performance. Normally shocks to these units when mounted in a vehicle are fine. Even a high speed car crash is likely to reach a peak of only 50g. Shocks directly to device enclosure can more easily go over the limit however care should be taken when handling the unit prior to mounting.

7. Connecting to DewesoftX®

There are several different ways to connect DS-IMU devices and use them inside DewesoftX® software. Each of the product lines will be described with all the possibilities of how to connect it.

7.1. DS-IMU1

DS-IMU1 can be connected in 4 different ways.

- Standalone DS-IMU1 with **PPS** synchronization (used when only DS-IMU1 is connected to the computer).
- Standalone DS-IMU1 with **Master clock** synchronization (used when only DS-IMU1 is connected to the computer and will be used inside DewesoftX's **NET option**)
- DS-IMU1 + several additional **SIRIUS/43** – **more than 1 unit or SIRIUS + triggered camera → PPS synchronization** has to be used for DS-IMU1
- DS-IMU1 + **1 additional SIRIUS/43** can be synchronized in **Master clock mode** and then used with
- DewesoftX's **NET option** to connect multiple vehicles/testing places

7.1.1. Standalone DS-IMU1 with PPS synchronization

To use this synchronization mode only DS-IMU1's USB has to be connected (over which it is powered and data is transferred). **Sync (4 pin 0B Lemo) connector must not be connected**, otherwise the unit will not send the data. Details on how to set the software are written in the next chapter, where **PPS synchronization** has to be picked.



Image 31: Connection of DS-IMU device

7.1.2. Standalone DS-IMU1 with Master clock synchronization

To use this synchronization mode only DS-IMU1's USB has to be connected (over which it is powered and data is transferred). **Sync (4 pin 0B Lemo) connector must not be connected**, otherwise the unit will not send the data. Details on how to set the software are written in the next chapter, where **Master clock synchronization** has to be picked.

With this mode DS-IMU1 can be used in the **NET option** to synchronize with other computers, which has a GPS device, which outputs PPS.

7.1.3. DS-IMU1 with more than 1 SIRIUS/43 or with SIRIUS/43 + triggered camera in PPS synchronization mode

Synchronization mode, where there is more than 1 additional SIRIUS/43, DS-IMU1, has to be **PPS sync**. Which means that only samples from DS-IMU1 will be related to PPS and not a complete system, because SIRIUS/43 can have either input/output on the Sync connector. The result of such synchronization is that there might be a small delay between IMU data and analog/camera data.

The same is valid for systems where SIRIUS/43 + triggered cameras are used, because on SYNC connectors there is a sample rate divider, which has to trigger the camera and therefore cannot be used for PPS synchronization. Therefore in such cases **SYNC connector from the IMU must not be connected**.

Details on how to set the software are written in the next chapter, where **PPS synchronization** has to be picked.

7.1.4. DS-IMU1 with 1x SIRIUS/43 in Master clock synchronization mode

In this configuration DS-IMU1 is connected together with a single Dewesoft device (either 43/SIRIUS) and is providing Time + PPS signal to this system. With such usage data from DS-IMU1 and SIRIUS/43 data will be synchronized with accuracy higher than 0.001 ms.



Image 32: Connection of DS-IMU device

This system can then be used in the **NET option** with another system and will be totally synchronized to it. **In such systems PPS has to be connected** and **Master clock** mode has to be turned ON. Synchronization of SIRIUS/43 **must be set to External → GPS PPS**, otherwise DS-IMU1 will not output data.

Details on how to set the software are written in the next chapter, where **Master clock synchronization** has to be picked.

7.2. DS-IMU2

DS-IMU2 can be connected in 4 different ways.

- Standalone DS-IMU2 with PPS synchronization (used when only DS-IMU2 is connected to the computer).
- Standalone DS-IMU2 with Master clock synchronization (used when only DS-IMU2 is connected to the computer and will be used inside DewesoftX's NET option)
- DS-IMU2 + several additional SIRIUS/43 – more than 1 unit has to be synchronized with PPS synchronization mode (used when there is more than one external slice of SIRIUS or 43, because it is possible to synchronize only one unit at a time)
- DS-IMU2 + 1 additional SIRIUS/43 can be synchronized in Master clock mode and then used with DewesoftX's NET option to connect multiple vehicles/testing places

7.2.1. Standalone DS-IMU2 with PPS synchronization

To use this synchronization mode only DS-IMU2's USB has to be connected (and 2 pin LEMO for power).

Sync (4 pin 0B Lemo) connector must not be connected, otherwise the unit will not send the data.

Details on how to set the software are written in the next chapter, where **PPS synchronization** has to be picked.



Image 33: Connection of DS-IMU device

7.2.2. Standalone DS-IMU2 with Master clock synchronization

To use this synchronization mode only DS-IMU2's USB has to be connected (over which it is powered and data is transferred). **Sync (4 pin 0B Lemo) connector must not be connected**, otherwise the unit will not send the data. Details on how to set the software are written in the next chapter, where **Master clock synchronization** has to be picked.

With this mode DS-IMU2 can be used in the **NET option** to synchronize with other computers, which has a GPS device, which outputs PPS.

7.2.3. DS-IMU2 with more than 1 SIRIUS/43 or with SIRIUS/43 + triggered camera in PPS synchronization mode

Synchronization mode, where there is more than 1 additional SIRIUS/43, DS-IMU2, has to be **PPS sync**. Which means that only samples from DS-IMU2 will be related to PPS and not complete systems, because SIRIUS/43 can have either input/output on a Sync connector. The result of such synchronization is that there might be a small delay between IMU data and analog/camera data.

The same is valid for systems where SIRIUS/43 + triggered cameras are used, because on SYNC connectors there is a sample rate divider, which has to trigger the camera and therefore cannot be used for PPS synchronization. Therefore in such cases **SYNC connectors from the IMU must not be connected**.

