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PinPointR

User Manual

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About This Manual

The ImpulseRadar PinPointR is a state-of-the-art, self-contained Ultra-Wide Band (UWB) Ground Penetrating Radar (GPR) system. The dual frequencies and mechanical design combined with the various accessories like the GPS mounting kit make the system suitable for different kind of locating and mapping applications.

For information on other applications and/ or configurations, please contact your local ImpulseRadar representative, or contact our sales team at sales@impulseradar.se

This manual is structured as follows:

- Section 1 – Hardware systems and accessories
- Section – Appendices additional, notes and technical information

We welcome your feedback concerning this manual and its content. Please send your comments or suggestions to us at info@impulseradar.se

Hardware Overview

The ImpulseRadar PinPointR is a dual-channel GPR system based on a modern real-time sampling (RTS) technology platform, offering state-of-the-art data acquisition capabilities. The PinPointR system incorporates two separate GPR-channels, co-located at the same mid-point, as well as an in-built GPS as standard.

GPR UNIT	Centre Frequency
PinPointR	400 and 800 MHz

The PinPointR is a push-cart system supported by several accessories, as shown in Figure 1 below.

Figure 1 PinPointR System Overview

Data collection is managed over an Ethernet Wi-Fi link and a suitable Android device running the ImpulseRadar ViewPoint App (ViewPoint). With ViewPoint, the operator may collect single line data, albeit with two frequencies, or a few different types of

multi-line projects. Whether a single line of project-based data has been collected, datasets may be directly imported into the ImpulseRadar CrossPoint software (CrossPoint) for processing and evaluation in a Windows environment.

GPR Unit

The GPR unit has a field-rugged design equipped with both a low and high-frequency channel, making it possible to detect shallow and deep utilities simultaneously. Power is supplied via a removable and rechargeable Li-ion battery, which is conveniently located on the top of the unit. Figure 2 below shows the location of the ON/OFF button and the connector sockets for odometer and external GPS.

The unit also includes a high-quality differential GPS receiver (Ublox/ Tallysman). There is no external connection to this component, although markings on the housing indicate the approximate internal location.

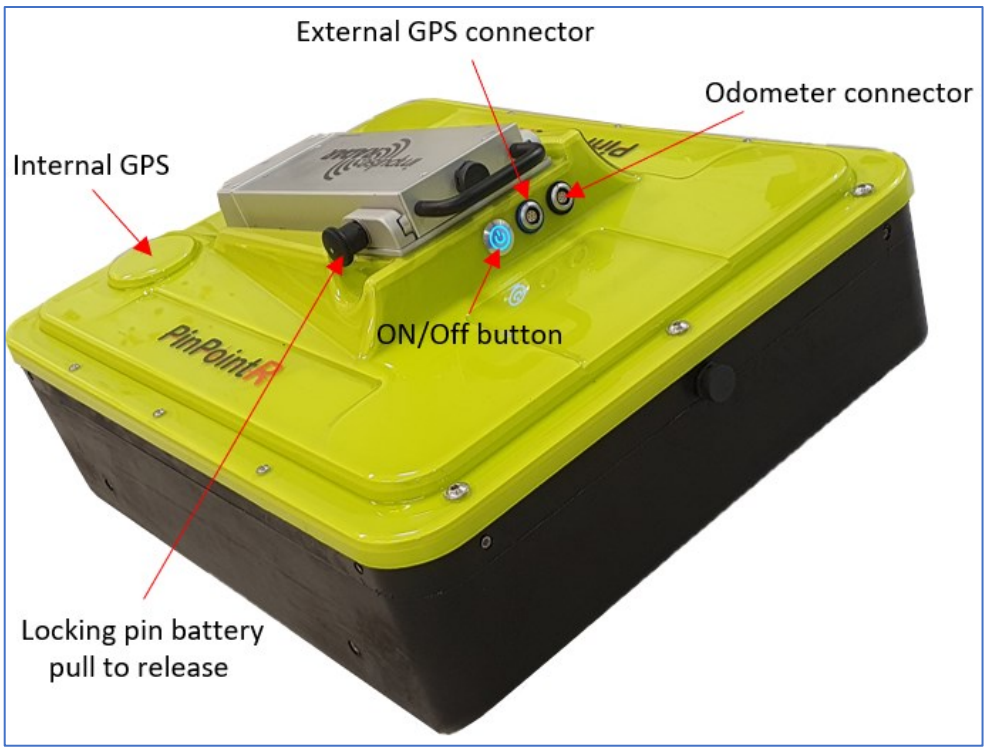


Figure 2 PinPointR GPR unit with battery attached.

