www.westermo.com


# DDW-002-B1

EN 50155 Ethernet Broadband Bridge

# Table of Contents

# 1. General Information

## 1.1. Legal Information

The contents of this document are provided “as is”. Except as required by applicable law, no warranties of any kind are made in relation to the accuracy and reliability or contents of this document, either expressed or implied, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. Westermo reserves the right to revise this document or withdraw it at any time without prior notice.

Under no circumstances shall Westermo be responsible for any loss of data or income or any special, incidental, and consequential or indirect damages howsoever caused.

More information about Westermo can be found at www.westermo.com.

## 1.2. About This Guide

This guide is intended for installation engineers and users of the Westermo products.

It includes information on safety and regulations, a product description, installation instructions and technical specifications.

## 2.1. Warning Levels

Warning signs are provided to prevent personal injuries and/or damages to the product. The following levels are used:

| Level of warning | Description | Consequence personal injury | Consequence material damage |
|---|---|---|---|
|  WARNING | Indicates a potentially hazardous situation | Possible death or major injury | Major damage to the product |
|  CAUTION | Indicates a potentially hazardous situation | Minor or moderate injury | Moderate damage to the product |
|  NOTICE | Provides information in order to avoid misuse of the product, confusion or misunderstanding | No personal injury | Minor damage to the product |
|  NOTE | Used for highlighting general, but important information | No personal injury | Minor damage to the product |

*Table 1. Warning levels*

## 2.2. Safety Information

**Before installation:**

Read this manual completely and gather all information available on the product. Make sure it is fully understood. Check that your application does not exceed the safe operating specifications for the product.

**SAFETY DURING INSTALLATION**

The product must be installed and operated by qualified service personnel and installed into an apparatus cabinet or similar, where access is restricted to service personnel only.

During installation, ensure a protective earthing conductor is first connected to the protective earthing terminal (only valid for metallic housings). Westermo recommends a cross-sectional area of at least 4 $mm^2$.

Note that this product can be connected to two different power sources. Upon removal of the product, ensure that the protective earthing conductor is disconnected last.

**HAZARDOUS VOLTAGE**

Do not open an energised product. Hazardous voltage may occur when connected to a power supply.

**PROTECTIVE FUSE**

The power supply wiring must be sufficiently fused.

It must be possible to disconnect manually from the power supply. Ensure compliance to national installation regulations.

Replacing the internal fuse must only be performed by Westermo qualified personnel.

**REDUCE THE RISK OF FIRE**

To reduce the risk of fire, use only telecommunication line cords with a cable diameter of AWG 26 or larger. Regarding power cable dimensions, see chapter Interface Specifications.

**HOT SURFACE**
Be aware that the surface of this product may become hot. When it is operated at high temperatures, the external surface may exceed Touch Temperature Limit according to the product's relevant electrical safety standard.

**ELECTROSTATIC DISCHARGE (ESD)**
Prevent electrostatic discharge damage to internal electronic parts by discharging your body to a grounding point (e.g. use a wrist strap).

## 2.3. Care Recommendations

Follow the care recommendations below to maintain full operation of the product and to fulfill the warranty obligations:

- Do not drop, knock or shake the product. Rough handling above the specification may cause damage to internal circuit boards.
- Use a dry or slightly water-damp cloth to clean the product. Do not use harsh chemicals, cleaning solvents or strong detergents.
- Do not paint the product. Paint can clog the product and prevent proper operation.

If the product is used in a manner not according to specification, the protection provided by the equipment may be impaired.

If the product is not working properly, contact the place of purchase, the nearest Westermo distributor office or Westermo technical support.

## 2.4. Product Disposal

This symbol means that the product shall not be treated as unsorted municipal waste when disposing of it. It needs to be handed over to an applicable collection point for recycling electrical and electronic equipment.

By ensuring the product is disposed of correctly, you will help to reduce hazardous substances and prevent potential negative consequences to both the environment and human health, which could be caused by inappropriate disposal.