Details on how to set the software are written in the next chapter, where **PPS synchronization** has to be picked.

7.2.4. DS-IMU2 with 1x SIRIUS/43 in Master clock synchronization mode

In this configuration DS-IMU2 is connected together with a single Dewesoft device (either 43/SIRIUS) and is providing Time + PPS signal to this system. With such usage data from DS-IMU1 and SIRIUS/43 data will be synchronized with accuracy higher than 0.001 ms.



Image 34: Connection of DS-IMU device

This system can then be used in **NET option** with another system and will be totally synchronized to it. **In such systems PPS has to be connected** and **Master clock** mode has to be turned ON.

Synchronization of SIRIUS/43 must be set to **External → GPS PPS**, otherwise DS-IMU2 will not output data.

Details on how to set the software are written in the next chapter, where **Master clock synchronization** has to be picked.

7.3. DS-GYRO1

DS-GYRO1 can be connected in 4 different ways, but practically there are just 3 possibilities.

- Standalone DS-GYRO1 with PPS/Master clock synchronization (used when only DS-GYRO1 is connected to the computer).
- DS-GYRO1 + several additional SIRIUS/43 – more than 1 unit or SIRIUS + triggered camera → PPS synchronization has to be used for DS-GYRO1
- DS-GYRO1 + 1 additional SIRIUS/43 can be synchronized in Master clock mode, where data coming from the gyro device and SIRIUS/43 will be synchronized

7.3.1. Standalone DS-GYRO1 with PPS synchronization

To use this synchronization mode only DS-GYRO1's USB has to be connected (over which it is powered and data is transferred). **Sync (4 pin 0B Lemo) connector must not be connected**, otherwise the unit will not send the data. Details on how to set the software are written in the next chapter, where **PPS or Master clock synchronization** has to be picked.



Image 35: Connection of DS-IMU device

DS-GYRO1 can not be used in the NET option, because devices don't have real PPS, but just generated out of an internal clocking system, to be able to synchronize one additional SIRIUS/43.

7.3.2. DS-GYRO1 with more than 1 SIRIUS/43 or with SIRIUS/43 + triggered camera in PPS synchronization mode

Synchronization mode, where there is more than 1 additional SIRIUS/43, DS-GYRO1, has to be PPS sync. Which means that only samples from DS-GYRO1 will be related to internal PPS and not complete systems, because SIRIUS/43 can have either input/output on the Sync connector. The result of such synchronization is that there might be a small delay between GYRO data and analog/camera data.

The same is valid for systems where SIRIUS/43 + triggered cameras are used, because on SYNC connectors there is a sample rate divider, which has to trigger the camera and therefore cannot be used for PPS synchronization. Therefore in such cases **SYNC connector from the GYRO must not be connected**.

Details on how to set the software are written in the next chapter, where **PPS synchronization** has to be picked.

7.3.3. DS-GYRO1 with 1x SIRIUS/43 in Master clock synchronization mode

In this configuration DS-GYRO1 is connected together with a single Dewesoft device (either 43/SIRIUS) and is providing Time + PPS signal to this system. With such usage data from DS-GYRO1 and SIRIUS/43 data will be synchronized with accuracy higher than 0.001 ms.



Image 36: Connection of DS-GYRO device

This system **can not** be used in **NET option** with another system, because the PPS signal is generated from the internal clock and not related to GPS PPS signal.

Synchronization of SIRIUS/43 **must be set to External → GPS PPS**, otherwise DS-IMU1 will not output data.

Details on how to set the software are written in the next chapter, where **Master clock synchronization** has to be picked.

8. Software configuration

8.1. Settings

After connecting the device to the PC installation of the RS232 driver is needed.



Important

If using Dewesoft inertial measurement units with S-BOX connect USB to the back of S-BOX into USB2.0 port.

- Download DewesoftX® software and plugin from www.dewesoft.com.
- Install driver for RS232 converter (CDM v2.10.00 WHQL Certified file)
- Run DewesoftX® software --> go to Settings --> Devices --> Click on the plus button and under Plugins you will find the DS-IMU option.

