

C-thrue



ORIGINAL INSTRUCTION IN ENGLISH LANGUAGE



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1 INTRODUCTION

This document describes the **C-thrue** radar system and its accessories (including the **C-thrue XS**); it relates to the concepts the user should learn before initiating the utilization of these devices. Therefore, it is mandatory to carefully reading the entire document before starting the system.

This manual contains the description of the above mentioned Georadar system detailing the packaging, the assembly procedure, and the operating procedures of the system.

1.1 Estimated Reading Time

The estimated reading time of the entire document is 120 minutes.

1.2 Purpose

The purpose of this document is to drive the Reader to a list of actions to install and use the **C-thrue** system and accessories, in a thorough, correct, and safe way.

The structure of the manual is organized in a collection of "how-to" as well as descriptive chapters. Each chapter contains illustrations and basic descriptions of the main operations to be carried out for system installation and use on field.

1.3 Application field

This system is designed to locating rebars, voids, post-tension cables, cavities, conduits, and any other object embedded into concrete. It is optimized to be used in building construction sites, and for various operations including (for example) building renovation, evaluation of the status of overpasses, bridges, tunnels surveys, as well as for detailed analysis of the original engineering project and comparison with the "as-built" drawings.

1.4 Intended readership

The intended Reader(s) of this manual is/are the technician(s) in charge of using the system that has undergone the IDS GeoRadar training for **C-thrue** and accessories. Training to users, may also be delivered by either IDS GeoRadar local Selling Units or Distributor Partners.

1.5 Authorization for use – national restriction

The use of **C-Thrue** system may be subject to a license and/or an authorization by the Competent Ministry of the country where the system will be used.

An individual license and restrictions are in place to date in the following European countries:

France: <https://www.anfr.fr/en/broadcasting-authorisation/reseaux-professionnels/les-frequences-utilisees-a-titre-temporaire/les-systemes-dimagerie-radar-de-type-gpr-wpr/>

Germany:

https://www.bundesnetzagentur.de/SharedDocs/Downloads/DE/Sachgebiete/Telekommunikation/Unternehmen_Institutionen/Technik/Inverkehrbringen/Produkten/Schnittstellenbeschreibungen/OrtungsfunkOR/SSBOR_N022.pdf?__blob=publicationFile&v=4

Portugal: <https://www.anacom.pt/render.jsp?categoryId=389647>

Romania: https://www.ancom.ro/radio-spectrum_2749

Spain: https://www.boe.es/diario_boe/txt.php?id=BOE-A-2011-19146


Sweden:

<https://www.pts.se/sv/bransch/radio/radiotillstand/ansokningshandlingar/>

Liechtenstein and Switzerland:

<https://www.bakom.admin.ch/bakom/en/homepage/frequencies-and-antennas/frequency-use-with-or-without-licences/radiocommunication-licences-in-general.html>

For more details with reference to the restriction, please refer to the following website: [ECO Frequency Information System \(cept.org\)](https://www.cept.org)

	CH	DE
	ES	FR
	LI	PT
	RO	SE

The use of the **C-thrue Remote Desktop Connection** (RDC) may be subject to local regulations.

In Europe, according to the ECC Decision ECC/DEC/(04)08, the use of the RDC is authorized for indoor use only.

1.6 CE marking



This equipment complies with the essential requirements and other relevant provisions of Directive 2014/53/UE, 2011/65/EU+2015/863/UE (RoHS), Regulation (EC) No 1907/2006 (REACH). The full Declaration of its Conformity can be found either on the CD or a separate document included with this product.

This is a Class A product. In a domestic environment it may cause radio interference. If so, the user may need to take adequate measures.

1.7 UKCA Marking



This equipment complies with the essential requirements of the Radio Equipment Regulations 2017 (S.I. 2017/1206). The full Declaration of its

Conformity can be found either on the CD or a separate document included with this product.