*Figure 1. WEEE symbol for treatment of product disposal*

## 2.5. Compliance Information

### 2.5.1. Agency Approvals and Standards Compliance

| Type | Approval/Compliance |
|---|---|
| EMC | • EN 50121-3-2/IEC 62236-3-2 Railway applications – Rolling stock – apparatus<br>• EN 50121-4/IEC 62236-4, Railway signalling and telecommunications apparatus<br>• EN/IEC 61000-6-1, Immunity residential environments<br>• EN/IEC 61000-6-2, Immunity industrial environments<br>• EN/IEC 61000-6-3, Emission residential environments<br>• EN/IEC 61000-6-4, Emission industrial environments<br>• IEEE 16, IEEE Standard for Electrical and Electronic Apparatus on Rail Vehicles<br>• Tested and verified for FCC part 15, class A |
| Safety | • EN/IEC 60950-1, IT equipment |
| Trackside | • EN 50124-1, Railway applications – Insulation coordination<br>• EN 50155, Railway applications - Electronic equipment used on rolling stock<br>• EN 61373, Railway applications - Rolling stock equipment. Shock and vibration tests.<br>• IEC 60068-2-27, Shock<br>• IEC 60068-2-64, Vibration, broadband random and guidance<br>• IEEE 1478, Environmental conditions for transit rail car electronic equipment<br>• EN 45545-2, Fire protection on railway vehicles |

*Table 2. Agency approvals and standards compliance*

### 2.5.2. FCC Part 15.105 Class B Notice

This product has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This product generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this product does cause harmful interference to radio or television reception, which can be determined by turning the product off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the unit and receiver
- Connect the product into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

### 2.5.3. Simplified Declaration of Conformity

Hereby, Westermo declares that this product is in compliance with applicable EU directives and UK legislations. The full declaration of conformity and other detailed information is available at www.westermo.com/support/product-support.

*Figure 2. The European Conformity and the UK Conformity Assessment markings*

# 3. Product Description

## 3.1. Product Description

The Wolverine series consists of Ethernet extenders and bridges for propagating Ethernet traffic over existing cabling. The Ethernet link can be allowed to be extended over longer distances than possible with pure copper Ethernet and at data rates of up to 70 Mbit/s.

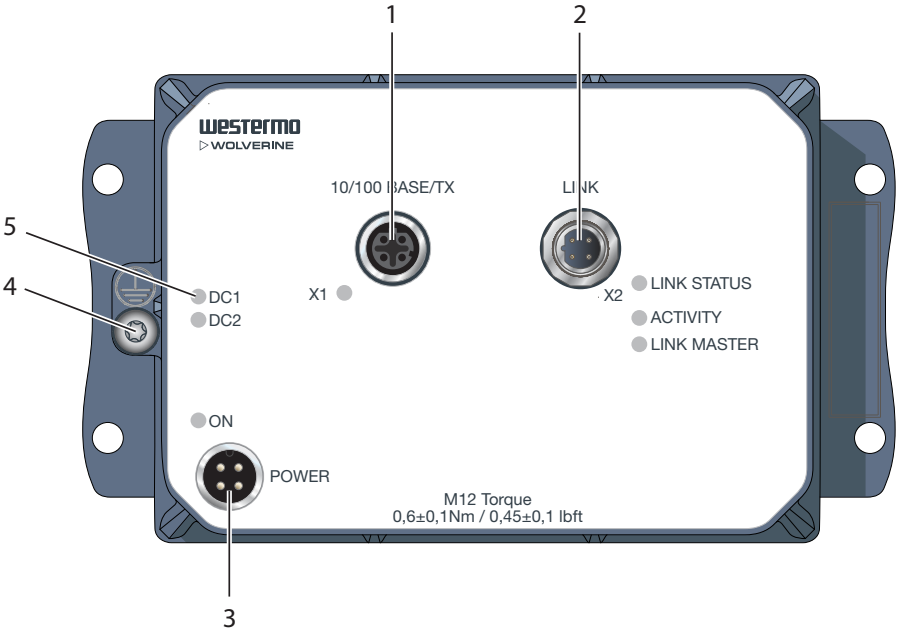
The DDW-002-B1 makes it possible to reuse many types of pre-existing copper cables since it is based on power line communication (IEEE 1901). A network with the DDW002-B1 devices is capable of bridging high bandwidth Ethernet traffic over 2-wire cables, even when there are corroded connectors. The powerline communication standard is designed to establish a reliable communication link over both twisted pair and parallell cabling.

