



USER GUIDE

M-001-215-03-USG-05-EN

TITAN PULSE660

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1. Document history

Revision	Date of release	Reason	Updated by	Reviewed by
01A	15/10/2024	1 st Revision - Draft A	W. Pretorius	J. Joubert
01	15/10/2024	1 st Revision - Release	W. Pretorius	J. Joubert
02A	14/02/2025	Update certification - Draft A	B. Roodt	W. Pretorius
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04	2025/05/13	Added ENACOM warning - Release	B. Roodt	P. Kruger
05A	2025/06/03	Updated grantee code - Draft A	B. Roodt	F. Maré
05	2025/06/03	Updated grantee code - Release	B. Roodt	F. Maré

2. Distribution

Name	Company	Role
Any employee	Epiroc Digital Safety Solutions South Africa Pty Ltd	Originator
Digital Solution Division, Parts and Services Division	Epiroc	Discretionary distribution

3. Approval

Name	Title	Date	Sign
H. du Plessis	Engineering Manager		

4. Scope

This document is a user's guide (USG) to describe the function of the *Titan Pulse660* (M-001-215-03). It provides the user with the relevant electrical and mechanical specifications and guides the user on the setup and installation of the device.

5. Intellectual property notice

The information in this document contains intellectual property developed and owned by Epiroc Digital Safety Solutions South Africa Pty Ltd is confidential, privileged, and only for the information of the intended recipient and may not be used, published, or redistributed without the prior written consent of Epiroc Digital Safety Solutions South Africa Pty Ltd.

6. Manufacturer details

Company Details	
Name	Epiroc Digital Safety Solutions South Africa Pty Ltd
Address	Unit 1 Agnone Park, 53 Adriana Crescent, Centurion, 0157, South Africa
Phone number	+27 12 661 4828

Table 1: Manufacturer details

7. Certification details

Certification Details	
FCC ID	2BPRY-21503V2
IC ID	32678-21503V2

Table 2: Certification Details

7.1 Declaration of Conformity in accordance with Directive 2014/53/EU

M-001-215-03 (Titan Pulse660 complies with the essential requirements and other relevant provisions of Directive 2014/53/EU, when used for its intended purpose.

The following marking applies to M-001-215-03 (Titan Pulse660):



Figure 1: CE mark

7.2 Declaration of Conformity in accordance with 47 CFR part 15

M-001-215-03 (Titan Pulse660 complies with the essential requirements and other relevant provisions of 47 CFR part 15, when used for its intended purpose.

The following marking applies to M-001-215-03 (Titan Pulse660):



Figure 2: FCC mark

8. Specification of accessories

Specification of accessories	
Unit	M-001-215-03
Includes	Titan Pulse460 module
Excludes	Titan PulseFlex Cables Rechargeable batteries

Table 3: Specification of accessories

9. Abbreviations

The abbreviations listed in Table 4 are used throughout the document.

Abbreviation	Description
COM	Communication
CRC	Cyclic redundancy check
CxD	Machine with sensor to allow proximity detection.
DC	Direct Current
GFSK	Gaussian Frequency Shift Keying
GMT	Greenwich Mean Time
GPIO	General-purpose input/output
ID	Identification
LED	Light Emitting Diode
LF	Low Frequency
NA	Not Applicable
NFC	Near-field Communication
OEM	Original Equipment Manufacturer
OOK	On-Off Keying
PC	Personal Computer
PDS	Proximity Detection System
RF	Radio Frequency
RSSI	Received signal strength indicator
RTC	Real-time Clock
RWM	Read Write module
UID	Unique Identifier
USB	Universal Serial Bus
VTP	Vehicle to Pedestrian
VTV	Vehicle to Vehicle

Table 4: Abbreviations

10. Introduction

The *Titan Pulse660* forms part of the TITAN family of collision avoidance products. The Pulse devices utilize technologies such as low frequency (LF) magnetic field and a sub-GHz transceiver for threat detection.

The *Titan Pulse660* is a transponder which emits an LF magnetic field that can be interpreted by other TITAN proximity detection devices within range. The system allows accurate proximity sensing of up to 20m, with an accuracy of 1m. The 125 kHz LF technology creates an adjustable short range magnetic field that allows for accurate detection within proximity of a vehicle or threat. This technology also allows for good penetration through objects.

