TN201SC User Guide (US-CA Regions)

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Proprietary and Confidential

bluwireless.com
@Blu_Wireless
bluwireless

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1. Overview

The Degas program delivers high bandwidth connectivity between train and trackside using mmWave technology in the 57-71 GHz radio band.

Table 1. Product types and part numbers

Product	Manufacturer	Type
TN201SC	Blu Wireless Technology Limited	Train top dual radio unit + in-train NPU unit.

The Degas program delivers high bandwidth connectivity between train and trackside using mmWave technology in the 57-71 GHz range.

2. TN201SC product components and accessories

Figure 1. TN201SC Train Unit product major components

2.1 Unit interchangeability

This product is manufactured and tested as a set of 3 components as identified in Table 2. Product components. As a result, to get the performance of the product as manufactured these components shall be installed as a set. Particularly in respect of the TN001xC and TN201SP, it is important that the TN001xC and TN201SP final 3 digits of the serial number match.

Table 2. Product components

Product	Included	Optional (defined at time of order)
TN201SC	TN201SP: Train-top antenna unit – dual radio TN001xC: Internal NPU Unit with an M12 10G wired Ethernet port TNCAB2A or TNCAB2B Cable (2m) to connect NPU to antenna unit	Height Adjustment plates Network ports fitted may vary.

3. Product Safety

Read all safety material in this document and the product installation guide before installation or use.

This symbol means that there is a safety caution or warning. You must comply with any text associated with this symbol to maintain product safety.

This symbol identifies safety information relating to the unit getting hot and the conditions which may cause this.

These products are radio products and must only be used in the geographical region identified in the sales type description. Use outside of the defined region is not permitted and could violate national spectrum usage regulations. The TN201SP portion of this product is intended for outdoor usage.

These products must not be used for any safety critical applications. Examples of such usage are: safety critical communication; emergency communication or response systems; being used to generate train position information for any rail operational purpose.

CAUTION: Only use DC power supplies or power sources meeting the technical requirements for voltage and power defined in the specification section of this document. Power supplies shall be suitably rated and certified in line with the installation environment.

CAUTION: Always install with an accessible switch or alternative accessible disconnect device to remove power from the unit. No disconnect devices are available at the product which are normally inaccessible after installation. Ensure that the switch or disconnect device is appropriately labelled.

Do not install or use the product in locations where other equipment heat sources will increase the ambient or case temperature beyond specified limits. Do not use when ambient or mounting point temperatures are below −25 or above 55 degrees Celsius.


WARNING: This device may become hot if covered. Should the unit be covered or otherwise become excessively hot whilst being installed or tested, turn the unit off and leave for one hour before touching.

Do not restrict airflow around or cover the TN201SC units. This may cause units to overheat and reduce performance.

WARNING: This product emits RF radiation in normal use. Do not install or use where, when powered on, any member of the public may be within 30cm of the unit. Temporary use is permitted at distances above 15cm during installation or maintenance operations

If the product, attached cabling or mounting bracket is damaged, vandalised, misaligned or the unit is not operational, switch the unit off immediately by removing the power cable or switching off the power to the PSU and report to the appropriate installation, maintenance, or network operations centre.

Installation, uninstallation, and maintenance should only be performed by appropriately trained and qualified personnel for the environment in which the product is being installed. Product-specific training is available from Blu Wireless.

WARNING: During installation of units at height where units are not otherwise safely secured, always use a safety leash connected to a safety eye on the unit and another sturdy location to prevent units falling and causing injury or damage.

Always use all mechanical fixings when mounting units to their mounting or mounting to train infrastructure.

CAUTION: Do not remove any cover, cover screw or connector from the body of the equipment unless requested or permitted by the manufacturer. There are no user serviceable parts inside and opening the unit will invalidate the warranty and may compromise product safety and performance.

CAUTION: Where used within the UK and the EU and when connecting to the M12 10G ethernet port always use CAT 7 ethernet cable or better to maintain EMC performance Such cables should not exceed 30m in length.

CAUTION: Where used in the USA and Canada and when connecting to the M12 10G ethernet port always use CAT 6A ethernet cable or better to maintain EMC performance. Such cables should not exceed 30m in length

When cleaning any unit only use cold or warm water below 40 degrees Celsius with either no or only mild soap additives. Abrasives, solvents, harsh or corrosive cleaning materials or high-pressure water jets shall not be used.

All weather protecting seals for connectors (where provided with the product) must always be in place when installed, except for the brief period during installation.