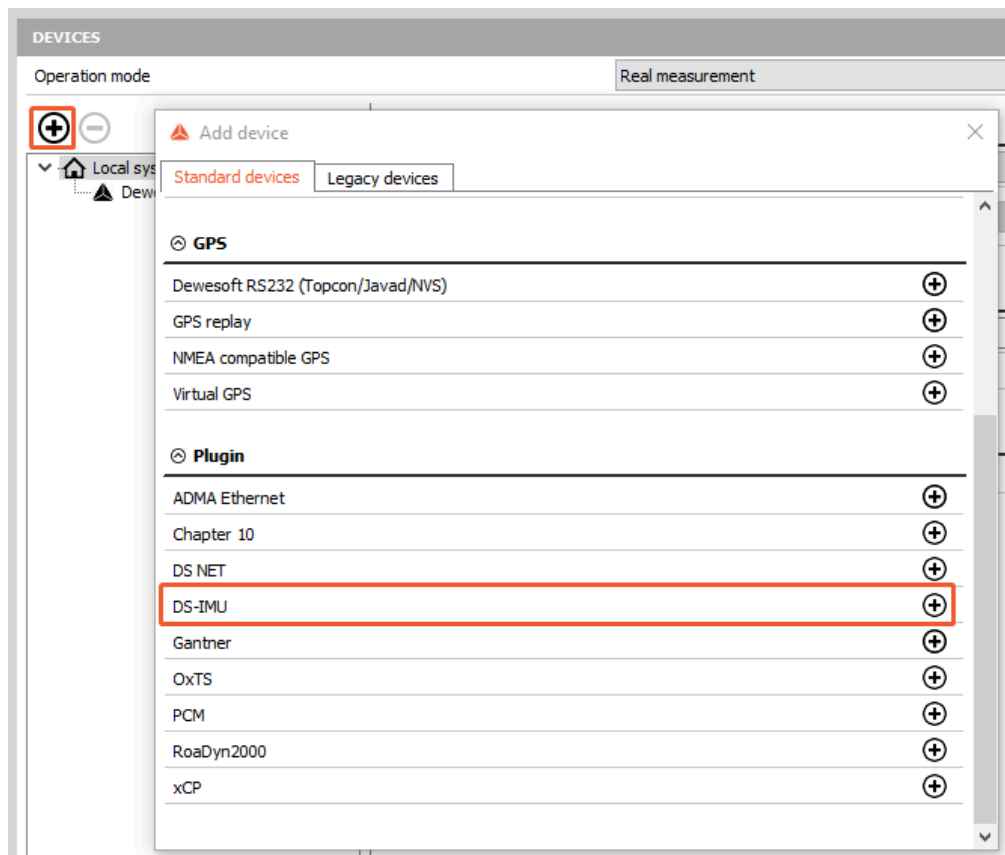


Image 37: How to add DS-IMU device

- The device should be automatically recognized, if not press the Rescan device.

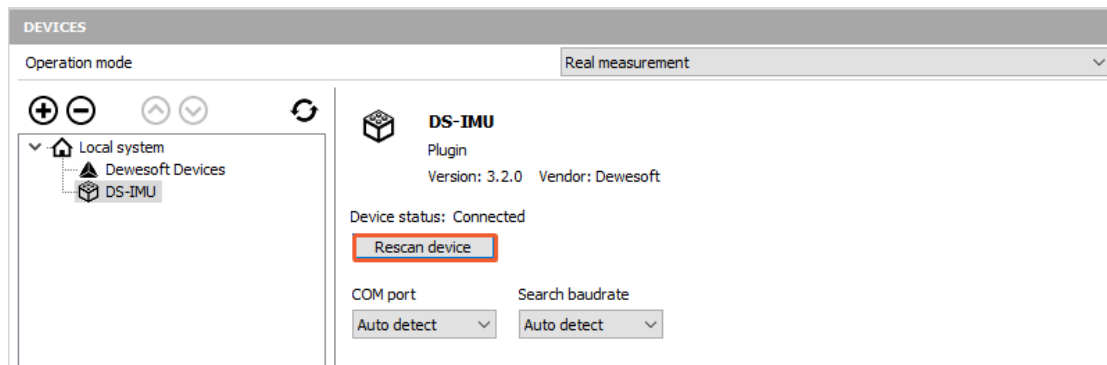


Image 38: Rescan the device

- If device is successfully recognized you will see all of the Device Info

🔍 Device info	
Serial	
Device ID	5 (DS-IMU2)
COM port number	7
Baudrate	1000000
Firmware version	3.000
Update firmware	🔍
Hardware version	2.000

Image 39: Device Information in Settings

- Next step is to select the synchronization. You need to click on the “Local system” to switch to the synchronization settings.

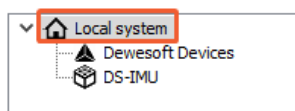


Image 40: Synchronization options

- Soft-sync → means that the device is in SoftSync

🔍 Synchronization	
Time source	PC Clock
PC Clock Clock provider Standalone	Automatic
DS-IMU No hardware sync	SoftSync

Image 41: Soft-Sync Synchronization options

- Master clock → means the device will use PPS and GPS time for synchronization of all Dewesoft devices. By using this function all analog data will be synchronized to GPS time. For this option you need to choose a DS-IMU device as Time Source.

⊙ Synchronization

Time source	DS-IMU
DS-IMU Clock provider	GPS PPS

Image 42: Master-Clock synchronization

3. Clock slave → When there is an additional GPS master clock the DS-IMU is in Clock slave mode

⊙ Synchronization

Time source	Dewesoft RS232 (Topcon/Javad/NVS) - COM8
Dewesoft RS232 (Topcon/Javad/NVS) - COM8 Clock provider	GPS PPS
DS-IMU Clock slave	GPS PPS

Image 43: Clock slave synchronization

- After performing all the changes press OK to confirm them.

8.2. Channel setup

Screen similar to the one below should show up:

Device connected	Device status	GPS mode	Number of used satellites	Upload changed settings Device setup equals this setup.	Download settings from device	Restart device	Disconnect device
Connected	Heading not ready	Standalone	Used satellites: 7	Upload to device	Download from device	Restart device	Disconnect

Image 44: Channel setup notification bar

On top of the screen it's possible to see:

- If device is connected or disconnected
- Which device is connected and serial number of it
- Which timing mode you have selected Settings
- Device status (Heading not ready means that the device is not initialized)
- GPS mode (Standalone, DGPS, Omnistar, RTK fixed)
- Number of used satellites
- Reset device (to re-initialize internal filter values)
- With widgets Data – Mounting – Configuration you can move between different screen options

8.2.1. Data

In the widget “Data” channels, which can be stored are shown. In the channel list it's possible to change channel name, color, default units, scaling, offset and zero offset to all of them.

Several conversion units are already predefined and can be chosen from drop-down list:

- Speed unit (meters/second, kilometers/hours, miles/hour)
- Acceleration unit (meters/second², g=9.80665 meters/second²)

It's possible to change the update rate of channels as well. Maximum for DS-IMU2 and DS-GYRO is 500 Hz and for DS-IMU1 is 100 Hz. Several channels are stored at lower sample rate, due to the limitation of RS232, otherwise there is Data overrun and you would start losing samples.

The last option in this widget is to enable “Reset distance on start of measurement” or in other words reset distance on start of storing inside measure mode.