This can lead to considerable financial savings when refurbishing a train with Ethernet communication, as existing train couplers can be reused without the need for a costly rebuild or even replacement. By simply installing a DDW-002-B1 on each side of the coupler, a bridge connecting the Ethernet networks on each side is created. The fact that no configuration is needed further contributes to the ease of use.

The DDW-002-B1 has been thoroughly tested by certified labs to ensure its compliance with the standard for electronic equipment used on rolling stock, the EN 50155. For several characteristics, Westermo exceeds the requirements mandated by the standard. Furthermore, the design is based on Westermo's long experience within the rolling stock market, which brings benefits such as vibration safe integrated connector threading, IP67 ingress protection with GORE-TEX® membrane to prevent condensation water build-up and ultimately a high MTBF and long service life under the harshest conditions.

Meeting the requirements for rolling stock, makes the DDW-002-B1 also very well suited for deployment in other applications with severe operating conditions and extreme environments.

## 3.2. Hardware Overview




| No. | Description | No. | Description |
|---|---|---|---|
| 1 | Ethernet port | 2 | Powerline connection |
| 3 | Power connection | 4 | Protective earth connection |
| 5 | LED indicators | | |

*Figure 3. Location of interface ports and LED indicators*

## 3.3. Connector Pinout

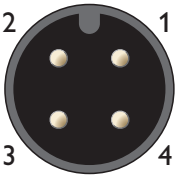
| Pin no. | Signal | Illustration |
|---|---|---|
| 1 | +DC1 |  |
| 2 | +DC1 | |
| 3 | -COM | |
| 4 | -COM | |



*Table 3. Power connector*

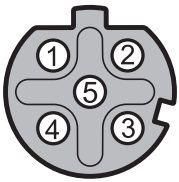
| Pin no. | Signal | Illustration |
|---|---|---|
| 1 | TD+ |  |
| 2 | RD+ | |
| 3 | TD- | |
| 4 | RD- | |
| Auto MDI/MDI-X is used. The table shows signals in MDI mode. | | |



*Table 4. Ethernet connector*

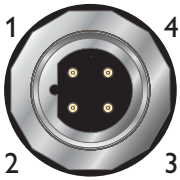
| Pin no. | Signal | Illustration |
|---|---|---|
| 1 | PLC1 |  |
| 2 | NC | |
| 3 | PLC2 | |
| 4 | NC | |
| PLC1 and PLC2 are polarity free | | |



*Table 5. Powerline connection*

## 3.4. LED Indicators

| LED | Status | Description |
|---|---|---|
| ON | OFF | Product has no power |
| | GREEN | All OK, no alarm condition |
| DC1 | OFF | Product has no power |
| | GREEN | Voltage present on DC1 |
| | RED | Power failure on DC1 |
| DC2 | OFF | Product has no power |
| | GREEN | Voltage present on DC2 |
| | RED | Power failure on DC2 |
| X1 | OFF | No link |
| | GREEN | Link established |
| | GREEN FLASH | Data traffic indication |
| LINK STATUS | OFF | No PLC link established |
| | ON | PLC link established |
| ACTIVITY | OFF | No traffic on PLC link |
| | GREEN | PLC traffic on PLC link |
| LINK MASTER | OFF | Device is not link master (if PLC link established) |
| | ON | Device is link master in the established PLC network |

*Table 6. LED indicators*

## 3.5. Dimensions

Dimensions are stated in mm and are regardless of model.

