



USER GUIDE

M-001-221-03-USG-06-EN

TITAN PULSE460

Table of Contents

1.	DOCUMENT HISTORY.....	4
2.	DISTRIBUTION.....	4
3.	APPROVAL.....	4
4.	SCOPE.....	4
5.	INTELLECTUAL PROPERTY NOTICE.....	4
6.	MANUFACTURER DETAILS.....	5
7.	CERTIFICATION DETAILS.....	5
7.1	DECLARATION OF CONFORMITY IN ACCORDANCE WITH DIRECTIVE 2014/53/EU.....	5
7.2	DECLARATION OF CONFORMITY IN ACCORDANCE WITH 47 CFR PART 15.....	5
8.	SPECIFICATION OF ACCESSORIES.....	5
9.	OVERVIEW.....	6
9.1	OPERATING PRINCIPAL.....	6
10.	INSTALLATION AND OPERATION.....	7
10.1	CONNECTIONS.....	7
10.2	COMMUNICATION.....	8
10.3	STATUS LED COLOURS.....	8
10.4	PARAMETERS.....	8
11.	MAINTENANCE.....	9
12.	ELECTRICAL SPECIFICATIONS.....	9
13.	RF SPECIFICATIONS.....	9
14.	MECHANICAL SPECIFICATIONS.....	10
14.1	PRODUCT DRAWINGS.....	10
15.	ENVIRONMENTAL SPECIFICATIONS.....	10
16.	VARIANTS.....	11
18.	WARNINGS.....	13
18.1	FCC STATEMENT.....	13
18.2	IC STATEMENT.....	13
18.3	ENACOM WARNING.....	13
18.3.1	Equipment installed in vehicles.....	13
18.4	MODIFICATION STATEMENT.....	13
18.4.1	FCC Warning.....	13
18.4.2	ISED Warning.....	13
18.5	RF EXPOSURE WARNINGS.....	14
18.5.1	Mobile Device RF Exposure Statement.....	14
18.6	INTERFERENCE STATEMENT.....	14
18.7	WIRELESS NOTICE.....	14
19.	DISCLAIMER.....	15

List of Figures

Figure 1: CE mark.....	5
Figure 2: FCC mark.....	5
Figure 3: TITAN family interaction process flow for LF message.....	6
Figure 4: Titan Pulse460 PCIe connector.....	7
Figure 5: Titan Pulse460 u.FL RF antenna connectors.....	7
Figure 6: Titan Pulse460 dimensions.....	10

List of Tables

Table 1: Manufacturer details.....	5
Table 2: Certification details.....	5
Table 3: Specification of accessories.....	5
Table 4: u.FL RF antenna connectors.....	7
Table 5: Titan Pulse460 status LED colours.....	8
Table 6: Parameters.....	8
Table 7: Titan Pulse460 electrical specifications.....	9
Table 8: RF specifications.....	9
Table 9: Titan Pulse460 environmental specifications.....	10
Table 10: Titan Pulse460 variant descriptions.....	11

1. Document history

Revision	Date of release	Reason	Updated by	Reviewed by
01A	25/01/2024	1 st Revision - Draft A	M. Conradie	W. Pretorius
01	25/01/2024	1 st Revision - Release	M. Conradie	W. Pretorius
02A	14/02/2025	Update certification - Draft A	B. Roodt	W. Pretorius
02	14/02/2025	Update certification - Release	B. Roodt	W. Pretorius
03A	20/03/2025	Added CE mark - Draft A	B. Roodt	J. Wuth
03	26/03/2025	Added CE mark - Release	B. Roodt	J. Wuth
04A	2025/05/13	Added ENACOM warning - Draft A	B. Roodt	P. Kruger
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
06A	2025/08/04	Added single module notice - Draft A	B. Roodt	F. Maré
06	2025/08/04	Added single module notice - Release	B. Roodt	

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 Pulse460 (M-001-221-03). 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

Manufacturer 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-22103V3
IC ID	32678-22103V3

Table 2: Certification details

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

M-001-221-03 (Titan Pulse460 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-001-221-03 (Titan Pulse460):



Figure 1: CE mark

7.2 Declaration of Conformity in accordance with 47 CFR part 15

M-001-221-03 (Titan Pulse460 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-001-221-03 (Titan Pulse460):



Figure 2: FCC mark

8. Specification of accessories

Specification of accessories	
Unit	M-001-221-03
Includes	PCB Assembly X2 mounting screws
Excludes	Enclosure 915MHz u.FL antenna

Table 3: Specification of accessories

9. Overview

The Titan Pulse460 forms part of the TITAN family of collision avoidance products. The Pulse devices utilize technologies such as LF magnetic field detection, sub-GHz RF, and UWB time-of-flight for threat detection. The Titan Pulse460 is a module that forms the core of the Pulse devices. It contains the microprocessor and performs all the processing of the sensor. The Titan Pulse460 contains the sub-GHz RF transceiver, NFC EEPROM, NVRAM, NOR flash and various communication peripherals used to control the circuitry on the baseboards it is plugged into.