Do not paint or allow any installation or other materials to coat or cover any surface of the unit. This is particularly important for the radio windows. This may adversely affect radio and/or thermal performance.

The GPS on this product is only for use within the product to assist with maximising system performance. It is not to be used for rail operational or safety critical activities.

Some variants of these products employ a class 1 laser for fibre optic network connections. Such lasers are considered safe under any normal use case, however, please use care when interacting with these products when the fibre connection is exposed.

The customer is responsible for conducting suitable system trials prior to extended roll-out of any system containing these products. Whilst all relevant EMC standards are assessed for these products, customers are responsible for satisfying themselves that radio frequencies used do not interfere with rail safety systems.

CAUTION: Do not update or change the software on this device except with changes, configuration and via methods approved of in writing by Blu Wireless. Uncontrolled changes may compromise product compliance and could cause unnecessary interference with other devices and system.

4. Regulatory

4.1 Radio regulatory information

Table 3. TN201SC RF characteristics: Relevant for all regions

RF Characteristic	Min	Nominal	Max	Comment
Operating Frequency Range	57 GHz	-	71 GHz	May be subject to national restrictions on use.
Transmitter RF Power	-	-	40 dBmi	

4.1.1 Radio product change statement

Blu Wireless does not permit or authorize any changes or modifications to the product, including changes to software, which may affect radio behaviour except where explicitly supported by the product configuration tooling and documentation provided by Blu Wireless.

4.2 United Kingdom and Europe

The Blu Wireless TN201SC radio equipment is designed to operate in the unlicenced 57 to 71GHz frequency allocation and is compliant with relevant market legislation and requirements.

4.2.1 United Kingdom

The Blu Wireless TN201SC radio equipment complies with the Radio Regulations 2017 and EN 302 567. Operation in the United Kingdom is subject to the requirements of OFCOM Interface Requirement 2030 and the UK Implementing Decision 2019 No. 1345.

This equipment operates under Interface/Notification Number: IR2030/7/4 2018/316/UK and is subject to geographic restriction when using frequencies in the 59–63.9GHz band. See UK IR2030 for further details.

UK Interface Requirement 2030

https://www.ofcom.org.uk/__data/assets/pdf_file/0028/84970/ir-2030.pdf

UK Implementing Decision 2019 No. 1345

https://www.legislation.gov.uk/eudn/2019/1345

4.2.2 Europe

The Blu Wireless TN201SC radio equipment complies with the Radio Equipment Directive 2014/53/EU and EN 302 567, operation in European Member, EFTA and candidate states is subject to the national interface requirements of the Member state and EC Decision 2019/1345 including any national or regional restrictions.

See EC Decision 2019/1345

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32019D1345

The following graphic identifies the countries and regions where there maybe restrictions on operating the equipment as defined by EU regulation. The national regulations in each country of operation should be reviewed prior to installing/operating the equipment to ensure the equipment will be in compliance with national spectrum regulations.

BE	BG	CZ	DK	DE	EE
IE	EL	ES	FR	HR	IT
CY	LV	LT	LU	HU	MT
NL	AT	PL	PT	RO	SI
SK	FI	SE	UK(NI)	NO	IS
LI	CH	TR			

4.3 USA

This product has been assessed with respect to FCC requirements, specifically 47 CFR 15 and certified.

Note that not all sales-types have been approved yet with respect to FCC requirements. Sales-types approved for use in the USA are:

- TN201SC-B

Other sales-types may be in the process of being approved. Please discuss any such requirements with Blu Wireless

4.3.1 FCC compliance statement

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment 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 equipment 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 equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment 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 equipment and receiver.

- Connect the equipment 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.

4.3.1.1 Usage restrictions in line regulatory requirements in aviation

Regulatory restrictions defined in 47 CFR 15.255 (b)

(2) Operation on aircraft is permitted under the following conditions:

(1) When the aircraft is on the ground.

(2) While airborne, only in closed exclusive on-board communication networks within the aircraft, with the following exceptions:

(i) Equipment shall not be used in wireless avionics intra-communication (WAIC) applications where external structural sensors or external cameras are mounted on the outside of the aircraft structure.