Index	Channel name	Description	Channel rate
0	Time	GPS time (date + time in microseconds)	Up to 500 Hz
1	System status	Status of internal filter and device	Up to 500 Hz
2	GNSS status	GNSS status (Standalone, DGPS, RTK mode,..)	Up to 500 Hz
3	Navigation	Channel assembled from latitude, longitude, height, roll and pitch and heading/jaw	Up to 500 Hz
4	Latitude	Latitude is a geographic coordinate that specifies the north-south position of a point on the Earth's surface	Up to 500 Hz
5	Longitude	Longitude is a geographic coordinate that specifies the east-west position of a point on the Earth's surface	Up to 500 Hz
6	Height	Height above the WGS84 reference ellipsoid (model to approximate sea level across the Earth)	Up to 500 Hz
7	Heave	Vertical heave position	20 Hz
8	Geodetic height	Ellipsoidal height (or ellipsoidal altitude), also known as geodetic height (or geodetic altitude)	20 Hz
9	Velocity north	Velocity north in ECEF coordinate system (described in section 3.8)	Up to 500 Hz
10	Velocity east	Velocity east in ECEF coordinate system (described in section 3.8)	Up to 500 Hz
11	Velocity down	Velocity down in ECEF coordinate system (described in section 3.8)	Up to 500 Hz
12	Velocity total	Total velocity (vector sum of all 3 directions)	Up to 500 Hz

13	Software distance	Calculated distance out of Velocity total	Up to 500 Hz
14	Velocity X	Velocity X in local coordinate system of device (coordinate system shown on device)	Up to 500 Hz
15	Velocity Y	Velocity Y in local coordinate system of device (coordinate system shown on device)	Up to 500 Hz
16	Velocity Z	Velocity Z in local coordinate system of device (coordinate system shown on device)	Up to 500 Hz
17	Body velocity X	Velocity in X axis of the device compensated for Roll and Pitch	Up to 500 Hz
18	Body velocity Y	Velocity in Y axis of the device compensated for Roll and Pitch	Up to 500 Hz
19	Body velocity Z	Velocity in Z axis of the device compensated for Roll and Pitch	Up to 500 Hz
20	Body acceleration X	Acceleration in X axis of the device compensated for Roll and Pitch	Up to 500 Hz
21	Body acceleration Y	Acceleration in Y axis of the device compensated for Roll and Pitch	Up to 500 Hz
22	Body acceleration Z	Acceleration in Z axis of the device compensated for Roll and Pitch	Up to 500 Hz
23	G force	G force is a vector sum of all 3 acceleration components shown in [g]	Up to 500 Hz
24	Roll	Roll is the angle of the vehicle around the X axis.	Up to 500 Hz
25	Pitch	Pitch is the angle of the vehicle around the Y axis.	Up to 500 Hz
26	Heading	Heading/Jaw is the angle of the vehicle around the Z axis.	Up to 500 Hz
27	Angular velocity X	Angular velocity X shows the amount of rotation which an object has per second around the X axis.	Up to 500 Hz
28	Angular velocity Y	Angular velocity Y shows the amount of rotation which an object has per second around the Y axis.	Up to 500 Hz
29	Angular velocity Z	Angular velocity Z shows the amount of rotation which an object has per second around the Z axis.	Up to 500 Hz
30	Slip angle	Slip angle is the angle between vehicle actual direction and direction where vehicle is pointing at	Up to 500 Hz
31	Accelerometer X	Raw acceleration in X axis	Up to 500 Hz
32	Accelerometer Y	Raw acceleration in Y axis	Up to 500 Hz

33	Accelerometer Z	Raw acceleration in Z axis	Up to 500 Hz
34	Gyroscope X	Raw angular velocity X	Up to 500 Hz
35	Gyroscope Y	Raw angular velocity Y	Up to 500 Hz
36	Gyroscope Z	Raw angular velocity Z	Up to 500 Hz
37	Magnetometer X	Measurement of magnetic field in X direction	Up to 500 Hz
38	Magnetometer Y	Measurement of magnetic field in Y direction	Up to 500 Hz
39	Magnetometer Z	Measurement of magnetic field in Z direction	Up to 500 Hz
40	IMU temperature	Internal temperature of the device	Up to 500 Hz
41	Pressure	Outside pressure	Up to 500 Hz
42	Raw latitude	Raw latitude is latitude coming directly from GNSS receiver (not filtered)	20 Hz
43	Raw longitude	Raw longitude is longitude coming directly from GNSS receiver (not filtered)	20 Hz
44	Raw heading	Raw Heading/Jaw is the heading coming directly from GNSS receiver (not filtered)	20 Hz
45	Raw height	Raw height is height coming directly from GNSS receiver (not filtered)	20 Hz
46	Raw velocity north	Raw velocity north is velocity north coming directly from GNSS receiver (not filtered)	20 Hz
47	Raw velocity east	Raw velocity east is velocity north coming directly from GNSS receiver (not filtered)	20 Hz
48	Raw velocity down	Raw velocity down is velocity north coming directly from GNSS receiver (not filtered)	20 Hz
49	Raw velocity total	Raw velocity total is a vector sum of velocity north, east and down	20 Hz
50	Raw tilt	Raw tilt is the tilt coming directly from GNSS receiver (not filtered)	20 Hz
51	Number of satellites	Number of satellites used by GNSS receiver	20 Hz
52	Navigation	Channel assembled from latitude, longitude, height, roll and pitch and heading/jaw	Up to 500 Hz
53	Event	Gives the status of the event in digital input. 1 or 0	Up to 500 Hz
54	Standard deviations	Result of how dispersed the data is in relation to the mean value	Up to 500 Hz