Connector panel

Refer to the arrangement shown in the previous section.

- Silver – ON/OFF button  . Press and hold the button for approximately two seconds to switch on the unit. Once on, the button glows blue. A subsequent press will switch off the GPR unit.

- Blue – External GPS  . It allows the connection of an external GPS to provide higher precision positioning. Communication is via a serial RS232 link using the NMEA 0183, V2 protocol, and GGA data string.

- Black – Measuring Wheel  . It allows the connection of the odometer cable (wheel encoder) from the pushcart.

All cable connectors are of high-quality from Yamaichi. To insert or remove a cable connector, hold the connector sleeve then gently push or pull the connector straight without turning. Each connector has a key slot to prevent damage if incorrectly connected into the wrong socket.

Battery

The PinPointR is powered via a removable and rechargeable Li-ion battery, which is a nominal 8.7 Ah/ 96.57 Wh, providing approximately 7-hours of continuous operation.

The battery fits securely to the top of the GPR unit. To insert, position it on the mounting plate and slide it gently into place until you hear the locking pin engage (click). To remove, pull the locking pin out, then gently slide the battery out and off from the mounting plate, as shown in Figure 3 below.

Note: ImpulseRadar Li-ion batteries are approved according to UN38.3 standard and can, therefore, be safely hand-carried on passenger aircraft or shipped by air cargo.

Figure 3 Exchanging PinPointR GPR battery.

Pushcart

The PinPointR pushcart allows the GPR unit to be manoeuvred easily over a range of surfaces. It incorporates several useful features including a height-adjustable tray for the GPR unit itself, as well as a foldable handle assembly, and a foot brake.

The GPR unit is mounted in a tray that is suspended under the push-cart hood by adjustable support straps, as shown in Figure 4. This arrangement allows the unit to be positioned on or very close to the ground's surface and 'float' freely vertically while following the contour of the ground, but also move over bumps and other small obstacles. When you receive the PinPointR system, the GPR unit will already be fitted into the tray, but it is possible to remove it. However, this should only be necessary should the tray become worn through prolonged and direct contact with the ground, or in the rare instance that the GPR unit fails. Should this be necessary, follow the removal procedure given in section 'GPR unit removal procedure'.