4.3.2 Product changes

Any product changes or modifications made which are not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment

4.4 Canada - English

This product complies with Innovation, Science and Economic Development Canada (ISED) requirements RSS-Gen, RSS-210 and RSS-102. Not all sales-types have been approved for use in Canada. The following sales types have been approved for use in Canada:

- TN201SC-B with IC number 28284-TN201SCB

Other sales-types may be in the process of being approved. Please discuss any such requirements with Blu Wireless

4.4.1 ISED compliance statements

This device contains licence-exempt transmitters and receivers that comply with ISED's licence-exempt RSSs. Operation is subject to the following two conditions:

(1) This device may not cause interference.

(2) This device must accept any interference, including interference that may cause undesired operation of the device

4.4.1.1 Safe use of radios

WARNING: This product emits RF radiation in normal use. Do not install or use where, when powered on, any member of the public may be within 30cm of the unit. Temporary use is permitted at distances above 15cm during installation or maintenance operations

4.4.1.2 Aviation usage

In line with regulatory restrictions defined in RSS-210 Annex J:

- Devices used on aircraft are permitted under the following conditions:
  - devices are used when the aircraft is on the ground

4.5 Canada - Francais

Ce produit est conforme aux exigences d'Innovation, Sciences et Développement économique Canada (ISDE) CNR-Gen, CNR-210 et CNR-102. Tous les types de vente n'ont pas été approuvés pour utilisation au Canada. Les types de vente suivants ont été approuvés pour une utilisation au Canada

- TN201SC-B : IC 28284-TN201SCB

4.5.1 ISED déclarations de conformité

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

(1) L'appareil ne doit pas produire de brouillage;

(2) L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

4.5.1.1 Utilisation sécuritaire des radios

AVERTISSEMENT : Ce produit émet un rayonnement RF lors d'une utilisation normale. Ne pas installer ou utiliser là où, lorsqu'il est sous tension, un membre du public peut se trouver à moins de 30cm de l'appareil. L'utilisation temporaire est autorisée à des distances supérieures à 15cm pendant les opérations d'installation ou de maintenance

4.5.1.2 Utilisation aéronautique

Conformément aux restrictions réglementaires définies dans CNR-210 Annexe J.

- Les dispositifs utilisés dans des aéronefs sont permis selon les conditions suivantes :
  - Les dispositifs sont utilisés lorsque l'aéronef est au sol.

5. Usage

These products are intended to support high bandwidth passenger internet connectivity and link the on-train network to the trackside network.