8.2.2. Mounting

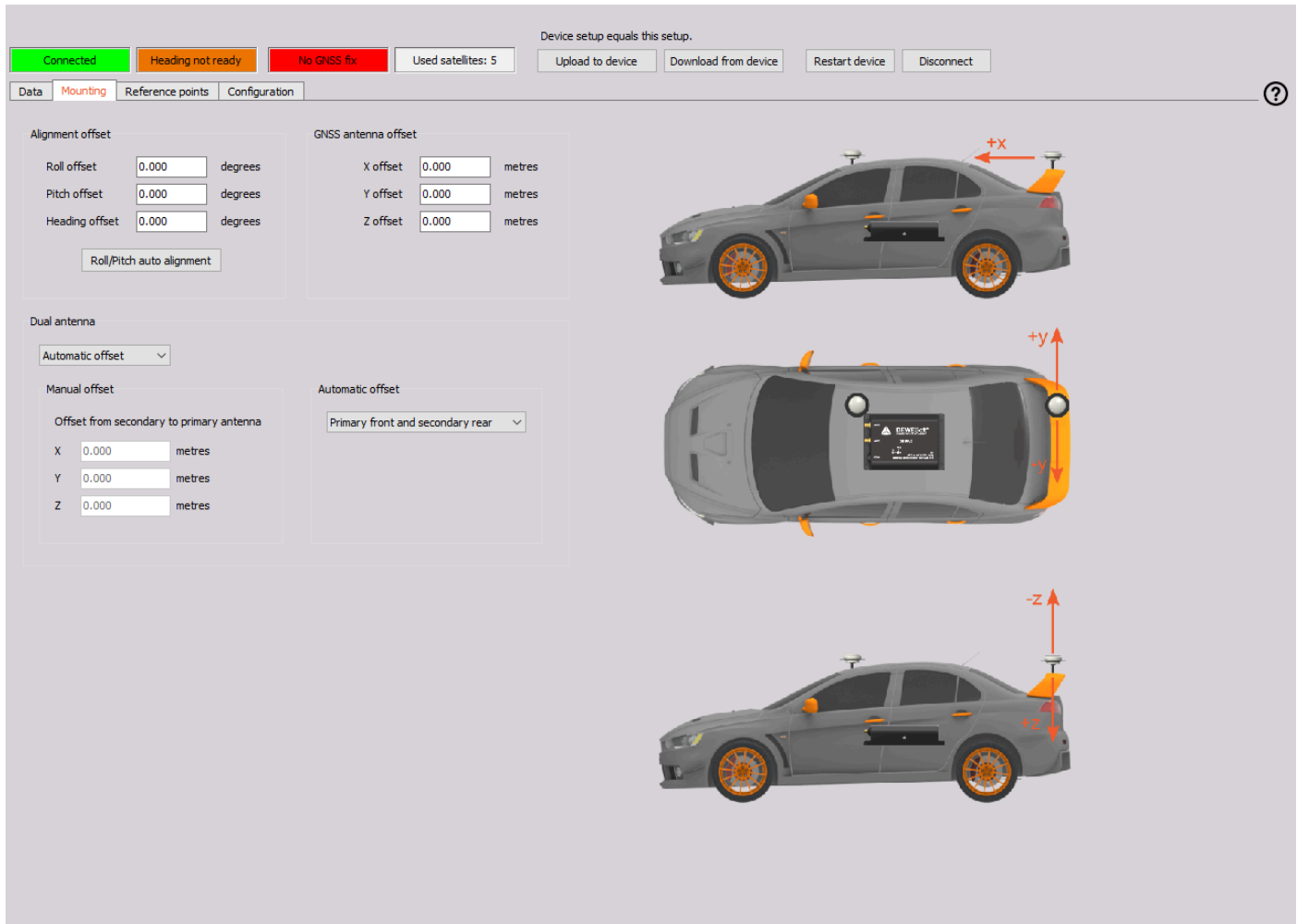


Image 45: Mounting settings

When you hover over different settings, the pictures will adjust accordingly.

8.2.2.1. Alignment offset

In this area it's possible to input angle offsets. This has to be done to compensate error of mounting and surface inclination. The most effective way of doing this is to drive on location, where you want to test (proving grounds, test circuit or just standing vehicle) and press the Set zero button. With doing this several outputs are compensated for Roll and Pitch offset.

8.2.2.2. GNSS antenna offset

This parameter has to be measured and filled carefully, because error of velocity can increase significantly due to different position of IMU and GPS antenna. Here you have to enter the distance between the GNSS antenna or in case of the DS-IMU2 primary GNSS antenna and inertial measurement unit.

8.2.2.3. Virtual measurement point

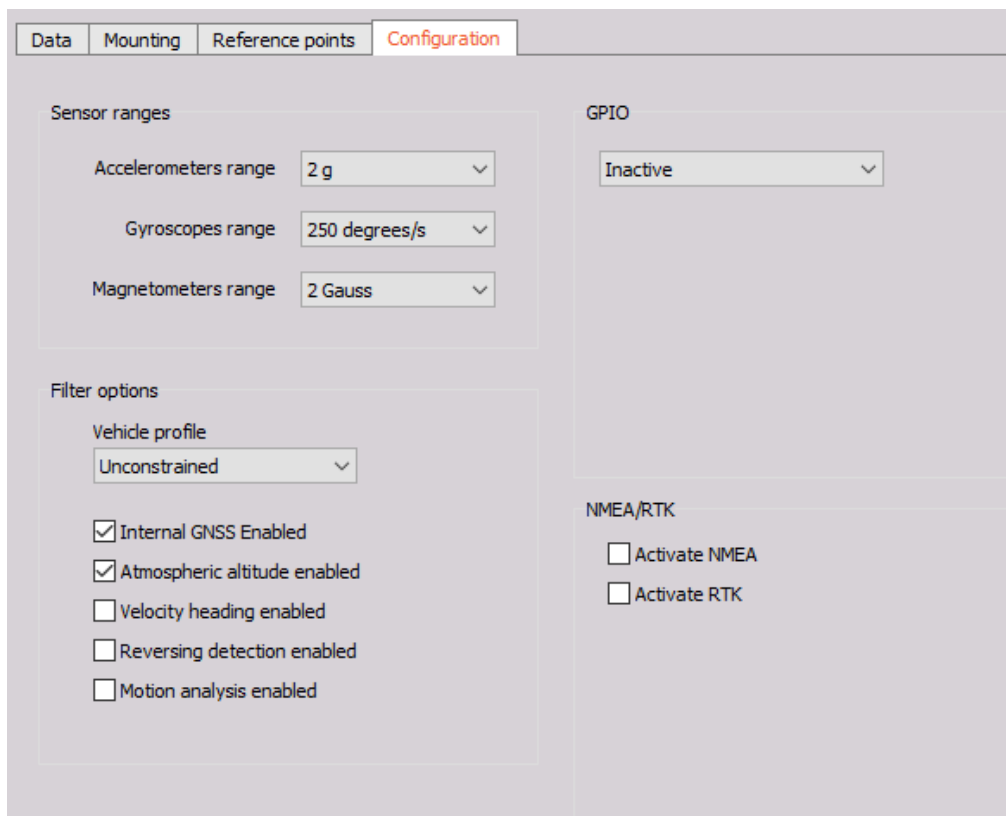
With this offset it's possible to shift position data to another point. So if you want to shift position data to CoG just enter offset from inertial platform to center of gravity.