When plugged into a compatible baseboard, the Titan Pulse460 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 915 MHz ISM band RF transceiver. The Titan Pulse460 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 Pulse460 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.

9.1 Operating principal

When plugged into a compatible baseboard, the Titan Pulse460 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 Pulse460 device.

Proximity tag devices like the tags placed inside the Cap lamps, simply transmit an RF message every few seconds for basic proximity detection. Whenever they observe a Titan Pulse460 LF field, they will send an RF message reporting the field, its observed field strength, and the source of the field.

The Titan Pulse460 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 Pulse460 is usually plugged into a management system like the TITAN Commander HMI, which receives this data from the Titan Pulse460 and displays warnings as required.

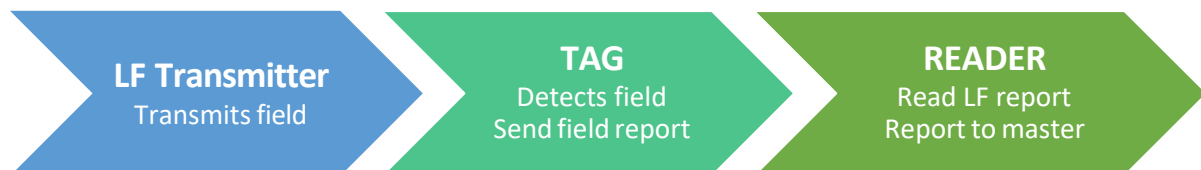


Figure 3: TITAN family interaction process flow for LF message

10. Installation and Operation

This section describes the installation and operation of the Titan Pulse460.

10.1 Connections

The Titan Pulse460 contains a PCIe connector that fits into the baseboard. The Titan Pulse460 also contains u.FL connectors to connect a RF antennas. Figure 4 shows the PCIe connector on the unit.

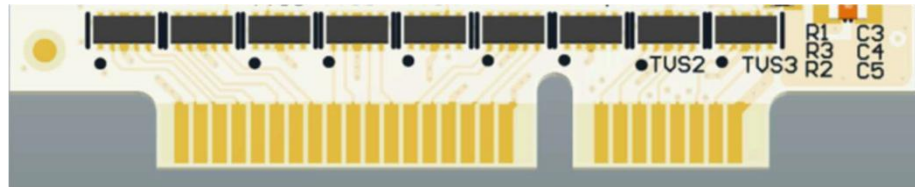


Figure 4: Titan Pulse460 PCIe connector

Connector Number	Description
1	915 MHz RF connector before amplifier (variant dependent)
2	XBee 915 MHz RF connector (variant dependent)

Table 4: u.FL RF antenna connectors

10.2 Communication

The Titan Pulse460 communicates using a proprietary unified, standard command protocol over a FDCAN bus. This protocol is based on a polled instruction set, as well as optional auto-forwarded packets. The Titan Pulse460 FDCAN bus is the only external wired communication used to communicate with host units and other Pulse units. The Titan Pulse460 needs to be plugged into a baseboard with an FDCAN transceiver to enable its FDCAN capability.

The Titan Pulse460 also communicates through UART and USB. These interfaces are used to communicate with modules on the baseboard or are brought out through a connector on the baseboard.

The RF transceiver on the Titan Pulse460 can also be used to communicate with the host and other devices.

10.3 Status LED colours

Table 5 details the LED states.

Colour	Meaning
 Green	Broadcasting RF message.
 Blue	Undefined.
 Violet	Transmitting LF field.
 White	Undefined.
 Red	Undefined.
 Yellow	Undefined.
 Cyan	Undefined.
 RGB	Bootloader mode when flashing RGB colours.

Table 5: Titan Pulse460 status LED colours

10.4 Parameters

The parameters of the Titan Pulse460 can be configured using NFC. Table 6 shows list of parameters for the Titan Pulse460. 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
LF Flags	Transmit LF Field	True
LF Flags	Use New LF	True

Table 6: Parameters.

11. Maintenance

If a Titan Pulse460 is connected to a vehicle management system through a baseboard, it will be able to detect if there is a fault with the Titan Pulse460.

Use the relevant test equipment to test the following functionality weekly:

- RF Transceiver
- LF transmit.
- LF receive (if applicable).
- CAN communications.
- RGB LEDs.

12. Electrical Specifications

The unit is powered by 5V DC. It only provides ESD protection and relies on the baseboard for reverse polarity and over-voltage protection.