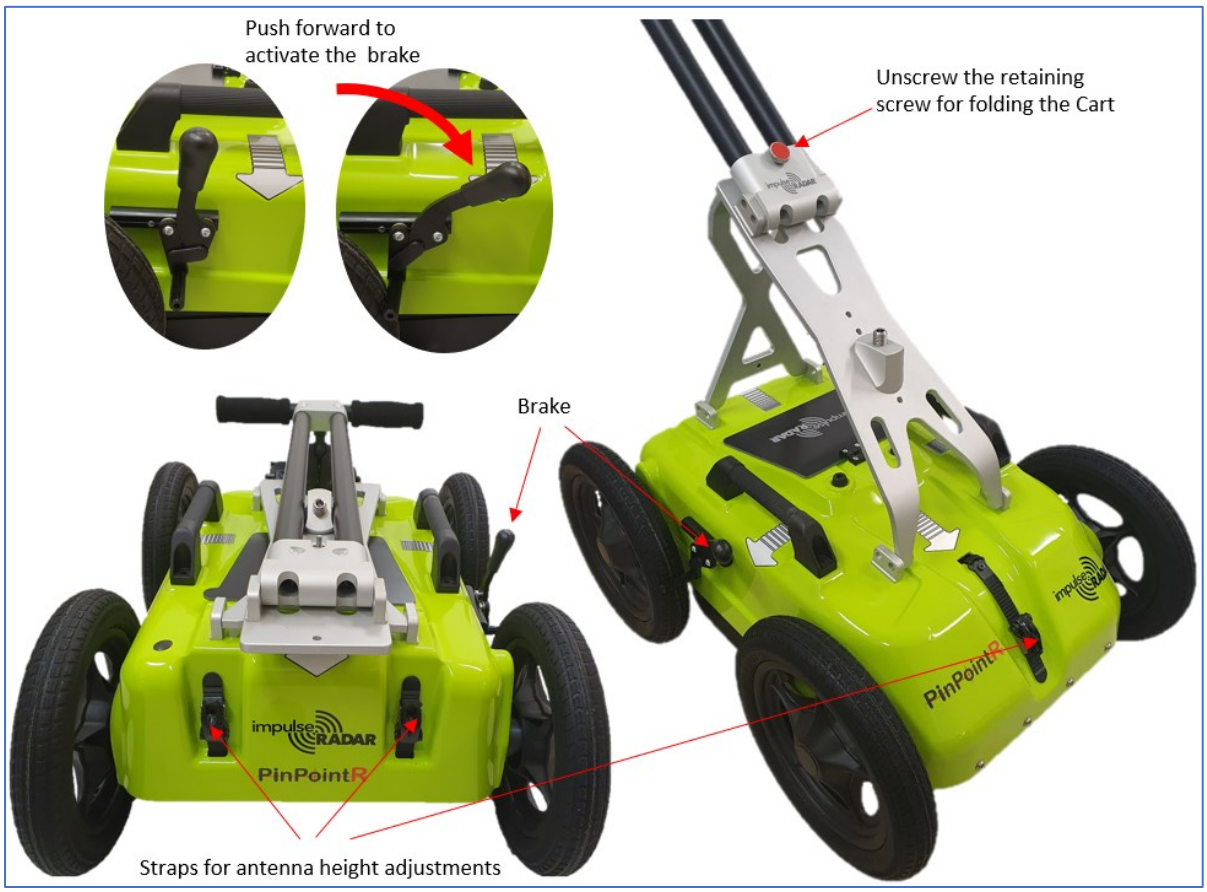


Figure 4 PinPointR pushcart features

The PinPointR pushcart incorporates a foldable handle assembly, so when the system is not in use, it can be folded for easier storage and transportation, as shown figure above. When unfolded for use, the handle assembly is fixed in place using a retaining screw. Depending on the model you have, this screw may be a threaded steel bolt that is fully removable, or on newer models, the screw is held in place within the handle assembly by a spring mechanism, as shown in Figure 5 below.

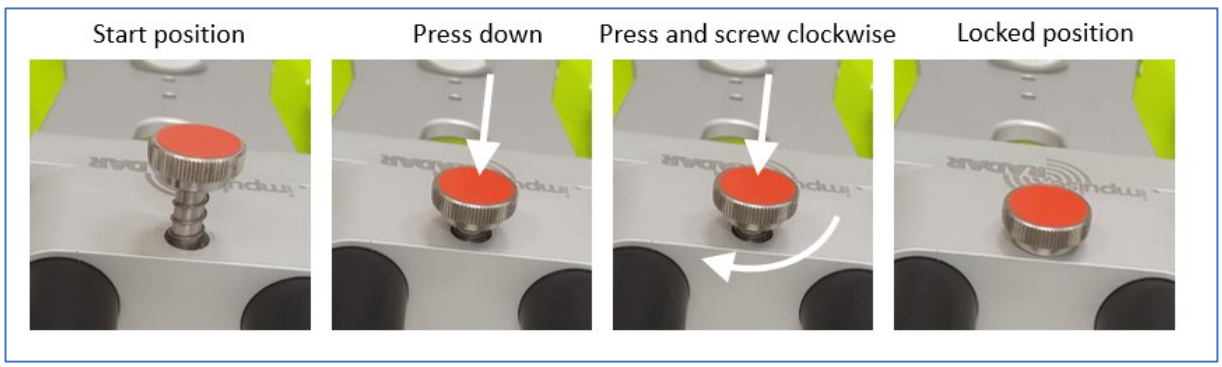


Figure 5 Retaining screw adjustment.