Licensing requirements in UK can be found here: <https://www.ofcom.org.uk/manage-your-licence/radiocommunication-licences/licensed-short-range>

2 HOW TO READ THE MANUAL

2.1 Manual Layout

As mentioned, this User Manual is structured in a “How to” manner.

In each of the relevant chapter, the User shall find the basics to carry out the **C-thrue** and accessories installation and use.

It is strongly recommended to go through this manual thoroughly, and to read it carefully. However, as the document is divided into a first part that is descriptive of the whole system, but also into procedures that are self-consistent and that can be read sparsely, it is not mandatory to read this document chapter after chapter, in case of need.

Please, note that images and pictures shown in the manual aims at supporting the Users in understanding the operation described. However, pictures and images portraited herein may, from time to time, slightly differ from the actual Hardware and Software they describe.

2.2 SYMBOLS

Warning messages are an essential part of the Safety Concept of the instrument. They appear wherever hazards or hazardous situations can occur.




Warning messages:



- make the user alert about direct and indirect hazards concerning the use of the product, and
- contain general rules of behaviour.

For the user’s safety, all safety instructions and safety messages shall be strictly observed and followed. Therefore, the manual must always be available to all persons performing any tasks described herein.

DANGER, WARNING, CAUTION and **NOTICE** has got standardized signal words for identifying levels of hazards and risks related to personal injury and property damage.

For safety purposes, it is important to read and fully understand the table below with the different signal words and their definitions. Supplementary safety information symbols may be placed within a warning message as well as supplementary text.

Type	Description
 DANGER	Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
 WARNING	Indicates a potentially hazardous situation or an unintended use which, if not avoided, could result in death or serious injury.
 CAUTION	Indicates a potentially hazardous situation or an unintended use which, if not avoided, may result in minor or moderate injury.

	• NOTICE: Note text/to keep in mind
	• Tip text

2.3 Glossary & Acronyms

DAD: Digital Antenna Driver

RADAR: RAdio Detection and Ranging

LASER: Light Amplification by Stimulated Emission of Radiation

USB: Universal Serial Bus

GPR: Ground Penetrating Radar

AC: Alternate Current

Q.R: Quick Response Code

Raw data: unprocessed data obtained during a field survey.

Maps: graphics showing the change in received radar signal with respect to the scanning direction.

Survey: the name given to a collection of acquisitions, which together cover all the areas of an investigation: typically, an entire job area.

Scan: a single movement of the system from the beginning to the end of a pre-established path.

Setup: initialization of a piece of equipment or a software process.

Encoder: a distance measurement device which constantly signals the distance travelled from the start of the scan back to the Control Unit.

Transmitter: part of the antenna dedicated to emitting the radar signals.

Receiver: part of the antenna dedicated to detecting the radar signals.

Augmented Reality: Digital on-site representation of data and targets through the external PC.

2.4 Reference

2.4.1 Bibliography

[BD1] MNG_2017_011_18_C-thrue User Manual

3 SAFETY DIRECTIONS

3.1 Description

The following directions enable the person responsible for the product, and the person who uses the equipment, to anticipate and avoid operational hazards.

The person responsible for the product must ensure that all users understand these directions and adhere to them.

3.1 Intended Use

The intended use of the **C-thrue** system and its accessories is the survey of concrete structure, in general, including but not limited to:

- Concrete inspections.
- Rebars and void detection and mapping.
- Measuring horizontal and vertical position of rebars and void.
- Creation of concrete tomography imaging.

3.2 Reasonably Foreseeable Misuse

Below, it is illustrated a list of possible misuse of the system, to be avoided:

- Use of the product without instruction.
- Use outside of the intended use and limits.
- Opening the product using tools, for example screwdrivers, unless this is permitted for certain functions.
- Modification or conversion of the product.
- Use after misappropriation.
- Use of products with obvious damages or defects.
- Use with accessories from other manufacturers without the prior explicit approval of IDS GeoRadar s.r.l.
- Inadequate safeguards at the working site.

3.3 Limits of Use

C-thrue can be used both day and night also in severe temperature conditions as the operating temperature range is from -20°C to +50°C (-4°F to +122°F). Storage temperature is -40°C to +60°C (-40°F to +140°F).

