

# Operation Instruction

## GPS with Dead Reckoning User Module OWL LTE (Industrial Cellular Router)

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OWL Industrial Cellular Routers  
GPS\_DR Module Application Note Rel. 0.3 08/2018  
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# About this Manual

This "Application" user manual contains the information you need to start operating the loaded software module. It takes you step by step from the first startup operation through to the basic settings for operation in your environment.

# 1 Safety Instructions

## ■ General safety instructions

You operate this device with electricity. The safe operation of the device depends on proper handling during transportation, storage and assembly, and proper use of operation and maintenance procedures. Improper use of this device can cause injury or property damage.

- Read this documentation, safety instructions and warnings before connecting any cables.
- Never start an operation with damaged components.
- The device does not contain any service components. If the device is not functioning correctly, or if it is damaged, turn off the power supply and return the device to Hirschmann for inspection.



## WARNING

### **UNCONTROLLED MACHINE ACTIONS**

To avoid uncontrolled machine actions caused by data loss, configure all the data transmission devices individually.

Before you start any machine which is controlled via data transmission, be sure to complete the configuration of all the data transmission devices.

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

## ■ Qualification requirements for personnel

- Allow only qualified personnel to work on the device who have the following characteristics:
  - ▶ Properly trained personnel who have practical knowledge and experience. This is the prerequisite for grounding and labeling circuits, devices, and systems in accordance with current technology safety standards.
  - ▶ Qualified personnel are aware of the dangers that exist in their work.

- ▶ Qualified personnel are familiar with appropriate measures against these hazards in order to reduce the risk for themselves and others.
- ▶ Qualified personnel receive training on a regular basis.

### ■ Intended usage

- Use the product only for the application cases described in the Hirschmann product information, including this manual.
- Operate the product according to the technical parameters. See chapter 6 for details.
- Connect components which are suitable for the requirements of the specific application case to the product.

### ■ National and international safety regulations

Verify that the electrical installation meets local or nationally applicable safety regulations.

### ■ Working voltage

- Connect only a working voltage that corresponds to the type plate of your device.
- Make sure the following requirements are met every time you connect the electrical conductors:
  - ▶ The power supply conforms to over voltage category I or II.
- ▶ The power supply has an easily accessible disconnecting device (such as a switch or a plug) which is clearly identified. So in case of an emergency, it is clear which disconnecting device belongs to which power supply cable.
  - ▶ The electrical wires are voltage-free.
  - ▶ The power supply is Class 2 compliant.
- ▶ The working voltage inputs are designed for operation with safety extra-low voltage. Connect only SELV circuits with voltage restrictions in line with IEC/EN 60950-1 to the working voltage connections.

- ▶ The wire diameter of the power supply cable is at least 1 mm<sup>2</sup> (North America: AWG16) on the working voltage input.
- ▶ The wire diameter of the ground conductor is at least 1 mm<sup>2</sup> (North America: AWG16).
- ▶ The power supply cables used are permitted for the temperature range required by the application case.

The power cords are suitable for ambient air temperatures of at least 167 °F (75 °C).

The power cord wires are made of copper.

Switch on the operating voltage for the device only when the following requirements are fulfilled:

- ▶ The housing is closed
- ▶ The terminal block is wired correctly
- ▶ The terminal block for the operating supply is connected

### ■ Installation site requirements

- Verify that there is at least 4 in (10 cm) of space above and below the device.
- Verify that there is at least 0.8 in (2 cm) of space on the right and left sides of the device.

### ■ Housing

Never insert pointed objects (narrow screwdrivers, wires, etc.) into the device or into the connection terminals for electric conductors. Do not touch the connection terminals.

### ■ Please, observe the following instructions

To prevent injury and damage to the device and to ensure that you comply with the relevant provisions, use original accessories only. Unauthorized modifications or unapproved utilization of accessories can result in damage to the router and in a breach of applicable regulations.

Unauthorized modifications or unapproved utilization of accessories can result in the termination of the guarantee.