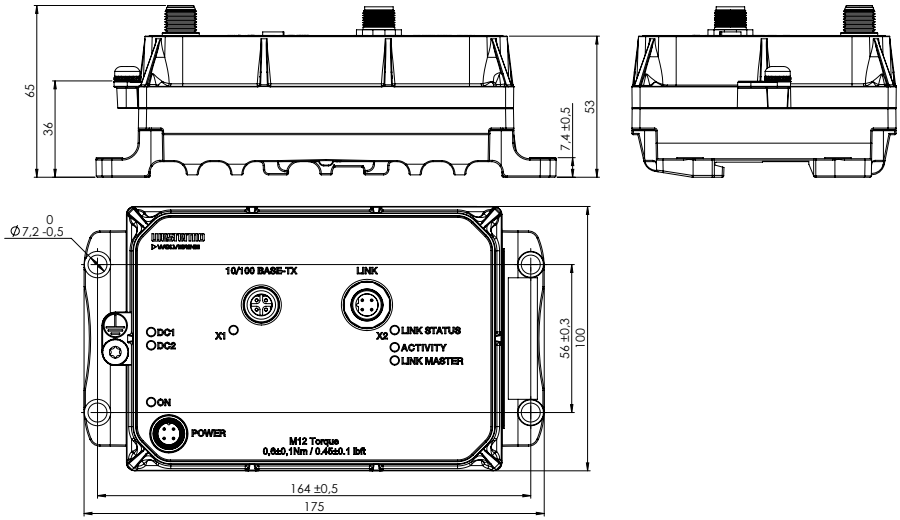



*Figure 4. Dimensional drawing*

# 4. Installation

## 4.1. Wall Mounting

There are four 6 mm bore holes intended for mounting the unit. The unit can be mounted vertical or horizontal. Use four M5 screws with 12 mm washer on a flat and stable surface.

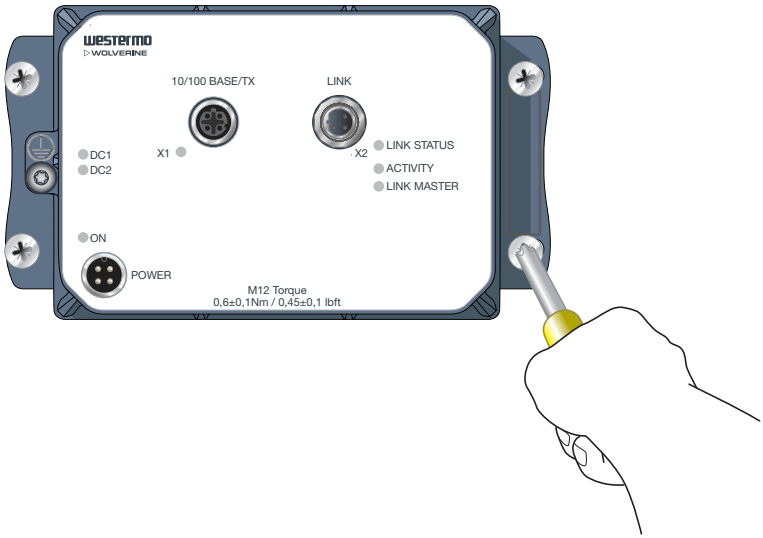



*Figure 5. Wall mounting*

## 4.2. Protective Earth Connection

For correct function, the earth connection needs to be properly connected to a designated PE rail. See the figure below.

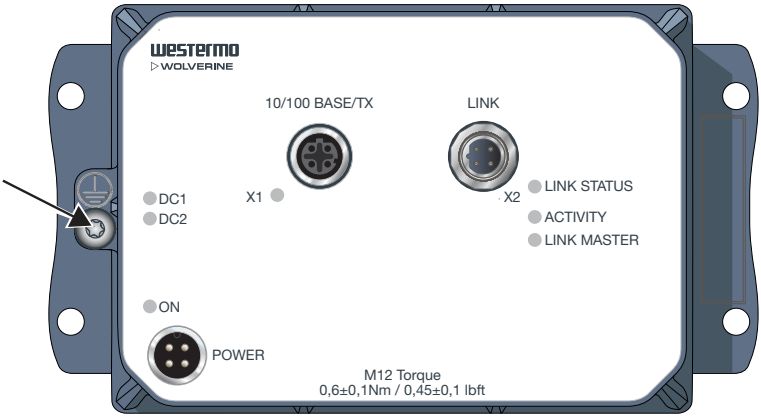



*Figure 6. Earth connection*

### 4.3. Connection of Cables

Recommended tightening torque for the M12 connectors is 0.6 Nm. When connecting the power cable, ensure that the pins are connected correctly before tightening the power cable to the unit.

**PROTECTIVE FUSE**

The power supply wiring must be sufficiently fused.