Environment: Suitable for use in an atmosphere appropriate for permanent human habitation. Not suitable for use in explosive environments.



WARNING: POTENTIALLY HAZARDOUS AREAS

working in hazardous areas, such as potentially explosive areas, or close to electrical installations, or similar situations, could result in death or serious injury.

PRECAUTION: Local safety authorities and safety experts must be contacted, by the person in charge of the product, prior commencing any survey in potentially hazardous areas for the due risk assessment.

3.4 Responsibilities

Manufacturer of the product - IDS GeoRadar s.r.l. is responsible for supplying the product, including the user manual and original accessories, in a safe condition.

Person responsible for the product - The person responsible for the product (the User) has the following duties:

- To understand the safety instructions on the product and the instructions in the user manual, and the Quick Guides, provided separately.
- To ensure that it is used in accordance with the instructions.
- To be familiar with traffic laws and local regulations relating to safety and accident prevention.

- To inform IDS GeoRadar s.r.l. immediately if the product and the application becomes unsafe.
- To ensure that the traffic laws, the national laws, regulations, and conditions for the operation of electromagnetics transmitters are respected.

NOTICE: Watch out for erroneous measurement results if the product has been dropped or has been misused, modified, stored for long periods.



Precautions:

Periodically carry out test measurements, particularly after the product has been subjected to abnormal use and before and after of important measurements.

3.5 Hazard of Use



WARNING: CRUSHING HANDS AND FINGERS

While installing and using the system, the risk of fingers pinch-out, may occur.

PRECAUTION: To mount and use the system, the user must always wear protective gloves and safety boots.



WARNING: RISK OF ACCIDENTS

During surveys there is a danger of accidents occurring if the user does not pay attention to the surrounding site conditions, such as obstacles, excavations, or traffic.

PRECAUTIONS: During operations, the user of the product must be fully aware of the existing site conditions, and potential dangers.



WARNING: ELECTROCUTION

Because of the risk of electrocution, it is dangerous to use poles and extensions near electrical installations such as power cables or electrical railways.



PRECAUTIONS: Keep at a safe distance from electrical installations. If it is essential to work in this environment, first contact the safety authorities responsible for the electrical installations and follow their safety instructions.



WARNING: LIGHTING STRICKING

If the product is used with accessories (for example pulling pole), the user may increase the risk of being struck by lightning.

PRECAUTIONS: Do not use the product during thunderstorm, outdoor.



WARNING: SECURING OF THE WORKING SITE

Inadequate securing of the working site can lead to dangerous situations, for example in traffic, on building sites, and at industrial installations.

PRECAUTIONS: Always ensure that the working site is adequately secured. Adhere to the regulations governing safety, accident prevention, and road traffic.

NOTICE: If the accessories used with the product are not properly secured and the product is subjected to mechanical shock, for example blows or falling, the product may be damaged.



Precautions:

When setting-up the product, make sure that the accessories are correctly adapted, fitted, secured, and locked in position.

Avoid subjecting the product to mechanical stress.

WARNING: EXPOSURE OF BATTERIES TO HIGH MECHANICAL STRESS, HIGH AMBIENT TEMPERATURE OR IMMERSION INTO FLUIDS

High mechanical stress, high ambient temperatures or immersion into fluids can cause leakage, fire, or explosions of the batteries.



PRECAUTIONS: Protect the batteries from mechanical influences and high ambient temperatures. Do not drop or immerse batteries into fluids.

NOTICE: If the product is improperly disposed, the following can happen:

- If polymer parts are burnt, poisonous gases are produced which may impair health.
- If batteries are damaged or are heated strongly, they can explode and cause poisoning, burning, corrosion or environmental contamination.
- By disposing of the product irresponsibly you may enable unauthorized persons to use it in contravention of the regulations, exposing themselves and third parties to the risk of severe injury and rendering the environment liable to contamination.