**Note:** Keep the SIM card away from small children as it can be easily swallowed.

- Before handling the SIM card, turn off the router and disconnect it from the power supply.
- The SIM card must not exceed the maximum voltage 30 V DC power connector on the router.
- Do not expose the router to extreme ambient conditions. Protect the router against dust, moisture and high temperature.
- The router should not be used at the petrol stations and around flammable and explosive materials. We remind the users of the duty to observe restrictions concerning the utilization of radio devices at petrol stations, in chemical plants, or in the course of blasting works in which explosives are used.
- When using the router in the close proximity of personal medical devices, such as cardiac pacemakers or hearing aids, you must proceed with heightened caution.
- If the router is in the proximity of TV sets, radio receivers, personal computers, and telephone it may cause interference.
- It is recommended that you should create an appropriate copy or backup of the important settings that are stored in the memory of the device.

## 2 User Module Description

User module GPS (Global Positioning System) allows your OWL LTE router to provide location and time information in all weather, anywhere on or near the earth, where there is an unobstructed line of sight to four or more GPS satellites.

Dead reckoning (DR) is the process of estimating one's current position based upon a previously determined position or "fix", and advancing that position based upon known or estimated course and speed over elapsed time. The OWL LTE M12 provides the user with estimates of vehicle position and velocity (even in the absence of GNSS information) by combining speed and heading sensor data into the navigation solution. With this combined system, the sensor inputs will help smooth over interruptions in the GNSS signals, while the satellites will provide updates and corrections for sensor drift. The result is improved navigation in environments such as tunnels and urban canyons.

Nevertheless Dead reckoning is subject to significant errors due to many factors as both speed and direction must be accurately known at all instants for position to be determined accurately. For example, if displacement is measured by an acceleration sensor, any discrepancy between the actual and assumed travelled distance measurement point, due perhaps to vibrations of the vehicle, will be a source of error. As each estimate of position is relative to the previous one, errors are cumulative, or compounding, multiplicatively or exponentially, if that is the co-relationship of the quanta.

## 3 Installation of the Software

This module is not contained in the standard router firmware. The upload of the different software module has to be done in the following way:

### 3.1 Delete GPS User module

**If there is already a GPS user module installed on the OWL LTE M12, this user module has to be deleted prior updating the GPS Firmware.**

### 3.2 Install User module Telit GPS Firmware updater

The OWL LTE M12 contains an innovative GPS receiver hardware with integrated 6-axis sensors. This receiver has to be reprogrammed to make Dead Reckoning possible. The first step is to upload a special user module to program the GPS receiver.

The file for the user module is called: **telitGpsUpdate.v3.tgz**

For details how to upload user module in the OWL LTE M12 see the user manual.

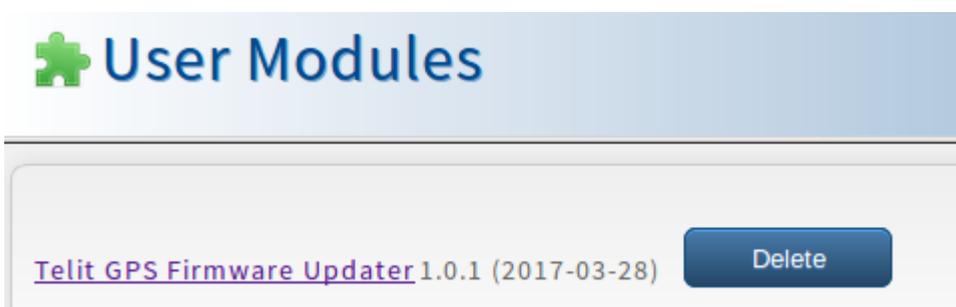


Figure 1 User Module

### 3.3 Upload binary file

Open the installed user module to upload the binary file.

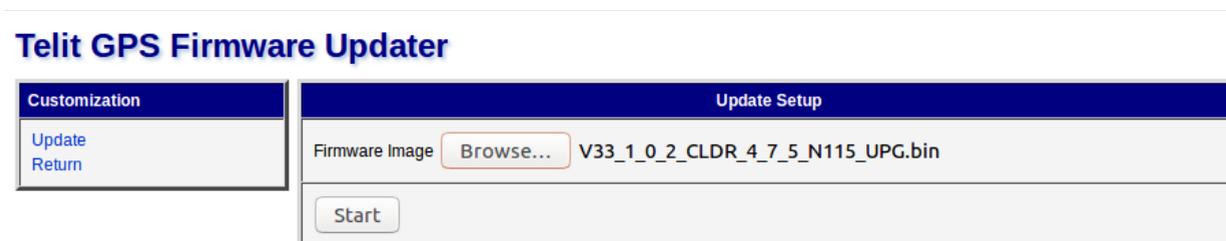


Figure 2 Firmware update

Browse for the correct binary file (**V33\_1\_0\_2\_CLDR\_4\_7\_5\_N115\_UPG.bin**) and press the start bottom.