Also, the pushcart also incorporates a simple brake mechanism on the rear-right wheel, which is easily engaged or disengaged using your foot.

Note: To ensure the proper operation of the spring-loaded retaining screw; you are advised to periodically lubricate the retaining screw and the threaded insert into which in screws. How often will depend on environmental factors but should form part of general preventative maintenance for all mechanical parts of the pushcart.

Note: for safety, you are advised to engage the wheel brake any time the system is not under your direct control, especially when working on a gradient.

GPR unit removal procedure

The following sequence is illustrated in Figure 6 below.

1. Grip the wheel connector as the picture shows and pull it out.
2. Remove the two rear and the front straps from the snap connectors and lift the cart-hood.
3. Disconnect the M5 screws that hold the GPR unit to the tray and slide the GPR unit out from the skid tray.
4. Close the push-cart hood and refit the rear and front straps into the snap connectors.
5. Adjust the front and back straps to obtain the desired height.
6. Connect the odometer cable again to the socket with the black bezel.

Note: Before lifting the push-cart hood, remember to disconnect the odometer cable first. Also, it is essential to loosen the front strap to avoid tension on the strap connection point.

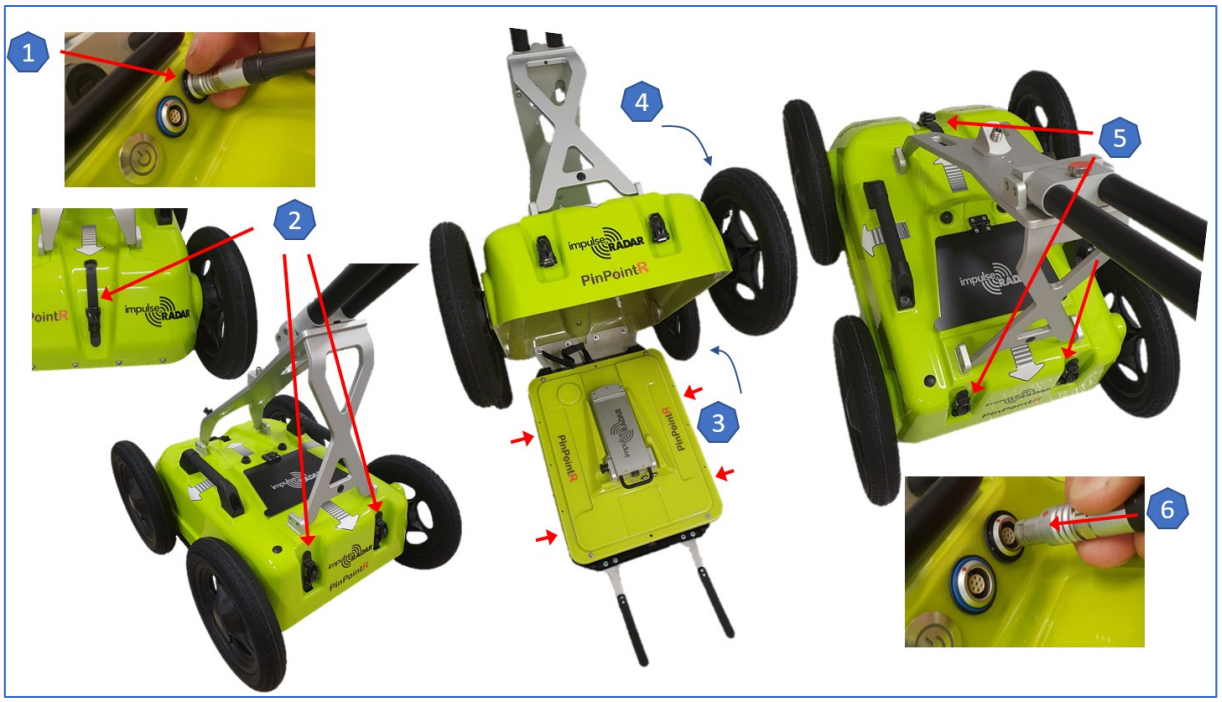


Figure 6 GPR Unit removal procedure

Odometer (wheel encoder)