RECYCLING



The crossed out wheeled bin symbol shown on the equipment indicates that the product must be recycled separately from other waste at the end of its useful life.

Separate waste disposal of this product at the end of its useful life will be organised and managed by IDS GeoRadar. When you decide to dispose of the equipment, contact IDS GeoRadar and follow the system that IDS GeoRadar has set up to permit the separate collection of the apparatus at its life end.

Adequate separate collection for its subsequent recycling, treatment and environmentally friendly disposal contributes towards avoiding any unnecessary effects on the environment and to health and favour the reuse or recycling of the materials that make up the equipment. Unauthorised disposal of this product as unsorted waste by its possessor will lead to an administrative penalty foreseen by national regulations.



NOTICE: Only IDS GeoRadar authorized technical service are entitled to repair this product.



WARNING: Short circuit of battery terminals

Risk of fire, electric shock, and damage.

PRECAUTIONS: Keep away any metallic or wet objects from the battery terminals inside battery housing.



WARNING: Short circuit of battery terminals

If battery terminals are short-circuited e.g., by coming in contact with jewellery, keys, metallised paper or other metals, the battery can overheat and cause injury or fire, for example by storing or transporting in pockets.

PRECAUTIONS: Make sure that the battery terminals do not come into contact with metallic objects.



WARNING: Battery may get hot after prolonged use.

Risk of burning injuries.

PRECAUTIONS: Avoid touching the hot battery. Allow the battery to cool down before removing it.

4 GENERAL DESCRIPTION

C-thrue and its own accessories are IDS GeoRadar systems designed as concrete scanner. The whole system, hardware and software, is optimized to detect specific targets (including rebars, post tension cable, void, cables, power cables...) for a broad range of applications including but not limited to building renovation, maintenance of underpasses and bridges, tunnel linings and/or reinforcement evaluations, etc...

4.1 Delivery Contents

IDS GeoRadar **C-thrue** Concrete Scanner, includes three possible configurations:

1. **C-thrue concrete scanner** (SAP 868510),
2. **C-thrue full concrete scanner package** (SAP 6014777),
3. **C-thrue XS** (SAP 1002690).

4.1.1 C-thrue concrete scanner (868510)

C-thrue, is delivered in a **hardcase** (869102) containing the basic accessories (Fig. 1).



Fig. 1 C-thrue Hardcase (869102)

The content of the hardcase includes the following:

- **C-thrue Concrete Scanner** (868510), with wrist lace (867952) Fig. 2,



Fig. 2 C-thrue Concrete Scanner (868510) (side view, on the right side)

- **6 C-thrue Reflective bars** (869050) Fig. 3,



Fig. 3 C-thrue Reflective bar (869050)

- **3 Li-ion C-thrue batteries** (865421) Fig. 4,



Fig. 4 Li-ion C-thrue battery (865421)

- **C-thrue battery charger** (865515) Fig. 5, with Shuko, UK and US adapters,



Fig. 5 C-thrue battery charger (865515)

- C-thrue paper grid (891907) Fig. 6,

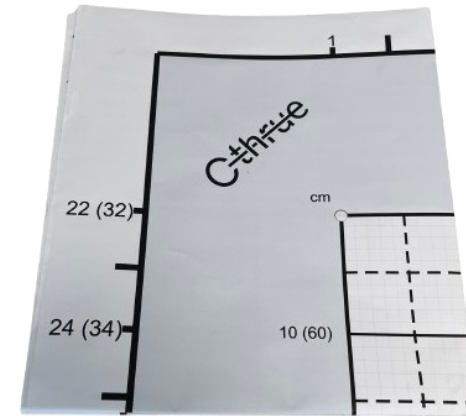


Fig. 6 C-thrue paper grid (891907)

Also, a set of sticky gums to be used to fix reflective bars on top of the survey surface, is included in the hardcase (Fig. 7).