The update process starts and provides information about the progress:

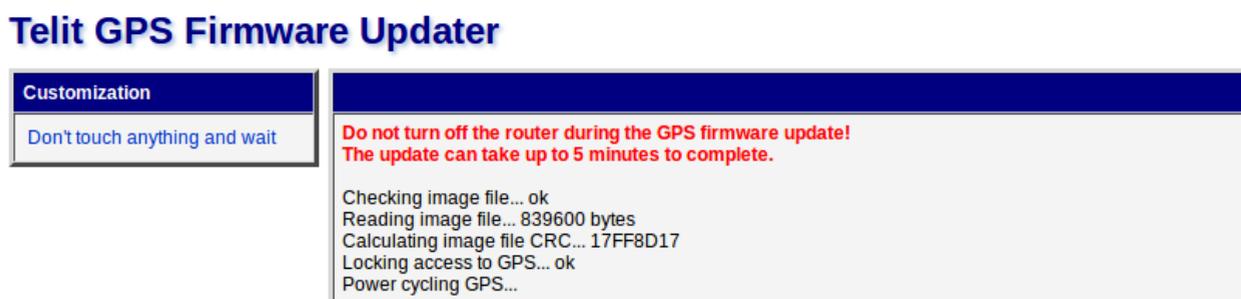


Figure 3 GPS Firmware updater

Please follow the instructions, don't turn of the router or do other actions to interrupt the communication between the router and the computer.

Any interruption may cause a fatal error and may result in an irreversible defect.

## Telit GPS Firmware Updater

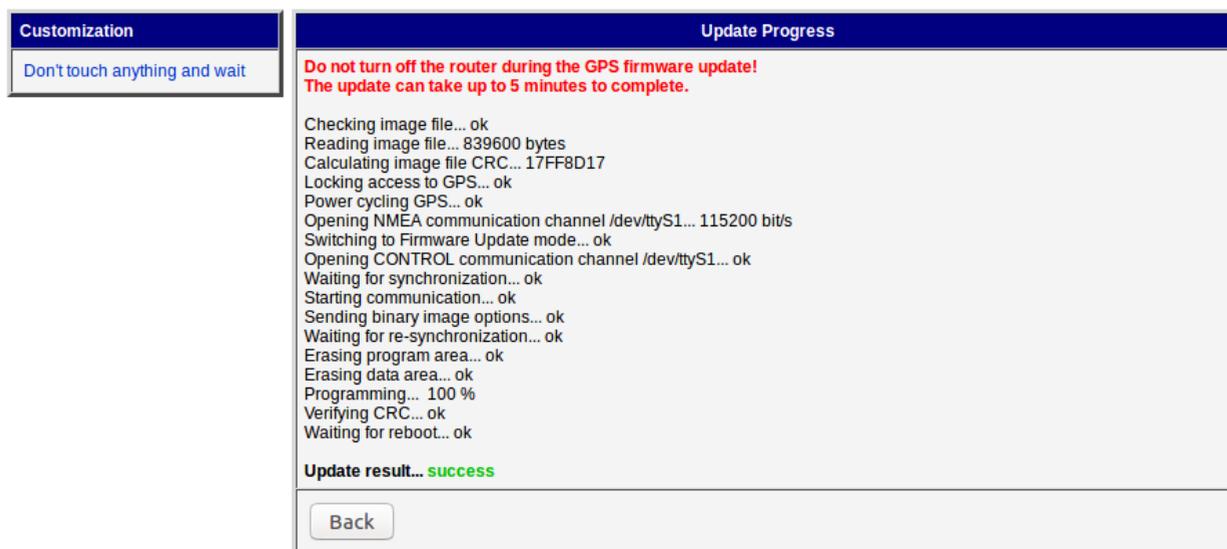


Figure 4 Successful update

At the end of the process the update was successful after the message shown in Figure 4 appears. If an error occurs, the procedure may be repeated several times. If the result is always the same please contact the Hirschmann Service Center.