All Pulse devices also incorporate a low power RF transceiver. The *Titan Pulse660* contains both, in order to communicate with all devices. The *Titan Pulse660* periodically broadcasts an RF message containing identifying information about itself, allowing it to be detected by other devices. It also receives RF messages from other devices, allowing it to detect them. This builds upon established Epiroc PDS systems, allowing for low power, medium range (50-100m) detection of vehicles, obstacles, and personnel.

The *Titan Pulse660* unit uses CAN bus communication, providing robust communication between devices and allowing dynamic configuration of these devices. It can also easily be configured in field via an NFC reader, without the need to open the enclosure or power the device.

This sensor is identical in functionality to that of the TITAN PULSE660. The only functional difference is that the *Titan Pulse660* utilises an internal ferrite coil antenna to generate the LF magnetic fields.

11. Operating principle

The *Titan Pulse660* is the magnetic field transmitter device, and therefore, transmits a short burst LF magnetic field every few hundred milliseconds. The range of this field is about 20m from the *Titan Pulse660* device.

Proximity tag devices like the TITAN Pulse130 placed inside the Cap lamps, simply transmit an RF message every few seconds for basic proximity detection. Whenever they observe a *Titan Pulse660* LF field, they will send an RF message reporting the field, its observed field strength, and the source of the field.

The *Titan Pulse660* is also set up as a reader device, and its purpose is to collect RF messages, including proximity messages and magnetic field reports. These messages are used to list surrounding tags; most crucially those present in an LF magnetic field. The *Titan Pulse660* is usually plugged into a management system like the TITAN Commander HMI, which receives this data from the *Titan Pulse660* and displays warnings as required.

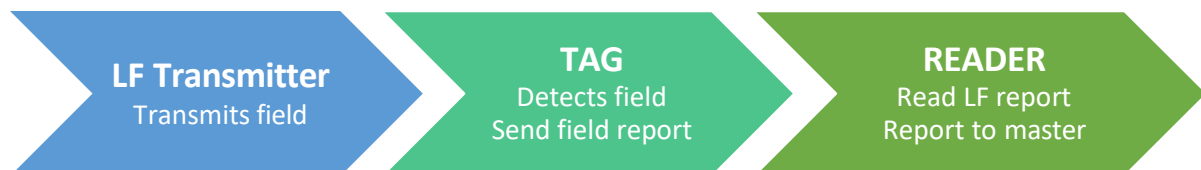


Figure 3: TITAN family interaction process flow for LF message

12. Application

The *Titan Pulse660* is the magnetic field transmitter device, and therefore, transmits a short burst LF magnetic field every few hundred milliseconds. This makes the *Titan Pulse660* device ideal for underground applications.

The pedestrian tag (TITAN Pulse130) and the TITAN *Pulse560* can communicate over RF. Thus, when a pedestrian enters the LF field, the pedestrian tag broadcast an RF response message to the proximity detection system.

13. Variants

Table 5 describes the different variants of the *Titan Pulse660*.

Variant	Description
V1	TITAN Pulse660 - 868Mhz
V2	TITAN Pulse660 - 915MHz

Table 5: *Titan Pulse660* variants

14. Electrical and Environmental Specifications

This section provides the electrical and environmental specifications of the *Titan Pulse660*.

14.1 Electrical specifications

Table 6 provide the electrical specifications of the *Titan Pulse660*.

Parameter	Minimum	Nominal	Maximum	Unit
Input Voltage	9	24	32	Vdc
Power Consumption	5	30	55	W

Table 6: Electrical specifications

14.2 Environmental specifications

Table 7 provides the environmental specifications of the *Titan Pulse660*.

Parameter	Minimum	Nominal	Maximum	Unit
Ambient temperature	0	25	50	°C

Table 7: Environmental specifications

15. Communication specifications

Table 8 provides the communication specifications for the *Titan Pulse660*.

Parameter	Units	Modulation/Format
RF	868 MHz / 915 MHz	GFSK
LF capabilities	125 kHz	OOK
NFC receiver	13.56 MHz	ISO 15693

Table 8: Communication specifications

15.1 Sub-1G specifications

Table 9 provides the RF specifications of the *Titan Pulse660*.

Parameter	Description
Radio type	Chipset: TI CC1120
Operational Frequency band	869.4 MHz to 869.65 MHz / 915Mhz to 928MHz
Opiating frequency (Transmit)	869.525 MHz / 916MHz
Opiating frequency (Receive)	869.525 MHz / 916MHz
Operating channel width	100 kHz
Modulation	GFSK

Table 9: RF specifications

15.2 Low frequency (LF) specifications

Table 10 provides the LF specifications of the *Titan Pulse660*.