When the pushcart is moved over the survey area, the distance travelled is measured using an odometer (wheel encoder), via a connection to the rear-right wheel. This odometer is also used to trigger the GPR measurement process. Depending on the model you have, the odometer mechanism may be via a belt drive (O-ring) or direct drive. Older models use the belt-drive, where the odometer is located above the centre of the wheel shaft and connected to it via a rubber O-ring. For newer models using the direct drive, the odometer is mounted centrally and directly to the wheel axel, so no O-ring is necessary.

If necessary, the O-ring can be replaced for belt-driven models by removing the wheel, as shown in Figure 7. For this purpose, a spare O-ring is cable-tied to the encoder cable under the pushcart hood.

Note: When refitting the wheel, use blue Loctite or equivalent to help secure the M6 retaining screw

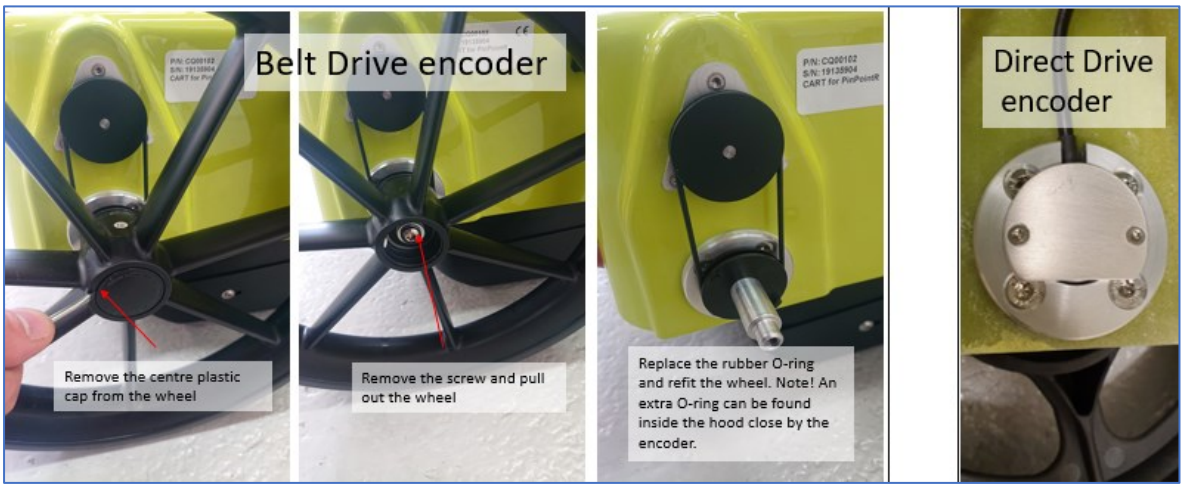


Figure 7 Belt vs. direct drive wheel encoder. Procedure for replacement of O-ring

External GPS mounting kit

An optional GPS mounting kit is available for the pushcart to support the connection of external GPS receivers, as shown in Figure 8 (GPS receiver not included). This kit contains extension poles, support arms, and an RS232 serial cable to facilitate the connection between the GPR unit and an external GPS receiver.

The GPS cable plugs into the GPR unit via the external GPS socket (blue bezel), while the other end is terminated with a standard 9-pin D-sub connector (male). When connecting an external GPS receiver, it must have an RS232 serial output via a wired connection. The GPS receiver should have its own RS232 serial cable that plugs into it, while the other end is terminated with a standard 9-pin D-sub connector (female).

Figure 8 PinPointR with installed external GPS.

With the male and female D-sub connectors are joined, a wired RS232 serial link is established between the external GPS receiver and the GPR unit.

Refer to **Error! Reference source not found.** for a description of the external GPS cable and pinouts.