After the successful update of the GPS receiver, delete the Telit GPS Firmware Updater.

### 3.4 Install GPS - DR User Module

Install the GPS-DR User module (**gps.v3.tgz**) and start it.

#### GPS-DR

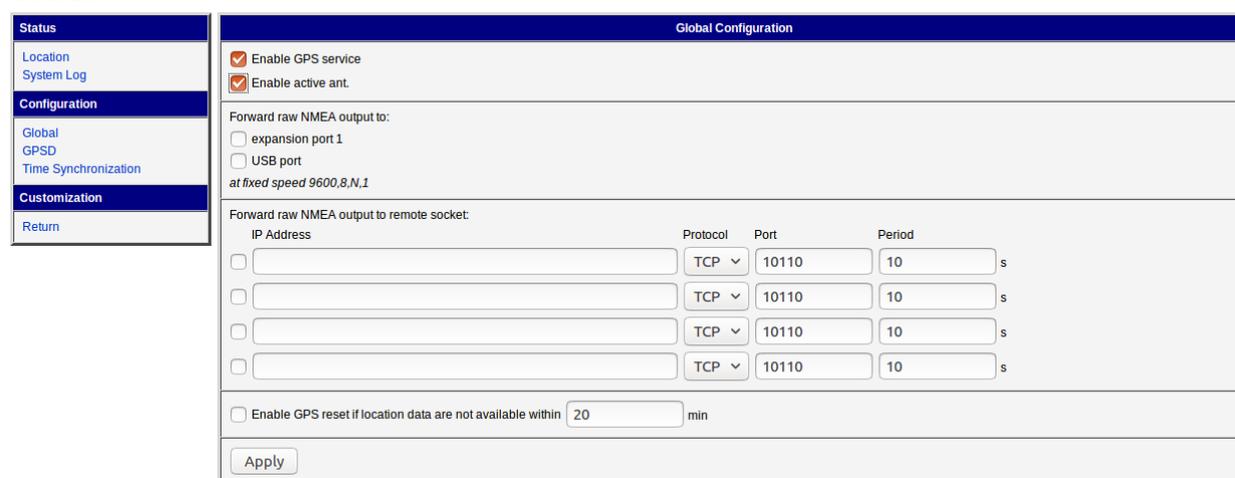


Figure 5 GPS-DR User module

The Dead Reckoning function will start immediately.

## 4 Web interface

The left part of the web interface contains the menu with pages for monitoring (*Status*), *Configuration* and *Customization* of the router. *Customization* block contains only the *return* item, which switches the GPS web interface to the interface of the router.

### 4.1 Location

If the device has an unobstructed line of sight to four or more GPS satellites, there are available detailed information about accurate location of the device (router).

Item	Description
Current time(UTC)	Current time in hhmmss format (it's patterned on Coordinated Universal Time)
Latitude	Geographic coordinate that specifies the north-south position (in degrees)
Longitude	Geographic coordinate that specifies the east-west position (in degrees)
Altitude	Specifies the height above sea level of a location (in meters)
Satellites in view	Number of satellites that are directly visible for the router
Fix status	Indicates the availability of data and its quality. If no data is available, the value of this item is 0. A nonzero value indicates the presence of data.
Speed over ground	Current speed of the router relative to Earth's surface (in knots)
Course over ground	The actual course the router is moving along at the moment relative to Earth's surface (in degrees)
Date	Current date in ddmmyy format

Table 1: Location Status

There is a clickable item called "Show on map" at the bottom part of the window that displays an exact location of the Hirschmann router on the map server of Google company (Google Maps) in a new tab.