Fig. 7 Sticky gums for reflective bar

4.1.2 C-thrue full concrete scanner package (SAP 6014777)

The **C-thrue** full package, includes all the articles described in the previous chapter (4.1.1), plus the following items:

- **C-thrue** remote handle (875951) Fig. 8,



Fig. 8 C-thrue remote handle (875951)

- **C-thrue** Remote Desktop software and AR kit (6014775) Fig. 9,

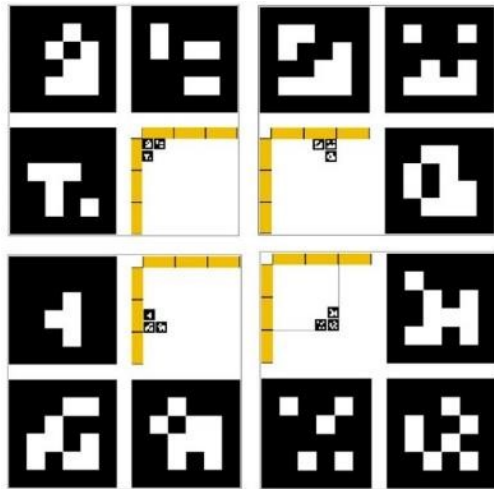


Fig. 9 AR kit including 4 QR codes

- PC with Remote Desktop and Augmented Reality SW kit Fig. 10.



Fig. 10 PC for AR kit

4.1.3 C-thrue XS (SAP 1002690)

C-thrue XS is a further optional package that can be used either in combination with **C-thrue**, or as a stand-alone tool. It includes the following:

- **C-thrue XS rigid case** (1002417) Fig. 11, where all the next items listed, are stored.



Fig. 11 C-thrue rigid case (1002417)

- **C-thrue XS antenna** (1002083),



Fig. 12 C-thrue XS antenna (1002083)

- **C-thrue XS safety lace** (867952) Fig. 13,



Fig. 13 C-thrue XS safety lace (867952)

- **C-thrue XS splitter** (997786),



Fig. 14 C-thrue XS splitter (997786)

- **C-thrue XS connection cable** (989840) Fig. 15.



Fig. 15 C-thrue connection cable (989840)

C-thrue XS, can also be provided with an optional handle that is the same as the one of **C-thrue** (Fig. 8). If not available already, this can be purchased separately, and it is delivered with a soft bag Fig. 16, and its own specific hook plate to the antenna.



Fig. 16 Handle with soft bag (999963)

4.2 C-thrue Configuration

The basic configuration is the **C-thrue** concrete scanner, and it features the following components:

- **A)** Multi-touchscreen, **B)** Handle with start/stop button, **C)** Wheels with (4) encoders (Fig. 17),

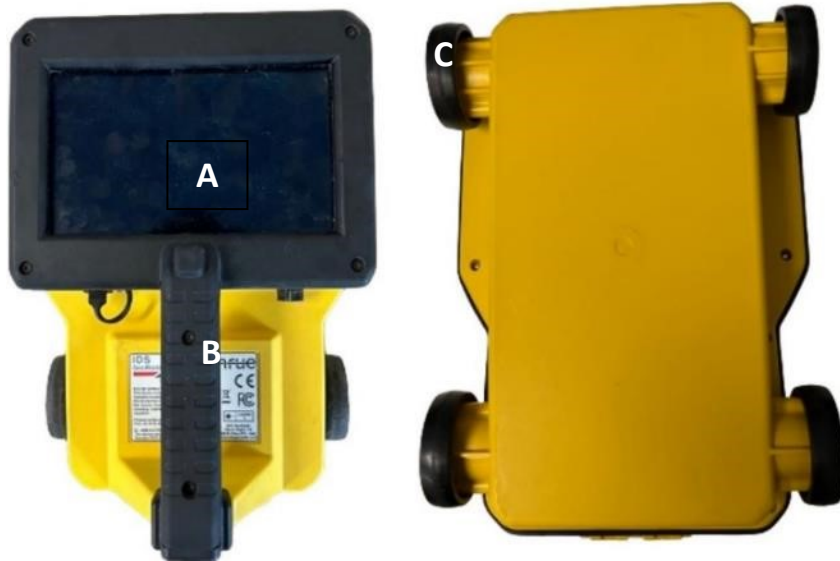


Fig. 17 C-thrue top (left) and bottom (right) view



For FCC rules and regulations, there is an additional button under the handle. It is necessary to hold this button during the acquisition, release at the end of it. The acquisition is stopped after about one second after the release of the button.