It must be possible to disconnect manually from the power supply. Ensure compliance to national installation regulations.

Replacing the internal fuse must only be performed by Westermo qualified personnel.

**NOTE - UNUSED CONNECTORS**

Unused connectors must be covered by a protective cap (delivered with the product), tightened to the specified torque in order to fulfill the specified ingress protection code.

### 4.4. Cooling

This product relies on convection cooling. Make sure that it is installed so that the ambient temperature is within the specified temperature range. Avoid obstruction of the airflow around the product.

### 4.5. Replacement of Product

Disconnect all cables and unscrew the product from the wall. MTTR (Mean Time To Repair), i.e. time for replacement of product is < 10 minutes.

### 4.6. EN 45545-2 Mounting Notes

Two product can be mounted together and as a single interior non-listed group in the sense of EN 45545-2 definitions. For multiple product, the spacing requirements for interior non-listed groups must be met.

### 4.7. Getting Started

The DDW-002-B1 is easy to use and install. The units work in a pair over existing copper cabling infrastructure and automatically connect to each other when the remote device is sensed over the interconnecting lines.

The installation procedure to get the application up and running is simple.

1. Connect the cable (twisted pair or parallell cable) to X2 pin 1 and 3 (polarity independent).
2. Connect Ethernet to the X1 port on the front of the DDW-002-B1.
3. Connect power to the devices.

The following settings are valid for the Ethernet interface:

- Ethernet auto-negotiation enabled
- Auto MDI/MDI-X
- Auto-polarity enabled

The DDW-002-B1 will automatically detect the possible data rate to the remote device (over the X2 - PLC interface ).

The link performance can easily be measured after the powerline link is established. Different types of methods and tools can be used.

One example of recommended software for throughput testing is Iperf. Please refer to Iperf user documentation for instructions of usage.

**NOTE**

If the PLC link is not established or the established data rate is not suffcient for the application, the distance might be too long between the devices.

The device is an unmanaged unit. If data throughput performance needs to be adjusted or if no powerline connection is established, check cabling between the devices.

### 4.8. Configuration

All necessary configurations are preconfigured from factory and no other changes in the settings can be done.

# 5. Specifications

## 5.1. Interface Specifications

| DC, Power port | |
|---|---|
| Rated voltage | 24 to 110 VDC |
| Operating voltage | 16.8 to 143 VDC (14.4 to VDC for 100 ms, 154 VDC for 1 s) |
| Rated current | 70 mA at 24 VDC, 30 mA at 110 VDC |
| Rated frequency | DC |
| Inrush current | 4 $mA^2s$ at 24 VDC, 64 $mA^2s$ at 110 VDC |
| Startup current | 140 mA at 24 VDC<br>60 mA at 110 VDC |
| Polarity | Reverse polarity protected |
| Redundant power input | Yes |
| Isolation | 1500 VAC rms to all other ports |
| Connector | 4-pin, male, M12, A-coded, recommended Westermo cables:<br>3146-1106 for 1.5 m<br>3146-1107 for 5 m |
| Cable size | M12, recommended power cable area 0.5 $mm^2$ (minimum 0.25 $mm^2$)<br>Cable dimensions depend on choice of M12 connector |

| X1 Ethernet ports | |
|---|---|
| Electrical specification | IEEE std 802.3 |
| Data rate | Auto-negotiation (10 Mbit/s or 100 Mbit/s) |
| Duplex | Auto-negotiation (full or half) |
| Circuit type | X1: TNV-1 |
| Transmission range | Up to 150 m with CAT5e cable or better |
| Isolation | 1500 VAC rms to all other ports |
| Connector | 4-pin, female, M12, D-coded, auto MDI/MDI-X, recommended Westermo cables:<br>3146-1100 M12-M12 - 1 m<br>3146-1101 M12-M12 - 5 m<br>3146-1103 RJ45-M12 - 1 m<br>3146-1104 RJ45-M12 - 5 m |
| Cabling | Shielded cable is recommended in severe electromagnetic environments |
| Conductive chassis | Yes |
| Number of ports | 1 |

| X2 powerline interface | |
|---|---|
| Data rate | Up to 70 Mbit/s (depending on cable characteristics and temperature) |
| Connector | 4-pin, M12, B-coded |
| Transmission range | Up to 300 m (depending on cable characteristics and temperature) |
| Electrical specification | Supports communication over wires powered from 0 to 143 VDC |