Parameter	Description
Radio type	Chipset
Operational Frequency band	119 kHz to 140 kHz
Operating frequency	125 kHz
Modulation	OOK

Table 10: LF specifications

15.3 Near field communication (NFC) specifications

Table 11 the NFC specifications of the *Titan Pulse660*. The NFC is mainly used for to configure the sensor.

Parameter	Description
Radio type	Chipset
Operational Frequency band	11.810 MHz to 15.310 MHz
Operating frequency (Receive)	13.56 MHz
Modulation	ASK
Standard	ISO 15693

Table 11: NFC specifications

16. Updating firmware

This section describes how to update the bootloader and the application of the *Titan Pulse660*.

16.1 Updating Bootloader

To update the bootloader of the *Titan Pulse660*, follow the steps below:

- Open the *Titan Pulse660* by removing the 8x M6 screws on the bottom of the unit.
- Connect a ST-Link between the PC and the *Titan Pulse660*.
- Connect the *Titan Pulse660* to the PC using a USB-A to USB-C cable.
- Open STM32CubeProgrammer or other preferred bootloading software.
- Click the “Open file” button and select the bootloader (.hex) file that you would like to program onto the unit. Refer to Figure 4.

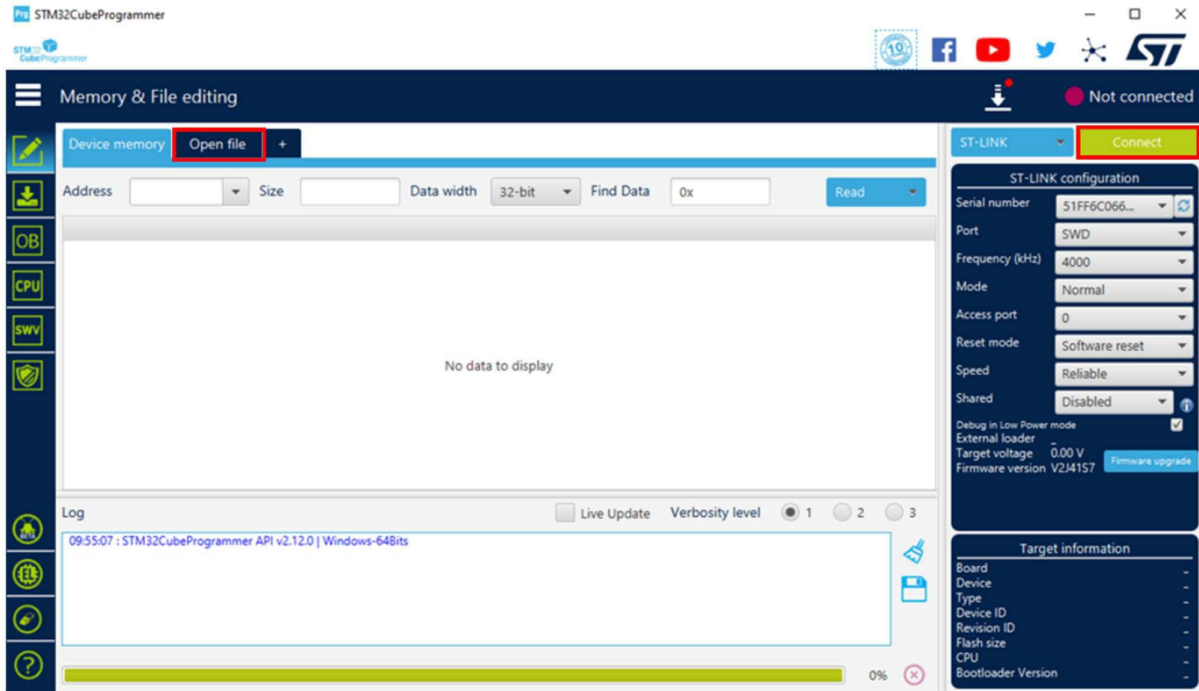


Figure 4: Bootloader process.

- Click the “Connect” button and verify that the program is connected to the unit. Refer to Figure 5.