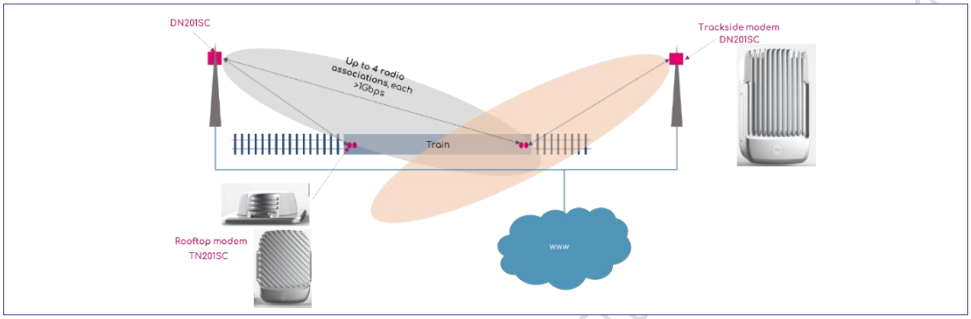

Figure 2. Radio connections for a typical installation

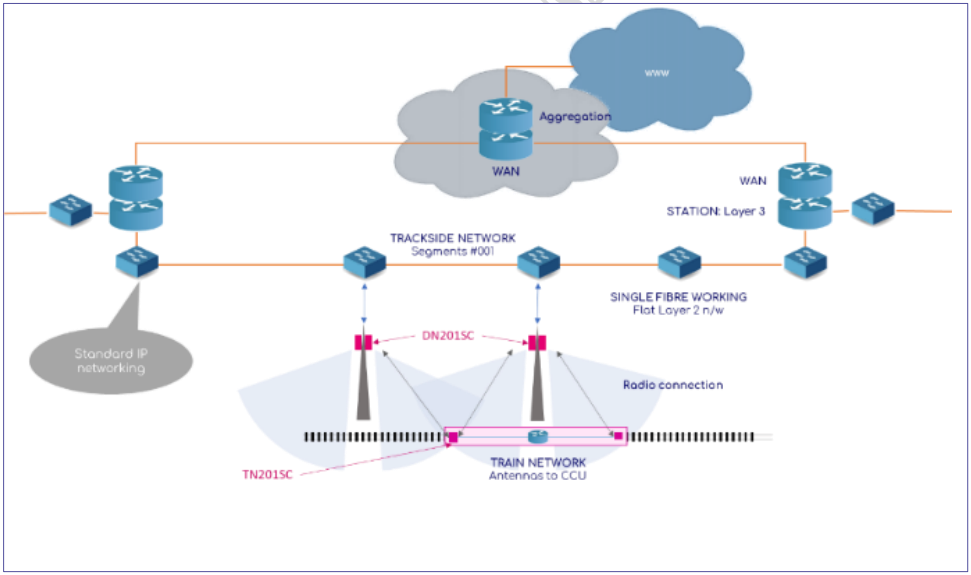

Figure 3. Typical trackside network

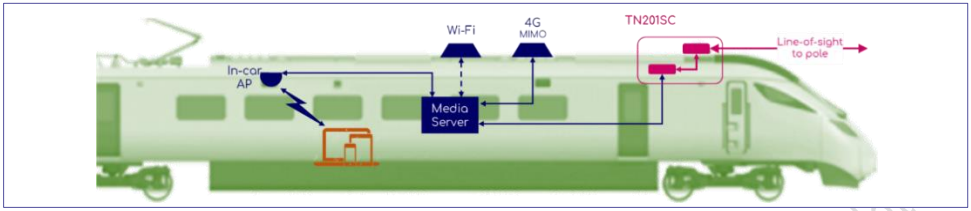

Figure 4. Typical on-train usage

6. Technical Specifications

6.1 Radio

Two products form radio links for use either between a vehicle such as a train and static infrastructure (DN201SC in conjunction with a TN201SC) or between nodes as part of a backhaul fixed wireless system where two DN201SC units communicate. The link characteristics for such links are described here. Normal conditions of use are described below.

The customer is responsible for the radio planning and system performance. Assistance in this can be found in radio deployment guide (BW-000976) from Blu Wireless in respect of environmental factors, radio range verses connection performance and line of sight requirements.

- System performance depends on several factors including:
  - Specified weather limits including rain intensity and environmental temperatures.
  - Agreed data throughput minima (average and absolute minima).
  - Robustness of connection required.
  - Range of train lengths supported.
  - Mobility dynamics.
  - Continuous line of sight coverage between units shall be maintained with a unit spacing not in excess of agreed maximum.

Radio communication in the mmWave range have an associated physics which means that under the following conditions full performance may not be achieved.

- Ice build-up on units.
- Metallic or conductive build-up on units. Grime should be removed periodically from the train-top units. Antennas are made of non-stick materials to reduce build-up.
- Heavy or unusual air pollution.
- Very heavy rain, sleet, snow, hail, or fog.
- During energetic thunderstorms temporary short-term reduction of performance may be observed, especially where this also influences power supplies or networking systems.
- Any form of power or networking outage.

Table 4. Radio performance and characteristics

Radio link characteristics	Min	Max	Comment
Radio frequencies	57 GHz	71 GHz	Note use of the full frequency range is subject to national regulations permitting their use
Transmit EIRP		40 dBmi	Conformant to the following standards/regulations: • EN302567 • FCC Part 15.255 • CEPT 07 03 • ISED RSS-Gen & RSS-210
Average throughput	1.25 Gbps		Measured at 150 kph over a distance equivalent to 10 mast spacings with full radio coverage. For trains 200 m long and mast spacing of 1 km where conditions for connection are met throughout
Minimum throughput	250 Mbps		At any location along a track where conditions for connection are met and with a maximum distance from the active train antenna to the active mast of 600 m
Azimuth beam steering range vs reference	−45°	45°	The product will steer the beam and perform to specification in this range. A slight loss of range may be seen at high steering angle (+ve or -ve) greater than 25°
Vertical beam offset from horizontal	−5°	+5°	Specified reception characteristics will be met within this range
Maximum train speed.	225 kph		

6.2 General specification

The following specifications may apply to any or all the component parts as defined in the header for each table. For most elements the mounting brackets, adapters and hardware are **not** included.

6.2.1 Physical characteristics

6.2.1.1 TN201SC

The TN201SC comprises 2 major components, an antenna unit on the train exterior and an NPU unit inside the train, connected by a cable. The product as delivered consists of all 3 parts.