## 5.2. Type Tests and Environmental Conditions

| Environmental phenomena | Basic standard | Description | Test levels |
|---|---|---|---|
| ESD | EN 61000-4-2 | Enclosure | Contact: ±6 kV<br>Air: ±8 kV |
| Fast transients | EN 61000-4-4 | Power port | ± 2 kV |
| | | Signal ports | |
| | | Earth port | |
| Surge | EN 61000-4-5 | Power port | L-E: ± 2 kV, 42 Ω, 0.5 µF, 1.2/50 µs<br>L-E: ± 0.5 kV, 12 Ω, 9 µF, 1.2/50 µs<br>L-L: ± 2 kV, 42 Ω, 0.5 µF, 1.2/50 µs<br>L-L: ± 1 kV, 2 Ω, 18 µF, 1.2/50 µs |
| | | Ethernet port | L-E: ± 2 kV, 2 Ω |
| Power frequency magnetic field | EN 61000-4-8 | Enclosure | 300 A/m; 0, 16.7, 50, 60 Hz |
| Pulsed magnetic field | EN 61000-4-9 | Enclosure | 300 A/m |
| Radiated RF immunity | EN 61000-4-3 | Enclosure | 20 V/m at (80 MHz to 2.7 GHz)<br>10 V/m at (2.7 to 6 GHz)<br>1 kHz sine, 80% AM |
| Conducted RF immunity | EN 61000-4-6 | Power port | 10 V, 80% AM, 1 kHz; (0.15-80) MHz |
| | | Ethernet ports | |
| | | Earth port | |
| Radiated RF emission | CISPR 16-2-3 | Enclosure | Class B (30 MHz to 2 GHz) |
| | ANSI C63,4 (FCC Part 15) | | |
| Conducted RF emission | CISPR 16-2-1 | Power port | Class B |
| | | Ethernet ports | |
| Dielectric strength | EN 60950-1 | Power port to all other ports | 1.5 kVAC rms, 50 Hz, 1 min |
| | | Fast Ethernet ports to all other ports | |
| | | Link to all other ports | |

*Table 7. EMC and electrical conditions*

| Environmental phenomena | Basic standard | Description | Test levels |
|---|---|---|---|
| Temperatures | EN 60068-2-1<br>EN 60068-2-2 | Operational | -40 to +70°C (-40 to +158°F) |
| | | Storage and transport | -50 to +85°C (-58 to +185°F) |
| Humidity | EN 60068-2-30 | Operational | 5-95% relative humidity |
| | | Storage and transport | |
| Altitude | | Operational | 2000 m/70 kPa |
| Service life | | Operational | 15 years |
| MTBF | MIL-217F2, GB, 25°C (+77°F) | | 1,568,000 hours |
| Vibration | IEC 60068-2-64 (random) | Operational | 2 m/s² rms 5-150 Hz |
| Shock | IEC 60068-2-27 | Operational | 10 g, 30 ms,<br>20 g, 11 ms |
| Enclosure | EN 60950-1 | Zinc | Fire enclosure |
| Weight | | | 1.4 kg |
| Degree of protection | EN 60529 | Enclosure | IP67 |
| Cooling | | | Convection |

*Table 8. Environmental and mechanical conditions*

# 6. Revision Notes

| Revision | Date | Change description |
|---|---|---|
| Rev. I | 2022-03 | Missing chapter 3.3 Connector pinout added |
| Rev. H | 2021-10 | 5.1 Interface Specifications; Power port updated |
| Rev. G | 2021-05 | Westermo logo updated, illustrations updated from brown to blue, new information structure throughout the manual, 1.2 About This Guide - new chapter, 2 Safety and Regulations - entire chapter updated. |

Westermo • Metallverksgatan 6, SE-721 30 Västerås, Sweden
Tel +46 16 42 80 00  Fax +46 16 42 80 01
E-mail: info@westermo.com
www.westermo.com

**6641-2280 REV. I** 2022 03 Westermo Network Technologies AB, Sweden