8.2.2.4. Dual antenna (only available at DS-IMU2)

Here it's possible to choose either:

- Automatic offset (which measures offset between antenna automatically)
- Manual offset (which is more accurate → therefore data output is more accurately, but you have to measure distance between primary and secondary antenna in coordinate system of IMU)

8.2.3. Configuration



The screenshot shows the 'Configuration' tab of the software interface. It contains the following settings:

- Sensor ranges:**
 - Accelerometers range: 2 g
 - Gyroscopes range: 250 degrees/s
 - Magnetometers range: 2 Gauss
- Filter options:**
 - Vehicle profile: Unconstrained
 - ☒ Internal GNSS Enabled
 - ☒ Atmospheric altitude enabled
 - ☐ Velocity heading enabled
 - ☐ Reversing detection enabled
 - ☐ Motion analysis enabled
- GPIO:**
 - Inactive
- NMEA/RTK:**
 - ☐ Activate NMEA
 - ☐ Activate RTK

Image 46: Configuration settings

8.2.3.1. Sensor ranges

At all inertial measurement units (DS-IMU1, DS-IMU2 and DS-GYRO1) it is possible to select different dynamic ranges of inertial sensors.

Accelerometer range: 2g, 4g and 16g,

Gyroscope range: 250 deg/s, 500 deg/s and 2000 deg/s,

Magnetometer range: 2 Gauss, 4 Gauss and 8 Gauss.

With selecting different ranges we limit the profile of movement and with this achieving higher resolution in certain ranges. Also the Kalman filter is then tuned to a certain range. If you go out of range at measurement, some of the results might be incorrect. Sensors over range can be detected in the System status channel.

8.2.3.2. Filter options

Since those sensors are made for different applications (automotive, aerospace, surveying, marine,.. testing), you have to choose a vehicle profile to increase performance of internal fusion filters to certain behavior.

Therefore you have to choose vehicle profile:

- Unconstrained
- Bicycle or Motorcycle
- Car
- Hovercraft
- 3D Underwater vehicle
- Fixed Wing Plane...

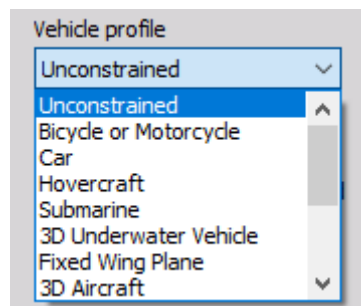


Image 47: Vehicle profile

After doing this, there are different configurations of sensor available:

- Internal GNSS Enabled (to use internal GNSS receiver instead of external)
- Atmospheric altitude enabled (to use pressure sensors to smooth altitude) → DS-IMU contains a sophisticated venting system that allows it to measure air pressure whilst keeping water out. There are two sets of vent holes on each side of the enclosure. It is very important that these remain clean and clear of debris. If debris gets into the vents they should be rinsed with fresh water. Foreign bodies should never be poked into the vent holes, this will break the environmental seal and void the warranty on the unit.
- Velocity heading enabled (to use velocity for heading, at DS-IMU2 means instead of using dual antenna, receiver uses only primary antenna for heading → no static heading, in mathematics it means heading derived from direction of velocity and acceleration. This option is working well with vehicles that do not move sideways. This heading is accurate only at velocity higher than 5 km/h. With DS-IMU2 we suggest using dual antennas unless there are problems with mounting secondary antennas.
- Reversing detection enabled (algorithm to find out when the vehicle is traveling in reverse) → if DS-IMU is mounted to the vehicle that does not reverse or does not use velocity heading or odometer, this function should be disabled.

- Motion analysis enabled (to use at nearly stationary movement, for better performance at very low velocity and is activated by dead reckoning)
- Magnetometers enabled (enabling algorithm to use internal magnetometer for in tunnel driving → available at DS-IMU1, at DS-IMU2 it's always enabled and calibrated with dual antenna)

8.2.3.3. Input/Output functions

DS-IMU2 and DS-IMU1 have one extra connector on which you can input some data (from speed sensor, OBDII, pitot tube) or output (PPS, GNSS data, NMEA data).

Both of them also have extra standard NMEA output on RS232 level. By activating this field, another field for configuration of NMEA output shows up. There you can choose different standard messages with up to 50 Hz output data rate.