Parameter	Minimum	Nominal	Maximum	Unit and condition
Input Voltage	4.8	5	5.5	Vdc
Power Consumption			0.52	W
LF Frequency		125		kHz
RF Frequency		915		MHz
CAN Bus Speed	110	250000	256000	Bits/s
Ambient Temperature	0	25	50	°C

Table 7: Titan Pulse460 electrical specifications.

13. RF specifications

Table 8 provides the RF specifications of the Titan Pulse460 module.

Parameter	Description
Radio type	Chipset: TI CC1120
Operational Frequency band	915Mhz to 928MHz
Opiating frequency (Transmit)	915MHz
Opiating frequency (Receive)	915MHz
Modulation	GFSK

Table 8: RF specifications

14. Mechanical Specifications

This section provides the mechanical information pertaining to the Titan Pulse460. All the measurements are in millimetres (mm).

14.1 Product drawings

Figure 6 shows the top and side views of the Titan Pulse460 module.

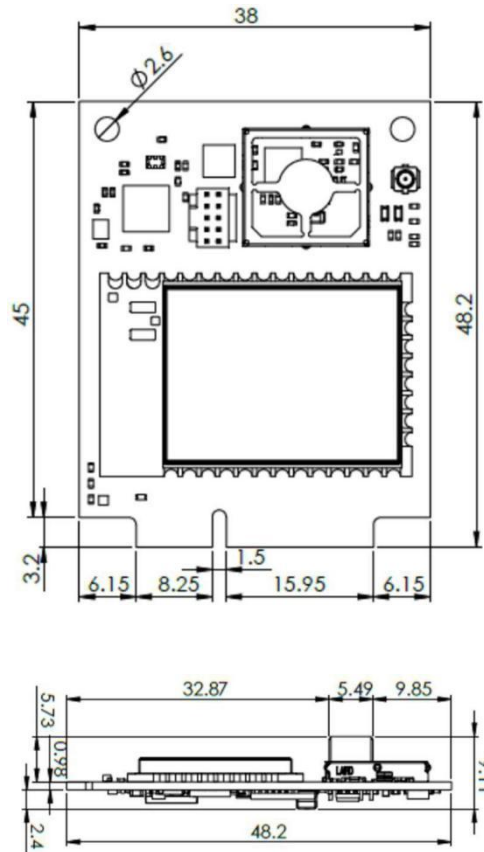


Figure 6: Titan Pulse460 dimensions.

15. Environmental Specifications

Table 9 details the environmental specification of the Titan Pulse460.

Condition	Range
Vibration	5G Peak
Shock	100G Peak
Operating Temperature	0°C up to 55°C
Storage Temperature	-20°C up to 70°C
Humidity	100% Condensing
Altitude	0 to 2000m.a.m.s.l.
Atmospheric Pressure	860hPa to 1060hPa

Table 9: Titan Pulse460 environmental specifications

16. Variants

Table 10 describes the different variants of the Titan Pulse460.

Variant	Description
V3	Titan Pulse460 Module - 915MHz
V4	Titan Pulse460 Module - 915MHz, No Xbee, No NVRAM

Table 10: Titan Pulse460 variant descriptions

18. Warnings

18.1 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.

18.2 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

18.3 ENACOM warning

18.3.1 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.

18.4 Modification Statement

18.4.1 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.

18.4.2 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.

18.5 RF Exposure Warnings

18.5.1 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 Pulse460 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

18.6 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.

18.7 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.

19. 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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The requirement for KDB 996369 D03:

2.2 List of applicable FCC rules

FCC CFR Title 47 Part 15 Subpart C Section 15.249

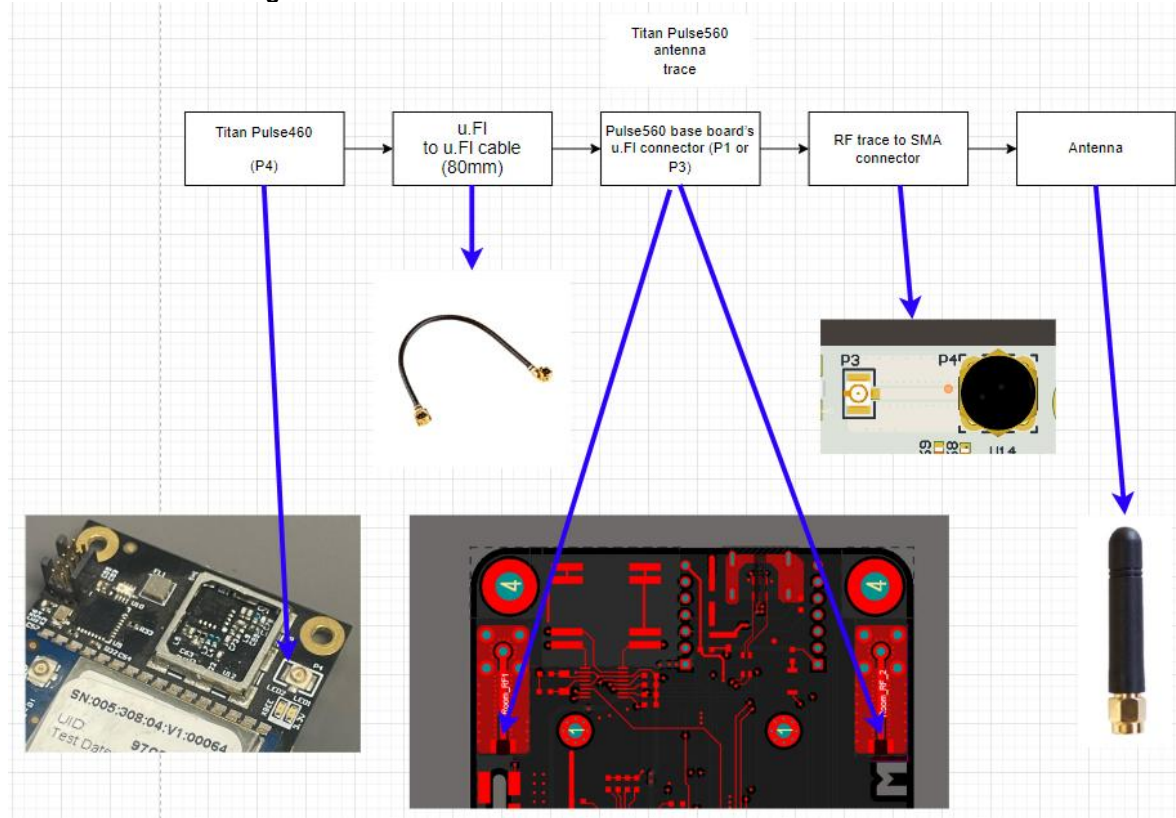
2.3 Summarize the specific operational use conditions

The module has been certified for Fix, Mobile applications. This transmitter must not be Co-located or operating in conjunction with any other antenna or transmitter.

2.4 Limited module procedures

Not applicable

2.5 Trace antenna designs



Type of antenna used: Stubby Antenna

Maximum antenna gain: 2dBi

Impedance required by antenna: 50Ω

Manufacture: RF Solutions

2.6 RF exposure considerations

This modular complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. This modular must be installed and operated with a minimum distance of 20 cm between the radiator and user body.

2.7 Antennas

The module use trace antenna design, customer can use the antenna as above trace antenna designs list type .

2.8 Label and compliance information

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.

Warning: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: 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.

If the FCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains Transmitter Module FCC ID: 2BPRY-22103V3 Or Contains FCC ID: 2BPRY-22103V3"

2.9 Information on test modes and additional testing requirements

The modular transmitter is only FCC authorized for the specific rule parts (FCC Part 15.249) list on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. The final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed when contains digital circuitry.

2.10 Additional testing, Part 15 Subpart B disclaimer

When testing host product, the host manufacture should follow FCC KDB Publication 996369 D04 Module Integration Guide for testing the host products. The host manufacturer may operate their product during the measurements.

2.11 Note EMI Considerations

host manufacture is recommended to use D04 Module Integration Guide recommending as "best practice" RF design engineering testing and evaluation in case non-linear interactions generate additional non-compliant limits due to module placement to host components or properties.

2.11 How to make changes

This module is stand-alone modular. If the end product will involve the Multiple simultaneously transmitting condition or different operational conditions for a stand-alone modular transmitter in a host, host manufacturer have to consult with module manufacturer for the installation method in end system. According to the KDB 996369 D02 Q&A Q12, that a host manufacture only needs to do an evaluation (i.e., no C2PC required when no emission exceeds the limit of any individual device (including unintentional radiators) as a composite. The host manufacturer must fix any failure.

IC modular usage statement

The modular can be installed or integrated in mobile or fix devices only. This modular cannot be installed in any portable device .

This modular complies with IC RF radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. This modular must be installed and operated with a minimum distance of 20 cm between the radiator and user body. Cette modulaire doit être installé et utilisé à une distance minimum de 20 cm entre le radiateur et le corps de l'utilisateur.

If the IC number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains IC:32678-22103V3"

The devices must be installed and used in strict accordance with the manufacturer's instructions as described in the user documentation that comes with the product.

This radio transmitter [IC:32678-22103V3] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Type of antenna used: Stubby Antenna

Maximum antenna gain: 2.0dBi

Impedance required by antenna: 50Ω

Manufacture: RF Solutions