- **D)** Battery compartment, **E)** Front side Laser, **F)** **C-thrue** reference point synchronized with cursor on Screen (Fig. 18),



Fig. 18 C-thrue back (left) and front (right) view

- **G)** left side Laser, **H)** reference tick for shallow antenna center, **I)** reference tick for deep antenna center, **L)** right side Laser, **M)** reference tick for shallow antenna center, **N)** reference tick for deep antenna center (Fig. 19),



Fig. 19 C-thrue left (left) and right (right) view



These lasers are a CLASS 1 Laser. This means that the laser is not detected by a naked eye and is not dangerous for the eyes itself.

- **O)** USB port, **P)** Power button, **Q)** Remote handle connector (Fig. 20).



Fig. 20 C-thru plugs panel



The USB port use is intended only for survey folder transfer, firmware and software updating through USB stick. Do not insert in the USB port any other type of external device.

C-thru includes a double polarization antenna (HH antenna in the front and VV antenna in the back). Dual polarization facilitates the detection of both first and second levels of rebars. The offset between the deep and shallow antenna centre, is 10 cm (Fig. 19).

Also, an EM sensor to detect live power cable is hosted in the rear part of the antenna case.

4.3 C-thrue full concrete scanner package Configuration

The full configuration of **C-thrue**, is characterized by the following additional features with respect to the basic **C-thrue** Concrete scanner:

- **The Remote handle** with **A)** Enable and Start/Stop/bookmark button, **B)** hook system to the **C-thrue** handle, **C)** cable connector, **D)** extension knob (Fig. 21),

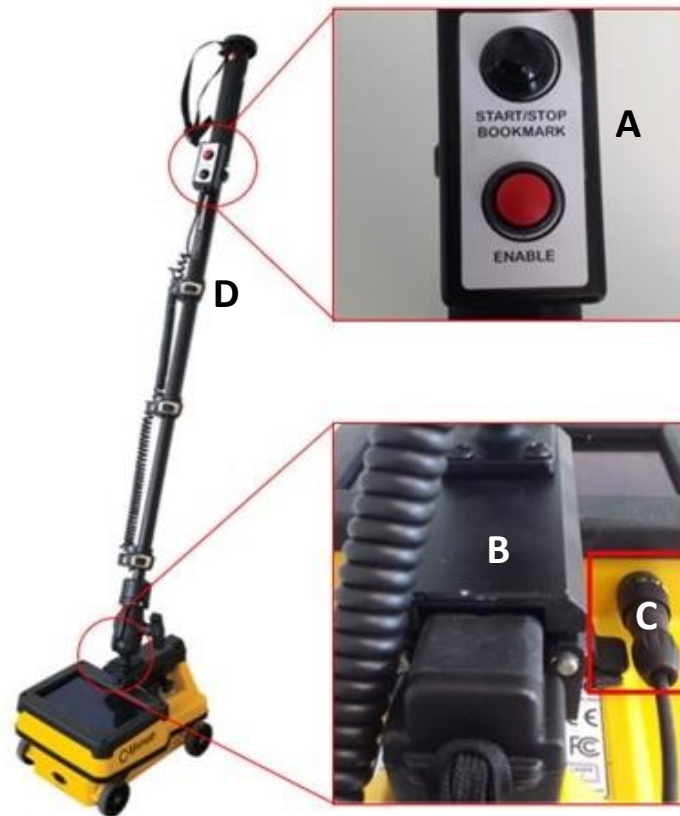


Fig. 21 Remote handle details

- **The PC** including pre-installed SW namely, **C-thrue Remote Desktop** SW (to remotely control the **C-thrue** by using the Remote Handle and PC), and **C-thrue Augmented Reality** SW (Fig. 22),



Fig. 22 C-Thrue Remote Desktop and Augmented Reality SW PC

- **The 4 QR code stickers** to be placed where the scan has been collected to be visualized afterward via the PC (Fig. 23).