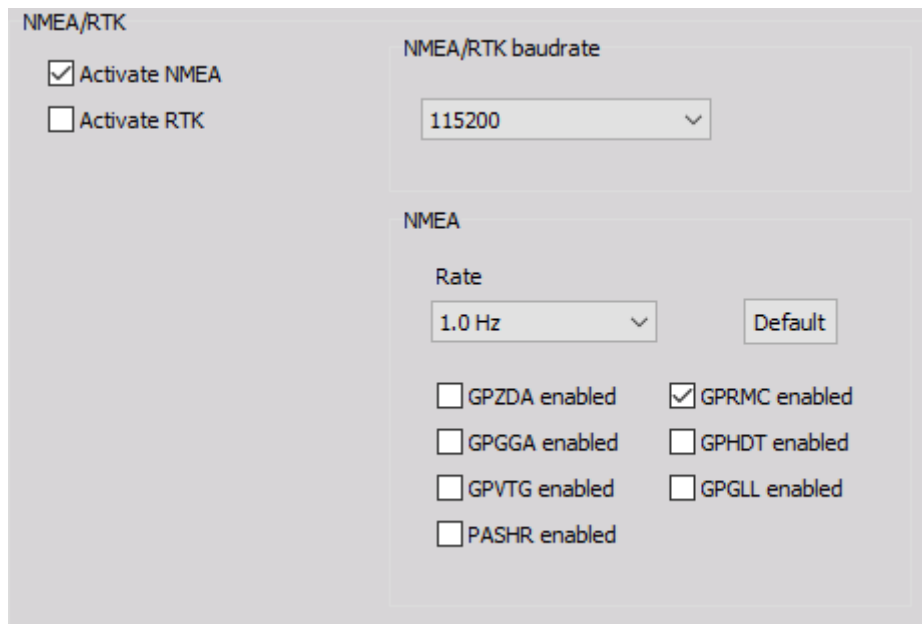


Image 48: Input/Output function

DS-IMU1 and DS-IMU2 also have the function of activating the RTK calculations (RTK1 for IMU1). This is used with either an external base station or for use with RTK Network to receive correction data inside the receiver. This port is also working on RS232 level.

Important



DS-IMU has to find satellites and then RTK connector should be connected, otherwise the GNSS receiver receives RTK correction data before it locks to the satellites and can mix it up. If this happens the unit has to be repowered and the RTK connection has to be removed as long as the unit does not receive 3D fixed.

9. Warranty information

Notice

The information contained in this document is subject to change without notice.

Note:

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The copy of the specific warranty terms applicable to your Dewesoft product and replacement parts can be obtained from your local sales and service office. To find a local dealer for your country, please visit <https://dewesoft.com/support/distributors>.

9.1. Calibration

Every instrument needs to be calibrated at regular intervals. The standard norm across nearly every industry is annual calibration. Before your Dewesoft data acquisition system is delivered, it is calibrated. Detailed calibration reports for your Dewesoft system can be requested. We retain them for at least one year, after system delivery.

9.2. Support

Dewesoft has a team of people ready to assist you if you have any questions or any technical difficulties regarding the system. For any support please contact your local distributor first or Dewesoft directly.

Dewesoft d.o.o.
Gabrsko 11a
1420 Trbovlje Slovenia

Europe Tel.: +386 356 25 300
Web: <http://www.dewesoft.com>
Email: Support@dewesoft.com
The telephone hotline is available Monday to Friday from 07:00 to 16:00 CET (GMT +1:00)

9.3. Service/repair

The team of Dewesoft also performs any kinds of repairs to your system to assure a safe and proper operation in the future. For information regarding service and repairs please contact your local distributor first or Dewesoft directly on <https://dewesoft.com/support/rma-service>.

9.4. Restricted Rights

Use Slovenian law for duplication or disclosure. Dewesoft d.o.o. Gabrsko 11a, 1420 Trbovlje, Slovenia / Europe.

9.5. Printing History

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10. Safety instructions

Your safety is our primary concern! Please be safe!

10.1. Safety symbols in the manual



Warning

Calls attention to a procedure, practice, or condition that could cause the body injury or death



Caution

Calls attention to a procedure, practice, or condition that could possibly cause damage to equipment or permanent loss of data.

10.2. General Safety Instructions



Warning

The following general safety precautions must be observed during all phases of operation, service, and repair of this product. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the product. Dewesoft d.o.o. assumes no liability for the customer's failure to comply with these requirements.

All accessories shown in this document are available as an option and will not be shipped as standard parts.

10.2.1. Environmental Considerations

Information about the environmental impact of the product.

10.2.2. Product End-of-Life Handling

Observe the following guidelines when recycling a Dewesoft system:

10.2.3. System and Components Recycling

Production of these components required the extraction and use of natural resources. The substances contained in the system could be harmful to your health and to the environment if the system is improperly handled at its end of life! Please recycle this product in an appropriate way to avoid unnecessary pollution of the environment and to keep natural resources.



This symbol indicates that this system complies with the European Union's requirements according to Directive 2002/96/EC on waste electrical and electronic equipment (WEEE). Please find further information about recycling on the Dewesoft web site www.dewesoft.com



Restriction of Hazardous Substances

This product has been classified as Monitoring and Control equipment and is outside the scope of the 2002/95/EC RoHS Directive. However, we take care of our environment and the product is lead-free.

10.2.4. General safety and hazard warnings for all Dewesoft systems

Safety of the operator and the unit depend on following these rules.