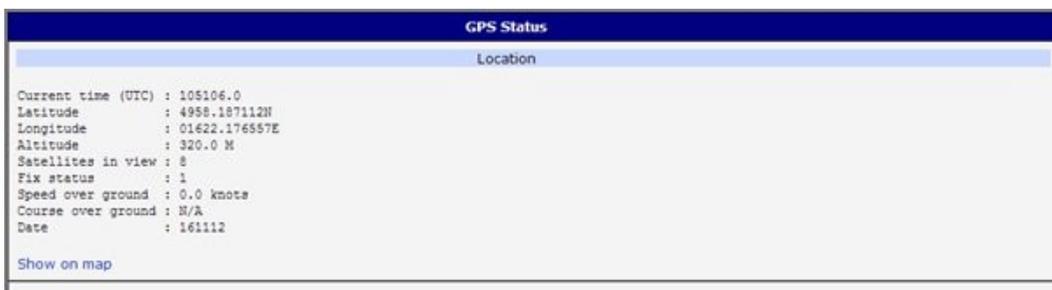


Figure 1: GPS Status – Location

## 4.2 System Log

In case of any problems it is possible to view the system log by pressing the System Log menu item. There are displayed detailed reports from individual applications running in the router. Using the Save button it is possible to save the system log to the computer.

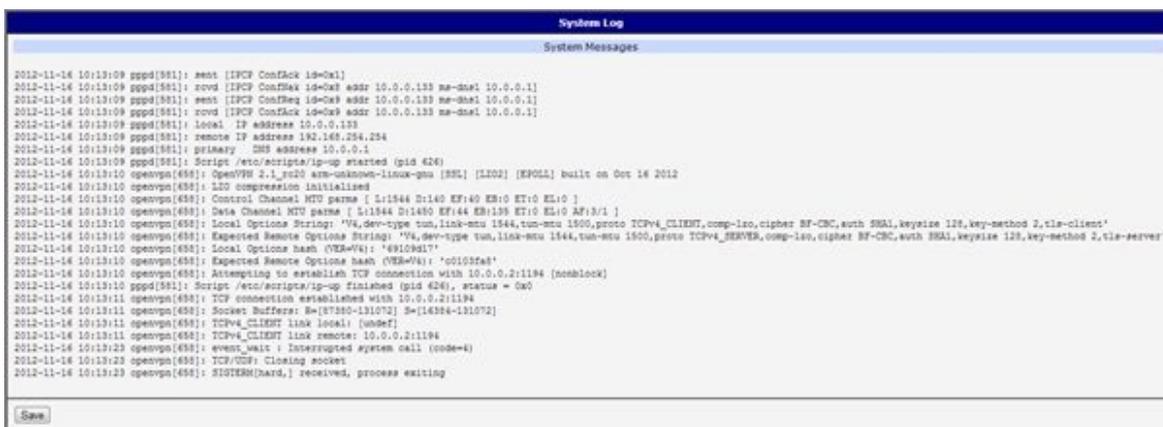


Figure 2: System Log

The System Log default size is 1000 lines. After completion of the 1000 lines it will be created a new file for storing system log. After completion of the 1000 lines in the second file, the first file will be deleted and then will be created a new one.

### 4.3 Global

After clicking the Global item in the configuration part of the menu, you can find a form that allows you to activate the GPS service by checking Enable GPS service item. In the next part of this form is an availability to choose the port that will be used for sending data from the GPS. You can select from the following options: expansion port 1, expansion port 2 and USB port (expansion port 1 and expansion port 2 are optional ports of the router). Data are stored in raw NMEA format. The configuration form also allows router to forward raw NMEA output to a remote socket. In this case it is necessary to check the box in front of the "configuration line" and define the following information:

Item	Description
IP Address	IP address to which the raw NMEA output will be forwarded
Protocol	The protocol by which raw NMEA output will be sent
Port	Port on which the communication will be underway
Period	Forwarding period

Table 2: Forwarding data to remote socket

At the bottom of the form, it can be enabled the automatic reset of GPS. It is performed every time when location data are not available within set number of minutes.

#### GPS-DR

IP Address	Protocol	Port	Period
<input checked="" type="checkbox"/> 192.168.1.231	TCP	30000	1 s
<input checked="" type="checkbox"/> 192.168.1.230	TCP	10110	1 s
<input checked="" type="checkbox"/> 192.168.1.229	TCP	10110	1 s
<input checked="" type="checkbox"/> 192.168.1.228	TCP	10110	1 s

Enable GPS reset if location data are not available within  min

Figure 3: Global Configuration

## 4.4 SNMP

The SNMP form can be displayed by selecting the SNMP item in the configuration part of the menu. If the Enable reporting to supervisory system option is checked, the router automatically sends messages to supervisory system at the specified period.