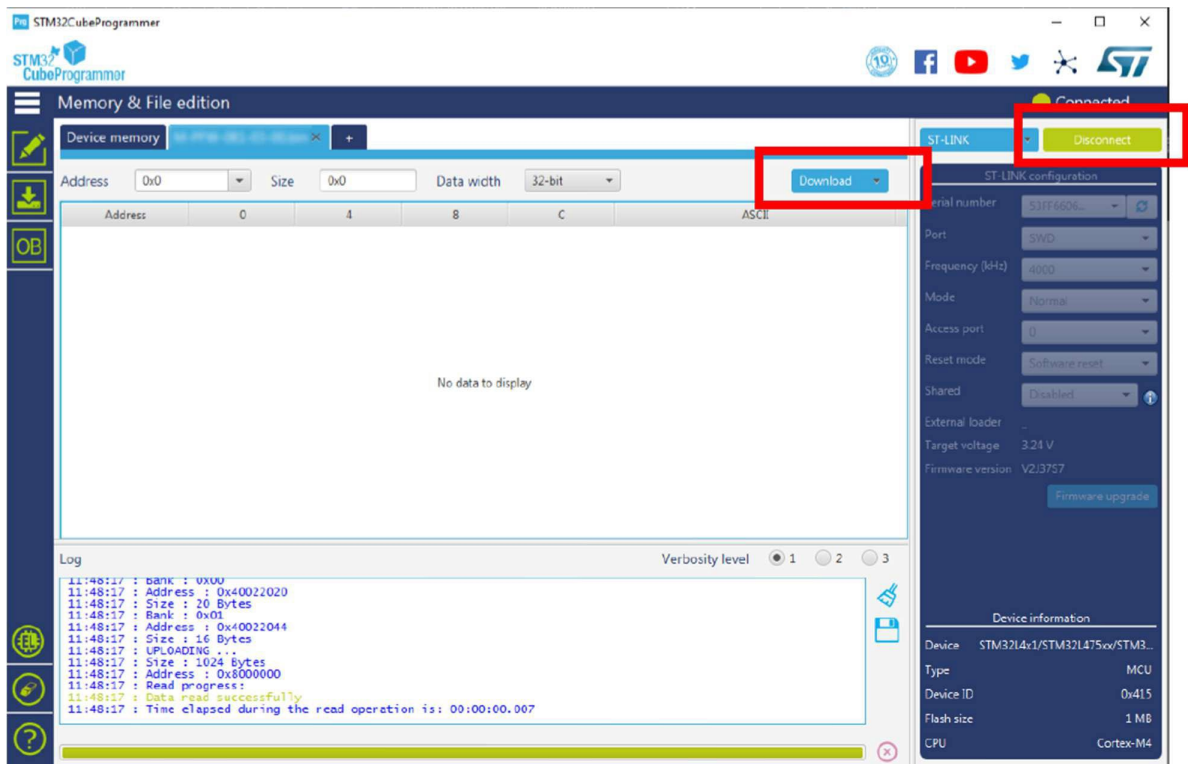


Figure 5: Unit connected and download button.

- Click the “Download” button and wait for the file to be loaded onto the device. If successful, the dialog prompt will be displayed as shown in Figure 6.

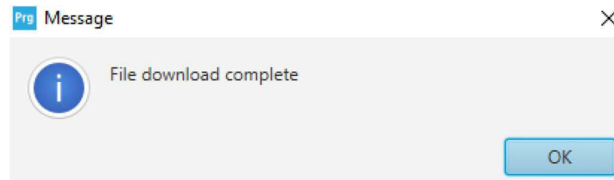


Figure 6: Bootloader successfully loaded dialog prompt.

16.2 Updating application firmware.

To update the application firmware of the *Titan Pulse660*, follow the steps below:

- Connect the *Titan Pulse660* to the CAN port of a TITAN Echo200.
- Connect the TITAN Echo200 to a PC using a USB-A to USB-C cable.
- Open the latest version of M-link Bootloader Utility software and select the CAN.
- Select the correct COM Port and file for the device as shown in Figure 7.

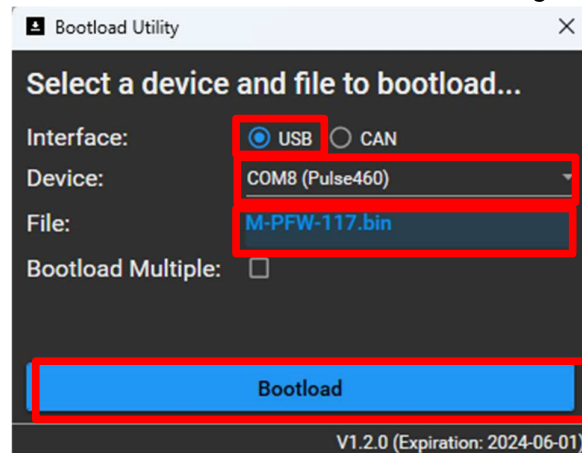


Figure 7: Load application firmware

17. Installation and operation

This section provides more detail on the operations of the *Titan Pulse660*.