- Use this system under the terms of the specifications only to avoid any possible danger.
- Read your manual before operating the system.
- Observe local laws when using the instrument.
- DO NOT touch internal wiring!
- DO NOT use higher supply voltage than specified!
- Use only original plugs and cables for harnessing.
- You may not connect higher voltages than rated to any connectors.
- The power cable and connector serve as Power-Breaker. The cable must not exceed 3 meters, the disconnect function must be possible without tools.
- Maintenance must be executed by qualified staff only.
- During the use of the system, it might be possible to access other parts of a more comprehensive system. Please read and follow the safety instructions provided in the manuals of all other components regarding warning and security advice for using the system.
- With this product, only use the power cable delivered or defined for the host country.
- DO NOT connect or disconnect sensors, probes or test leads, as these parts are connected to a voltage supply unit.
- Ground the equipment: For Safety Class 1 equipment (equipment having a protective earth terminal), a non-interruptible safety earth ground must be provided from the mains power source to the product input wiring terminals.
- Please note the characteristics and indicators on the system to avoid fire or electric shocks. Before connecting the system, please read the corresponding specifications in the product manual carefully.
- The inputs must not, unless otherwise noted (CATx identification), be connected to the main circuit of category II, III and IV.
- The power cord separates the system from the power supply. Do not block the power cord, since it has to be accessible for the users.
- DO NOT use the system if equipment covers or shields are removed.
- If you assume the system is damaged, get it examined by authorized personnel only.
- Adverse environmental conditions are Moisture or high humidity Dust, flammable gases, fumes or dissolver Thunderstorm or thunderstorm conditions (except assembly PNA) Electrostatic fields, etc.
- The measurement category can be adjusted depending on module configuration.
- Any other use than described above may damage your system and is attended with dangers like short-circuiting, fire or electric shocks.
- The whole system must not be changed, rebuilt or opened.
- DO NOT operate damaged equipment: Whenever it is possible that the safety protection features built into this product have been impaired, either through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use the product until the safe operation can be verified by service-trained personnel. If necessary, return the product to Dewesoft sales and service office for service and repair to ensure that safety features are maintained.
- If you assume a more riskless use is not provided anymore, the system has to be rendered inoperative and should be protected against inadvertent operation. It is assumed that a more riskless operation is not possible anymore if the system is damaged obviously or causes strange

noises. The system does not work anymore. The system has been exposed to long storage in adverse environments. The system has been exposed to heavy shipment strain.

- Warranty void if damages caused by disregarding this manual. For consequential damages, NO liability will be assumed!
- Warranty void if damage to property or persons caused by improper use or disregarding the safety instructions.
- Unauthorized changing or rebuilding the system is prohibited due to safety and permission reasons (CE).
- Be careful with voltages >25 VAC or >35 VDC! These voltages are already high enough in order to get a perilous electric shock by touching the wiring.
- The product heats during operation. Make sure there is adequate ventilation. Ventilation slots must not be covered!
- Only fuses of the specified type and nominal current may be used. The use of patched fuses is prohibited.
- Prevent using metal bare wires! Risk of short circuit and fire hazard!
- DO NOT use the system before, during or shortly after a thunderstorm (risk of lightning and high energy over-voltage). An advanced range of application under certain conditions is allowed with therefore designed products only. For details please refer to the specifications.
- Make sure that your hands, shoes, clothes, the floor, the system or measuring leads, integrated circuits and so on, are dry.
- DO NOT use the system in rooms with flammable gases, fumes or dust or in adverse environmental conditions.
- Avoid operation in the immediate vicinity of high magnetic or electromagnetic fields, transmitting antennas or high-frequency generators, for exact values please refer to enclosed specifications.
- Use measurement leads or measurement accessories aligned with the specification of the system only. Fire hazard in case of overload!
- Do not switch on the system after transporting it from a cold into a warm room and vice versa. The thereby created condensation may damage your system. Acclimatise the system unpowered to room temperature.
- Do not disassemble the system! There is a high risk of getting a perilous electric shock. Capacitors still might be charged, even if the system has been removed from the power supply.
- The electrical installations and equipment in industrial facilities must be observed by the security regulations and insurance institutions.
- The use of the measuring system in schools and other training facilities must be observed by skilled personnel.
- The measuring systems are not designed for use in humans and animals.
- Please contact a professional if you have doubts about the method of operation, safety or the connection of the system.
- Please be careful with the product. Shocks, hits and dropping it from already- lower level may damage your system.
- Please also consider the detailed technical reference manual as well as the security advice of the connected systems.
- This product has left the factory in safety-related flawlessness and in proper condition. In order to maintain this condition and guarantee safety use, the user has to consider the security advice and warnings in this manual.

EN 61326-3-1:2008

IEC 61326-1 applies to this part of IEC 61326 but is limited to systems and equipment for industrial applications intended to perform safety functions as defined in IEC 61508 with SIL 1-3.

The electromagnetic environments encompassed by this product family standard are industrial, both indoor and outdoor, as described for industrial locations in IEC 61000-6-2 or defined in 3.7 of IEC 61326-1.

Equipment and systems intended for use in other electromagnetic environments, for example, in the process industry or in environments with potentially explosive atmospheres, are excluded from the scope of this product family standard, IEC 61326-3-1.

Devices and systems according to IEC 61508 or IEC 61511 which are considered as “operationally well-trying”, are excluded from the scope of IEC 61326-3-1.

Fire-alarm and safety-alarm systems, intended for the protection of buildings, are excluded from the scope of IEC 61326-3-1.

10.3. Documentation version history

Version	Date	Notes
1.0.0	31-03-2015	☑ initial revision
V20-1	5-08-2020	Changed to the new template and update images
V20-2	12-10-2020	Updated connectors for all devices, added new synchronization options
V21-1	17-02-2021	Updated SBAS information for DS-IMU1 devices. SBAS is no longer present for IMU1 v6.1 and earlier.
V22-1	01-10-2022	Magnetic calibration removed and added recommendations about using magnetometer
V23-1	04-08-2023	Fix on page 45 and 12 about connecting DS-IMU2
V23-2	18-09-2023	Open sky conditions added in technical specifications
V24-1	06-05-2024	Added initialization parameters In DS-IMU1 Quick start
V24-2	29-10-2024	4.3.3.3. and 4.4.2.3. ACC Bias stability changed from 60 µg to 5mg

V24-3	12-11-2024	Channel list in section 8.2.1. was aligned accordingly to output channels
V26-1	02-02-2026	DS-IMU-N1 added