Item	Description
IP Address	Destination IP address to which the raw NMEA output will be forwarded
Period	Interval of sending messages to supervisory system (in seconds)

Table 3: SNMP configuration

Figure 4: Global SNMP Configuration

For sending GPS messages is used the following range of OIDs. The importance of individual items is described in table 2.1 Location on page 2.

Item	Description
.1.3.6.1.4.1.30140.7.1.0	gpsTimeUTC
.1.3.6.1.4.1.30140.7.2.0	gpsLatitude
.1.3.6.1.4.1.30140.7.3.0	gpsLongitude
.1.3.6.1.4.1.30140.7.5.0	gpsSatellites
.1.3.6.1.4.1.30140.7.6.0	gpsFixStatus
.1.3.6.1.4.1.30140.7.7.0	gpsSpeedOverGround
.1.3.6.1.4.1.30140.7.8.0	gpsCourseOverGround
.1.3.6.1.4.1.30140.7.9.0	gpsDate

Table 4: GPS OID

## 4.5 Time synchronization

Form for synchronization of the system time can be invoked by pressing Time Synchronization item in the configuration part of the web interface menu. Enable system time synchronization check box is used to activate automatic time synchronization. Number of hours after which the synchronization is performed must be defined in the box below.

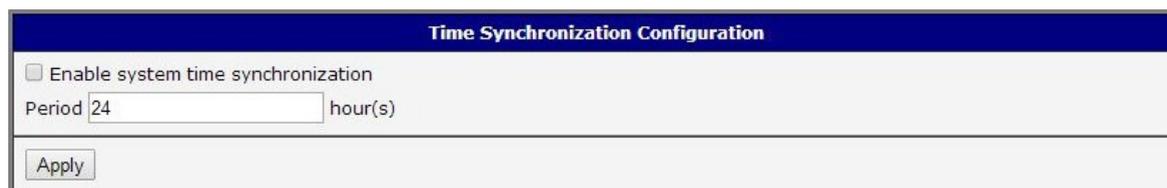


Figure 5: Time synchronization

# 5 Dead Reckoning

The GPS receiver is equipped with MEMS (3 axis accelerometer, 3 axis gyroscope) to track the movements of the vehicle. To create a valid relationship between the sensor data and the movement of the vehicle (course and speed), the OWL LTE M12 has to build up a cross-data matrix. This can be done only when the vehicle is moving and the GPS signal is good enough to provide correct position data.

To activate Dead Reckoning the bottom on the global page has to be ticked.

## GPS-DR

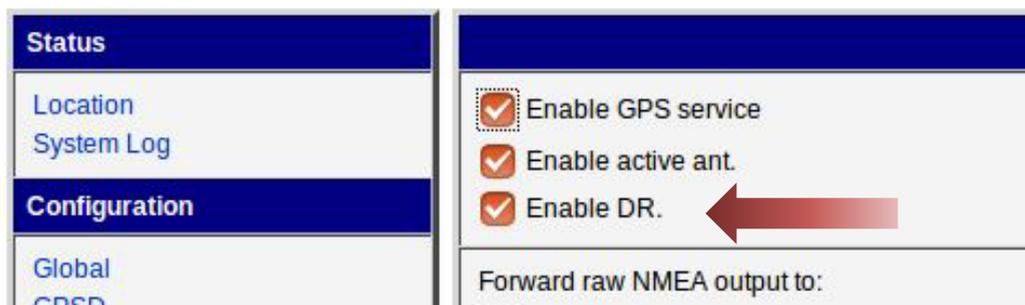


Figure 6: Global view

The embedded sensors are able to measure any type of acceleration and transverse forces occurring during the movement. This data points are needed for the dead reckoning calculations. This data collection is a continuously ongoing process. More data will increase the quality of the calculation. It depends on the driving route and on the variation of the speed how long it will take until sensor system has collected enough data points.

After first power up, it will take several minutes of active movements until the first qualified DR calculation results will be available. Under worst case conditions, in this case a smooth and straight forward pathway, the system will need an hour or even longer to build up a valid data set.

Nevertheless the system will provide GPS data from the first time the vehicle is moving and receiving GPS data.