Table 5. TN201SP train antenna unit physical characteristics

Physical Characteristics TN201SP Antenna unit	Min	Nom	Max	Comment
Number of radio antennas		2		With 180-degree angular separation.
Height		75 mm	78 mm	Excluding installation mounting plate. Spacing adapters may be available to adjust height for some installations.
Length (parallel to train axis)		200 mm	210 mm	
Width of antenna main body		154 mm		
Width of baseplate		175 mm		
TN201SP (O-ring style sealing) mounting plate hole – to achieve ingress protection requirements	31.95 mm	32 mm	32.05 mm	Base plate variants may be required for different mounting configurations. Please contact Blu Wireless prior to designing or using alternative plates.
Weight		2.3 kg	2.9 kg	Excludes any mounting adapters or hardware.
Diameter of connecting cable to NPU unit	5 mm	7 mm	12 mm	
Length of connecting cable to NPU unit	1.9 m	2.0 m	2.1 m	
Ambient operating temperature range	−25°C		40°C	
Mounting plate operating temperature	−25°C		55°C	
Unit mounting location	Nominally Train roof centreline			A survey may be required to ensure that both the Rolling Stock and Rail Network requirements and the requirements for line-of-sight connection with trackside units are met.
IP Rating – external surfaces		IP66		Ensure sealing is correctly designed and applied to seal the cable aperture in the roof of the train.
Limiting airspeed (structural limitation)	300 kph			

Table 6. TN001xC NPU train unit physical characteristics

Physical Characteristics TN001xC NPU unit	Min	Nom	Max	Comment
Height (above mounting plane)		38 mm		
Length		250 mm		
Width		205 mm		
Weight		3.0 kg		Excludes any mounting brackets or hardware
Operating temperature range	−25°C		55°C	
IP rating		IP54		

6.2.2 Interface details and pinout

Table 7. TN201SC interface details

TN201SC Interfaces	Detail
Power	M12 A connector VIN+: Pin 1 & 4 VIN-: Pin 2 & 3 The shield of the power cable may be used as earthing for EMC management
Network	Network connection A: M12X coded, 10G Ethernet (10G/5G/2.5G/1000BASE-T). Pin 1: DA+ Pin 2: DA− Pin 3: DB+ Pin 4: DB− Pin 5: DD+ Pin 6: DD− Pin 7: DC− Pin 8: DC+ Cat 7 network cable shall be used to connect to this port to maintain full EMC performance
Fibre connection	Product sales types with fibre connections may be available. Please discuss requirements with Blu Wireless.

6.3 Electrical protection, earthing and isolation

CAUTION: These products require the case to be earthed for Electromagnetic compatibility reasons. This may be achieved via the earth terminals on the case or the power cord shield if fully connected.

WARNING: The TN201SP train top unit must always be electrically connected to the train roof earth. Where OLE power systems may be encountered, this must conform to rolling stock requirements.

The casing of units shall be securely earthed, earthing points are available using the following robust threaded fixings:

- TN201SP Train top units may be earthed via the mating of the body of the unit to the train roof in some installations where required and permitted. In such installations both the mounting/adapter plate to the train and antenna unit to the adapter plate contact points must be clean during fitting and where necessary conductive assembly paste used to maintain a good high-capacity earth contact throughout the life of the product. The surface of the unit is either un-anodised or iridized allowing a highly conductive surface contact. Oxide layer build-up will need to be removed, through cleaning of the contact points, on any units with anodised options.
- TN001xC In-train units may be earthed by connecting the casing earth points shown in the figure below to the local earth. There are 2 M6 threaded holes available for such connections. Where the case needs to be earthed, an earthing connection via the unit mounting points is acceptable so long as a good electrical contact is ensured. The In-train unit is normally anodised, and this will need to be removed to allow such a connection.

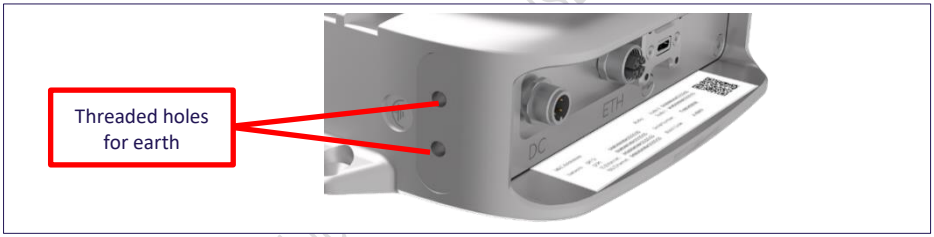

Figure 5. Earthing points: TN001xC In-train unit

6.3.1 Isolation

The DC power input on the TN001xC unit is isolated from the case and internal electronics via an internal isolated power supply.