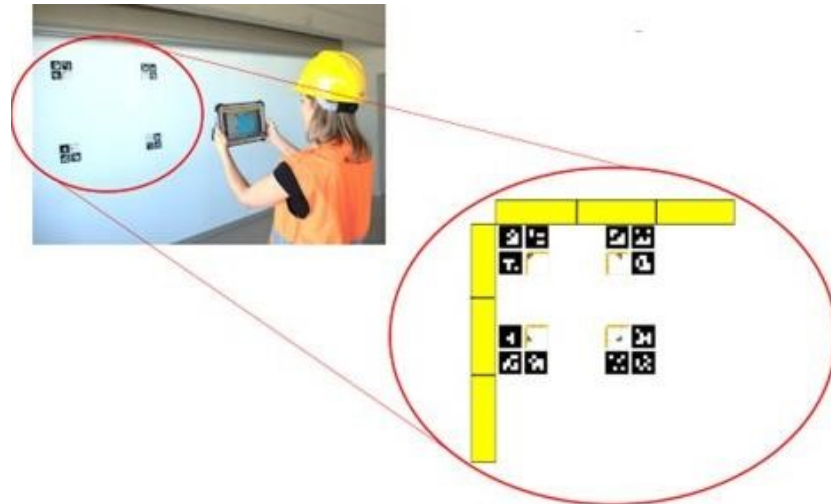


Fig. 23 using Augmented Reality kit

4.4 C-thrue XS Configuration

C-thrue XS configuration is characterized by the following features:

- **The Antenna:** **A)** Start/Stop/marker button, **B)** Status LED, **C)** (4) female threaded holes to couple the Remote handle, **D)** Remote Handle cable port, **E)** Power and data cable port, **F)** Wheel encoder, **G)** hook for the wrist lace (Fig. 24).



Fig. 24 C-thrue XS antenna

- **A: Antenna Start/Stop button**
 - Press once and quickly release, to **START** survey.
 - Press once quickly, to **place a marker**.
 - Press once again longer, to **STOP** survey.
- **B: Status LED** color coding:
 - **WHITE** blinking: Antenna powered and not connected to PC.
 - **BLUE** solid: Antenna powered, connected to PC, not in acquisition.
 - **GREEN** solid: Antenna powered, connected and in acquisition.
 - **RED**: HW error.
 - **PURPLE**: start error (restart).
- **The 5m Connection cable:** **H)** Connector to the (E) Power and data cable port (Fig. 25), **I)** connector to the **C-thrue XS** splitter plug (L) Fig. 26,



Fig. 25 C-thrue XS Connection cable

- **The Splitter:** **L**) Plug to the **C-thrue XS** Connection cable (**I**), **M**) USB plug to the Remote Desktop PC for C-thrue XS, **N**) LAN plug to the Remote Desktop PC for **C-thrue XS** (Fig. 26).

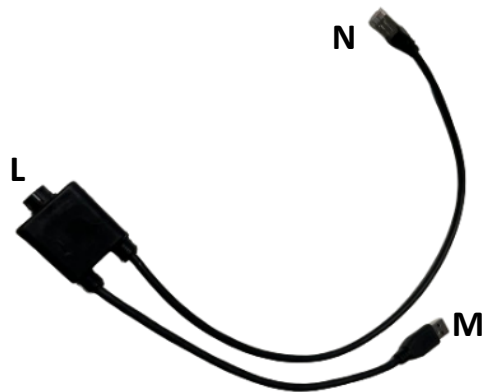


Fig. 26 C-thrue XS splitter

- **The PC**, with the same characteristics of Fig. 22.