Appendix A, External GPS

How RTK Works

RTK involves a stationary base station and one or more mobile GPS receivers, also known as rovers. Provided that the base station has continuous line-of-sight to each rover, it transmits GPS corrections to each in real-time using radio waves. If enough satellites are visible, RTK can provide a fixed position within a fraction of an inch. If insufficient satellites are visible, RTK can provide only a float solution, with a precision of a few inches.

Fixed RTK

RTK uses a complicated mathematical formula or algorithm to calculate the exact number of radio wavelengths between the satellites and the base station system -- a process known as ambiguity resolution -- and yield either a fixed or float solution. In a fixed solution, the number of wavelengths is a whole number or integer, and the algorithm is constrained to yield a whole number. A low number of visible satellites, poor satellite constellation geometry, and a week radio link between the base station and the rover may prevent a fixed solution.

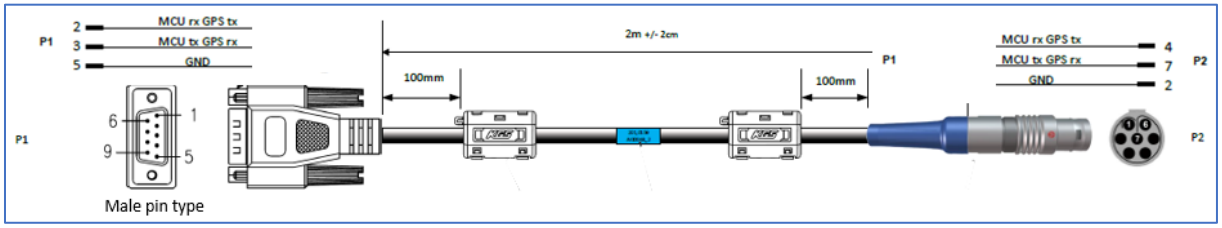
Float RTK

In a float solution, the algorithm does not yield an acceptable fixed solution, so the ambiguity is allowed to be a decimal or floating-point number. According to Tripod Data Systems, a float solution typically generates precise coordinates to between 4 and 18 inches over a known distance between two points of just over half a mile. If a float solution is the only solution available, it may be possible to reinitialize an RTK system, or wait, for a more precise fixed solution. However, if poor satellite visibility is to blame, a fixed solution may be unavailable.

Considerations

The precision of RTK data collection depends on the distance between the base station and the rovers, so it's desirable to keep the distance between them to less than 6 miles. RTK systems are available in single and dual-frequency versions; dual-frequency versions are typically

faster, more precise and operate over longer distances than single frequency versions, but they are correspondingly more expensive.



Appendix B – Regulatory Notices

The operation of GPR instruments is governed by various regulatory bodies and legislation depending on geographic location as follows:

- Europe ETSI EN 302 066-1&2 Vl.2.1
- US FCC, Part 15.F
- Canada IC RSS-220 limits

The CrossOver systems meets the legislation requirements for each of the above regulatory bodies.

A common requirement of these regulations is that GPR equipment should only be used by professionals and those who adhere to the following rules of operation:

- UWB-transmitters should always be used near the ground or the material under investigation.
- When not in use, the data collection should be stopped, and the unit/s switched off.
- The transmitters should not be directed upwards, only towards the investigation body.

Additional notes for users in Canada and the US

The operation of this Device is restricted to law enforcement, fire and rescue officials, scientific research institutes, commercial mining companies, and construction companies. Operation by any other party is a violation of 47U.S.C.301 and the operator may be subject to legal penalties.

Operation is subject to the following 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 of the Device.

The operation of this Device shall only occur when in contact with or within 1 m of the ground.

RSS 220:

Ce dispositif radar à pénétration du sol ne doit être utilisé qu'en contact avec le sol ou à au plus 1 m du sol.

Ce dispositif radar à pénétration du sol ne doit être utilisé que par des organismes d'application de la loi, des établissements de recherche scientifique, des sociétés minières commerciales, des entreprises de construction, et des organismes d'intervention d'urgence ou de lutte contre les incendies.

RSS GEN:

This Device contains license-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's license-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.