6.4 Overhead cable breakage protection

The TN201SP train-top antenna component of the TN201SC equipment is contained in an aluminium cased unit with forward and rearward facing windows made of plastic (for radio performance). The casing is designed so that the metal case will be the first point of electrically conductive contact for any broken cable that may slide across the top of the train. Where OLE systems may be encountered a low resistance and high-capacity earth connection is required between the TN201SP train-top case and the train earth via the roof fittings. Conductive pastes may be used, and care should be taken that any surface coating is fully removed from the contact point if present. Ensure any installation specific requirements do not impact the mating of the weather sealing to the train top.

All installations with the possibility of use with OLE systems must be installed to comply with operation rolling stock requirements and approved by the relevant authority.

6.5 Power connections

6.5.1 TN201SC power supply

Table 8. TN201SC power features

TN201SC power supply parameter	Units	Min	Nom	Max	Detail
Input voltage (long term)	Volts	20.0	36	48.0	Where used with a nominal 36 V power supply this will be compliant with EN50155 power excursions
Input voltage (<3seconds per excursion)	Volts	18.4		50.4	
Average Power consumption	Watts		42	55	
Operational short term power consumption (<3 second)	Watts			70	
Permitted power supply ripple with respect to average input voltage	Pk-pk variation			5%	

6.6 Example connector panel layouts for options

6.6.1 TN sales type A

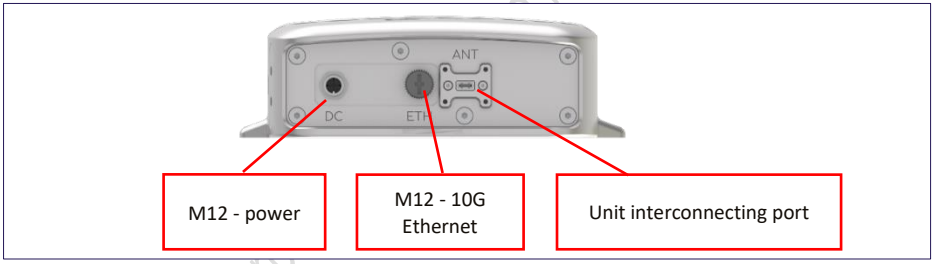

Figure 6. TN sales type A

6.6.2 TN sales type B

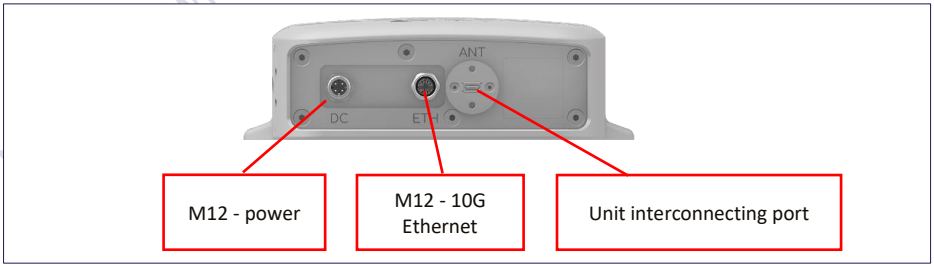

Figure 7. TN sales type B

6.7 Installation

Installation is described in Blu Wireless document BW-003989-GD.

7. Returns, end of life and recycling

Under all circumstances, contractual arrangements take precedence over this datasheet with respect to returned units.

7.1 End of life

These products should not be disposed of in normal waste.

Individual units at the end of their life may be recycled by sending to RECYCLING, Blu Wireless Technology Ltd, One Castlepark, Tower Hill, Bristol, UK. This address cannot accept multiple product shipments.

For larger scale shipments or decommissioning please contact Blu Wireless Ltd for shipping details.

By shipping units to Blu Wireless for recycling we can ensure that the best product recycling options are used. Contact Blu Wireless at One Castlepark, Tower Hill, Bristol, UK for an RMA number prior to shipment for recycling at which time the shipping location will also be advised.

7.2 Returns

Should any units require to be returned to Blu Wireless for any other reason than recycling, please contact Blu Wireless at One Castlepark, Tower Hill, Bristol, UK for an RMA number prior to shipment at which time the shipping location will also be advised. Unsolicited returns will be treated as end-of-life with no further responsibilities accepted by Blu Wireless Technology Ltd.