17.1 Connections

The *Titan Pulse660* has two 8-way M12 circular connectors (female, Y-coded), used for both power and communication (via CAN bus). Both use the same pin assignment. Figure 8 shows the connectors on the unit, while Figure 9 shows the connector pin assignment.

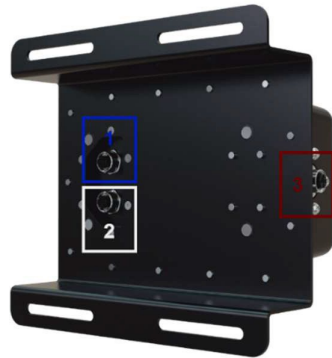


Figure 8: *Titan Pulse660* connectors

Connector Nr.	Description
1	CAN and power in/out
2	CAN and power in/out
3	LF antenna connector

Table 12: *Titan Pulse660* connector descriptions

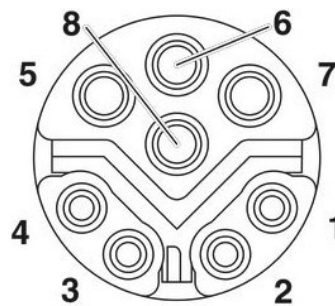


Figure 9: Y-coded female Phoenix connector pins

Pin Number	Wire Colour	Pin Usage	Description
1	White and orange	CAN_H	CAN high signal
2	Orange	CAN_L	CAN low signal
3	White and green	CAN_Sense_1	CAN sense signal 1
4	Green	CAN_Sense_2	CAN sense signal 2
5	Blue	VIN	Power positive
6	White	VIN	Power positive
7	Brown	GND	Power ground
8	Black	GND	Power ground

Table 13: Y-coded female Phoenix connector pin assignment

17.2 Setup

If communication with the vehicle management system is required, it can be connected to a CAN bus network. The CAN bus should be laid out as a single daisy-chain, with the bus passing through the *Titan Pulse660* using its two connectors. The last device at each end of the chain should be terminated. Figure 10 shows such a setup.

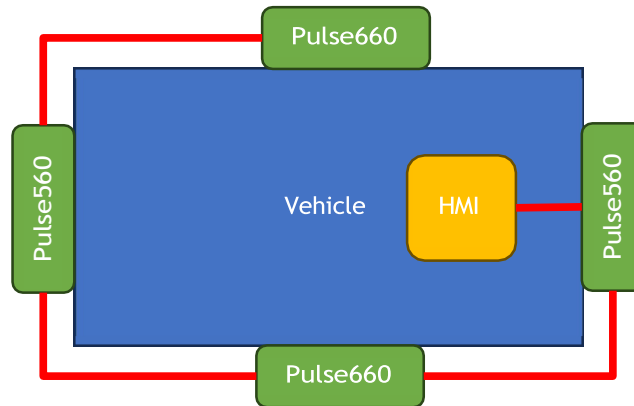


Figure 10: Illustration of CAN Bus Daisy-Chain Network

17.3 Near field communication (NFC)

The *Titan Pulse660* includes a near field communication (NFC) interface. Using the M-Link Utility software a user can seamlessly change the parameters of the *Titan Pulse660*. For a list configurable parameter, please see Section 18 of this document.

The NFC location on *Titan Pulse660* can be located at the side of the unit as shown in Figure 11.



Figure 11: NFC location

17.4 Communication

The *Titan Pulse660* communicates using a proprietary unified, standard command protocol over a CAN bus. This protocol is based on a polled instruction set, as well as optional auto-forwarded packets. The *Titan Pulse660* CAN bus is the only external wired communication used to communicate with host units and other Pulse units.

17.5 Status LED colours

The left LED is designated as the status LED, while the right LED is designated as the activity LED. Table 14 and Table 15 details the LED states.