As long as the vehicle is not moving or the GPS signal is not available, no data point can be collected.

This data collection has to be done for both direction of motion.

The quality of the dead reckoning signal depends on the quality of measurement data. If no or only little data are available, the positioning error will be higher, nevertheless GPS data are provided on all circumstances.

The data matrix is permanently stored on the OWL LTE M12 and is available after a power down.

All collected data will be deleted if the "Enable DR" button in the global page is unticked. When activating GPS-DR the data collection process starts again from scratch.

If the GPS-DR user module is installed again, all the data sets will be lost and the data collection has to start again.



Figure 7 Result of a test

The picture above shows a result of a drive along a highway. The red color of the line is the part of the drive where the GPS antenna was switched off. Not receiving GPS signals, the data points have been calculated. There is a small mismatch between the road (the actual track) and the calculated data. The start conditions of the DR calculation have a major impact on the quality of the result. If the number of the GPS satellites visible for the device is low before the DR calculation starts, the quality of the from the GPS device delivered speed and course figures is low. This can lead to bad start conditions for the DR calculation.

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## 6 Recommended Literature

[1] UM\_Configuration\_OWL-LTE-01100\_EN

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## A. Abbreviations used

ACA	AutoConfiguration Adapter
ACL	Access Control List
BOOTP	Bootstrap Protocol
CLI	Command Line Interface
DHCP	Dynamic Host Configuration Protocol
FDB	Forwarding Database
GUI	Graphical User Interface
HTTP	Hypertext Transfer Protocol
	Hypertext Transfer Protocol Secure
ICMP	Internet Control Message Protocol
IEEE	Institute of Electrical and Electronics Engineers
IGMP	Internet Group Management Protocol
IP	Internet Protocol
LED	Light Emitting Diode
LLDP	Link Layer Discovery Protocol
F/O	Optical Fiber
MAC	Media Access Control
MIB	Management Information Base
MRP	Media Redundancy Protocol
MSTP	Multiple Spanning Tree Protocol
NMS	Network Management System
NTP	Network Time Protocol
PC	Personal Computer
PTP	Precision Time Protocol
QoS	Quality of Service
RFC	Request For Comment
RM	Redundancy Manager
RSTP	Rapid Spanning Tree Protocol
SFP	Small Form-factor Pluggable
SFTP	SSH File Transfer Protocol
SNMP	Simple Network Management Protocol
SNTP	Simple Network Time Protocol
TCP	Transmission Control Protocol
TFTP	Trivial File Transfer Protocol
TP	Twisted Pair
UDP	User Datagram Protocol
URL	Uniform Resource Locator
UTC	Coordinated Universal Time
VLAN	Virtual Local Area Network
UTC	Coordinated Universal Time
VLAN	Virtual Local Area Network

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## B. Maintenance

Hirschmann is continually working on improving and developing their software. Check regularly whether there is an updated version of the software that provides you with additional benefits. You find information and software downloads on the Hirschmann product pages on the Internet (<http://www.hirschmann.com>).

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## C. Readers' Comments

What is your opinion of this manual? We are constantly striving to provide as comprehensive a description of our product as possible, as well as important information to assist you in the operation of this product. Your comments and suggestions help us to further improve the quality of our documentation.

Your assessment of this manual:

	<b>Very Good</b>	<b>Good</b>	<b>Satisfactory</b>	<b>Mediocre</b>	<b>Poor</b>
Precise description	<input type="radio"/>				
Readability	<input type="radio"/>				
Understandability	<input type="radio"/>				
Examples	<input type="radio"/>				
Structure	<input type="radio"/>				
Comprehensive	<input type="radio"/>				
Graphics	<input type="radio"/>				
Drawings	<input type="radio"/>				
Tables	<input type="radio"/>				

Did you discover any errors in this manual? If so, on what page?

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Suggestions for improvement and additional information:

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General comments:

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Sender:

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Company / Department: Name

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/ Telephone number: Street:

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Zip code / City:

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E-mail:

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Date / Signature:

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Dear User,

Please fill out and return this page

- ▶ as a fax to the number +49 (0)7127/14-1600 or
- ▶ per mail to

Hirschmann Automation and Control GmbH Department 01RD-NT  
Stuttgarter Str. 45-51  
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### ■ Technical Questions

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