GPR Use Coordination (USA)

FCC regulation requires users of GPR equipment to coordinate the use of their GPR equipment as described below:

§15.525 Coordination requirements.

(a) UWB imaging systems require coordination through the FCC before the equipment may be used. The operator shall comply with any constraints on equipment usage resulting from this coordination.

(b) The users of UWB imaging devices shall supply operational areas to the FCC Office of Engineering and Technology, which shall coordinate this information with the Federal Government through the National Telecommunications and Information Administration. The information provided by the UWB operator shall include the name, address and other pertinent contact information of the user, the desired geographical area(s) of operation, and the FCC ID number and other nomenclature of the UWB device. If the imaging device is intended to be used for mobile applications, the geographical area(s) of operation may be the state(s) or county(ies) in which the equipment will be operated. The operator of an imaging system used for fixed operation shall supply a specific geographical location or the address at which the equipment will be operated. This material shall be submitted to Frequency Coordination Branch, OET, Federal Communications Commission, 445 12th Street, SW, Washington, D.C. 20554, Attn: UWB Coordination.

(c) The manufacturers, or their authorized sales agents, must inform purchasers and users of their systems of the requirement to undertake detailed coordination of operational areas with the FCC prior to the equipment being operated.

For your convenience, the information required by the FCC is indicated on the next page, please print, and fill in the information and put the letter in the mail. FCC will respond with confirmation of coordination.

Date: _____

To:
Frequency Coordination Branch., OET
Federal Communications Commission
445 12th Street, SW
Washington, D.C. 20554
ATTN: UWB Coordination
Fax: 202-418-1944

RE: FCC GROUND PENETRATING RADAR COORDINATION NOTICE

COMPANY NAME:

_____

_____

PRIMARY ADDRESS:

_____

_____

_____

CONTACT INFORMATION [CONTACT NAME AND PHONE NUMBER]:

_____

_____

_____

AREA OF OPERATION [COUNTIES, STATES OR LARGER AREAS]:

_____

_____

_____

FCC ID (tic the box)

CrossOver 4080: 2ALZQ-CO4080 ☐

Appendix C – Specifications

ImpulseRadar products are under continuous development, and we reserve the right to change specifications at any time and without prior notice. You may verify product specifications at any time by contacting our headquarters at; support@impulseradar.se

PinPointR/CrossOver-4080

GPR UNIT	
Technology	ImpulseRadar real-time sampling
Antenna type	PinPointR/CrossOver dual channel
Centre frequency	CH-1: 400 MHz / CH-2: 800 MHz
Signal to noise ratio (SNR)	> 100 dB
Significant/useful number of bits	> 16 bits
Scans/second	> 800
Survey speed	> 130 km/h @ 5 cm point interval
Time window	400 ns
Bandwidth	> 120%, fractional, -10 dB
Acquisition mode	Wheel, time, or manual
Positioning	Wheel encoder, internal DGPS, external GPS (NMEA 0183 protocol) and Total Station (pseudo NMEA)
Power supply	12 V Li-Ion rechargeable battery, or external 12 V DC source
Power consumption	1.26 A
Operating time	7 hours
Dimensions	444 x 355 x 194 mm
Weight	6.35 kg (including battery)
Operating temperature	-20° to +50°C
Environmental	IP65
Regulatory certification	CE, FCC, and IC Approved
CART	
Dimensions (folded for transport)	870 x 540 x 370 mm
Dimensions (when in use)	1010 x 540 x 1030 mm
Wheels	4 x Ø315 mm
Weight	12.8 kg (Pushcart only) [1], 20 kg (Pushcart, GPR unit & Device) [2]
USER INTERFACE	
Display	720 x 1280 pixel or better
Operating system	Android™ >ver. 6.0 (Marshmallow) or later
Memory	2.7 GB SDRAM or better
Processor	Intel Atom x5-Z8550, Quad-core 2.3 GHz Krait 400 or better
Recommendation	Samsung Galaxy Tab Active Pro, or equivalent

[1] Pushcart, skid plate and Tablet holder, [2] Pushcart, skid plate, GPR unit, Tablet holder and Android Device