Colour	Meaning
 Green	CAN communication active.
 Blue	Undefined.
 Violet	Undefined.
 White	Undefined.
 Red	Error / fault.
 Yellow	No CAN communication.
 Cyan	Undefined.
 RGB	Bootloader mode. If the LED rapidly flashed red, green, and blue, the device is in bootloader mode awaiting a firmware image. If this is unexpected, it could indicate that firmware has failed to load more than once.

Table 14: *Titan Pulse660* status LED colours (LED 1, left)

Colour	Meaning
 Green	Sending RF broadcast.
 Blue	Undefined.
 Violet	Sending LF message: The LED will flash violet for ~50ms for every time a magnetic field is transmitted.
 White	Restart. The LED will flash white when the device restarts. RWM present. The LED will flash white every second if an RWM is detected.
 Red	Undefined.
 Yellow	Undefined.
 Cyan	Undefined.
 RGB	Bootloader mode. If the LED rapidly flashed red, green, and blue, the device is in bootloader mode awaiting a firmware image. If this is unexpected, it could indicate that firmware has failed to load more than once.

Table 15: *Titan Pulse660* activity LED colours (LED 2, right)

18. Parameters

The parameters of the *Titan Pulse660* can be configured using NFC. The below shows list of parameters for the *Titan Pulse660*. All other parameters are not applicable and should be left at default values.

Category	Parameter	Value
Tag Settings	Tag Type	Select based on application
Tag Settings	RF Power	10
Tag Settings	CAN Slave ID	Configure based on application
Tag Settings	Vehicle ID	Configure based on application
Tag Settings	RF Broadcast Interval	500
Tag Settings	LF Broadcast Interval	500
Tag Settings	LF Power	100
Tag Function Flags	Tag Enable	True
Tag Function Flags	Heartbeat	True
Tag Function Flags	Always on	True
Tag Function Flags	CAN Termination	True
868 MHz Flags	Broadcast ID 868 MHz	True
868 MHz Flags	RF Receiver 868 MHz	True
868 MHz Flags	Use New RF	True
LF Flags	Transmit LF Field	True
LF Flags	Use New LF	True

Table 16: Parameters.

19. System maintenance

This section describes the maintenance process that needs to be followed for a *Titan Pulse660*.

19.1 Physical inspection

The *Titan Pulse660* should be visually inspected for any notable discrepancies. This includes damage to the wires, or a crack in the enclosure or any other anomalies that might influence the sensor's functionality.

19.2 Power and CAN communication test

The *Titan Pulse660* can be powered using one of the Y-Coded CAN connectors. Ensure that Status LED on the *Titan Pulse660* lights up. The status LED should be amber and go green ones the sensor detects the TITAN Commander Gateway on the CAN network.

19.3 NFC test

Refer to Section 17.3 for the process of changing the tag settings. If the RWM does not show the blue LED to indicate that it is connected at a near distance, then the NFC is not working. This should be noted on the Tag and the tag may not be redistributed.

20. Mechanical Specifications

This section describes the mechanical specifications of the *Titan Pulse660*.

20.1 Dimensions

The mechanical dimensions of the *Titan Pulse660* can be seen in Figure 12.

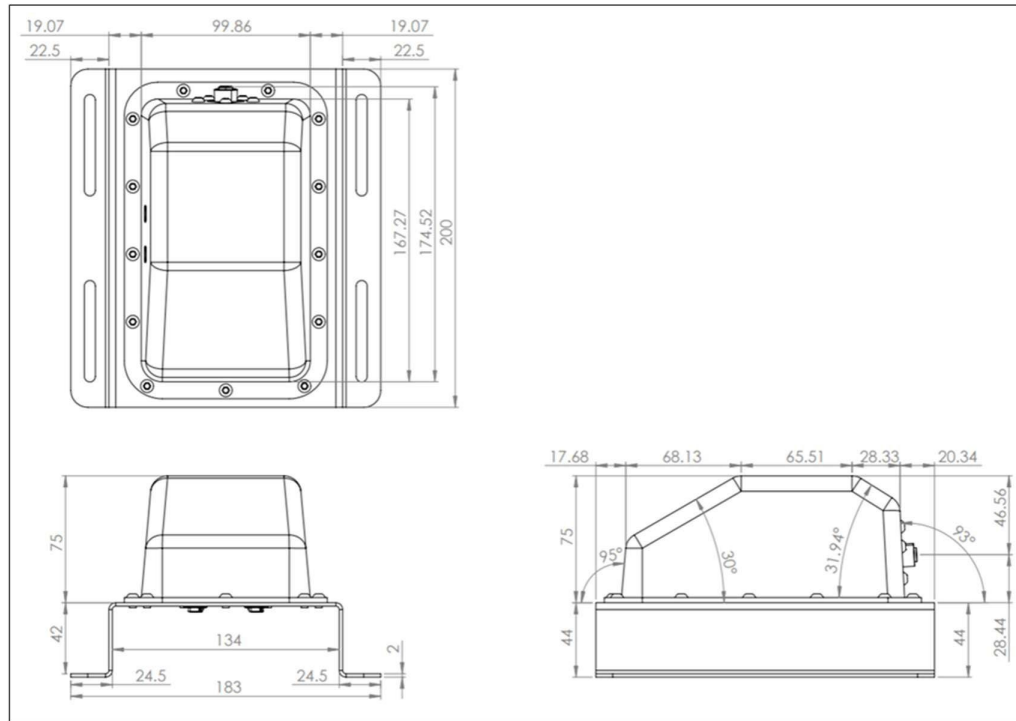


Figure 12: *Titan Pulse660* dimensions.

21. Warnings

21.1 FCC Statement

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

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.

Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

21.2 IC Statement

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

- This device may not cause interference.
- This device must accept any interference, including interference that may cause undesired operation of the device.

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 :

- L'appareil ne doit pas produire de brouillage;
- L'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement

21.3 ENACOM warning

21.3.1 Equipment installed in vehicles

- **Resolution 854/2020:** When regulatory identification is not visible due to installation inside vehicles, the identification should be included in manuals or on-board documentation.
- **Resolution 586/2023:** In such cases, identification should be included in the manuals, on-board documentation, or the official website of the manufacturer/importer, as per points II, III, and IV.

21.4 Modification Statement

21.4.1 FCC Warning

Epiroc Digital Safety Solutions South Africa Pty Ltd has not approved any changes or modifications to this device by the user. Any changes or modifications could void the user's authority to operate the equipment.

21.4.2 ISED Warning

Epiroc Digital Safety Solutions South Africa Pty Ltd n'approuve aucune modification apportée à l'appareil par l'utilisateur, quelle qu'en soit la nature. Tout changement ou modification peuvent annuler le droit d'utilisation de l'appareil par l'utilisateur.

21.5 RF Exposure Warnings

21.5.1 Mobile Device RF Exposure Statement

1. Mobile Device definition: Mobile: (§2.1091) (b) – A mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitter's radiating structure(s) and the body of the user or nearby persons. Per §2.1091d(d)(4) In some cases (for example, modular or desktop transmitters), the potential conditions of use of a device may not allow easy classification of that device as either Mobile or Portable. In these cases, applicants are responsible for determining minimum distances for compliance for the intended use and installation of the device based on evaluation of either specific absorption rate (SAR), field strength, or power density, whichever is most appropriate.
2. RF Exposure –
 - a. For FCC: This device is only authorized for use in a mobile application. At least 20 cm of separation distance between the *Titan Pulse660* device and the user's body must be maintained at all times.
 - b. For IC: La distance entre l'utilisateur et de produits ne devrait pas être inférieure à 20cm

21.6 Interference statement

This device complies with Part 15 of the FCC Rules and Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie 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, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

21.7 Wireless notice

This device complies with FCC/ISED radiation exposure limits set forth for an uncontrolled environment and meets the FCC radio frequency (RF) Exposure Guidelines and RSS-102 of the ISED radio frequency (RF) Exposure rules. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Le présent appareil est conforme à l'exposition aux radiations FCC / ISED définies pour un environnement non contrôlé et répond aux directives d'exposition de la fréquence de la FCC radiofréquence (RF) et RSS-102 de la fréquence radio (RF) ISED règles d'exposition. L'émetteur ne doit pas être colocalisé ni fonctionner conjointement avec à autre antenne ou autre émetteur.

22. Disclaimer

Although great care has been taken to try to ensure that the information contained in this document is accurate, some inaccuracies are inevitable. Neither the authors and editors of Epiroc Digital Safety Solutions South Africa Pty Ltd reviews, nor those responsible for compiling and disseminating this document, are responsible for any adverse consequences of these inaccuracies.

Please do not hesitate to notify us at Epiroc Digital Safety Solutions South Africa Pty Ltd of any mistakes or omissions you encounter, to enable us to make the necessary corrections if required.

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