5 HOW TO SET UP C-THRUE AND ACCESSORIES

This chapter describes the basic steps to guide the user through the mounting operation to install **C-thrue** and its accessories.

5.1 How to set up C-thrue

To mount basic configuration of **C-thrue** and start using it, the following steps should be performed:

1. Open the Hardcase and take off the main systems and accessories included (Fig. 27),



Fig. 27 Opening the C-thrue hardcase, step 1

2. Insert the wrist lace (Fig. 28),



Fig. 28 install the wrist lace, step 2

3. Insert the battery in the rear battery compartment (Fig. 29),



Fig. 29 insert the battery, step 3

4. Wear the wrist lace before starting the **C-thrue** (Fig. 30),



Fig. 30 wear the wrist brace, step 4

5. Turn on the **C-thrue** by pressing the power button (Fig. 31).



Fig. 31 turn on the system, step 5

5.2 How to set up C-thrue full concrete package

Starting from the set up as per previous paragraph 5.1 above, go through the following steps:

1. Place the hook system of the Remote Handle, on top of the **C-thrue** handle, with the screw towards the right side of the system (Fig. 32),



Fig. 32 coupling the Remote Handle to the C-thrue, step 1

2. Bring the screw below the handle and fix it to the opposite side, against the plate (Fig. 33),



Fig. 33 coupling the Remote Handle, step 2

3. Insert the pole on to the pivoting head of the hook just fixed, by matching the metal ball with the vertical opening (Fig. 34),



Fig. 34 coupling the Remote Handle, step 3

4. Then turn 180° and close the red quick release (Fig. 35).



Fig. 35 coupling the Remote Handle, step 4

5. Plug the cable of the remote handle, to the connector on top of the **C-thru** plug panel in front and below its handle(Fig. 21).

5.3 How to set up C-thrue XS

C-thrue XS can be used in two modes:

1. **C-thrue XS** stand-alone, or
2. **C-thrue XS** with **C-thrue**

5.3.1 How to set up C-thrue XS stand alone

1. Plug one end of the **C-thrue XS** connection cable onto the **C-thrue XS** splitter (Fig. 36),



Fig. 36 C-thrue XS stand-alone set up, step 1

2. Plug the opposite end of the **C-thrue XS** connection cable onto the **C-thrue XS** antenna left connector (Fig. 37),



Fig. 37 C-thrue XS stand-alone set up, step 2

3. Plug the LAN plug and the USB plug of the **C-thrue XS** splitter, onto the LAN and USB connector of the PC where the **C-thrue** Remote Desktop software is Installed.

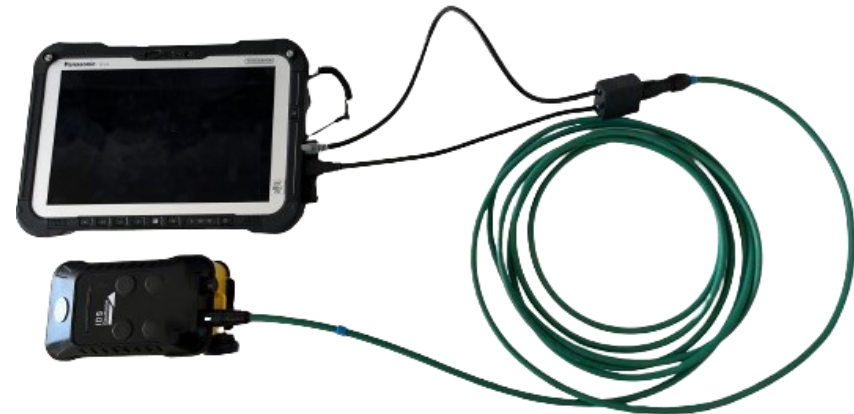


Fig. 38 C-thrue XS Stand -alone set up, step 3

5.3.2 How to set up C-thrue XS with C-thrue

1. Plug one end of the **C-thrue XS** connection cable onto the **C-thrue XS** antenna (Fig. 39),



Fig. 39 C-thrue XS with C-thrue set up, step 1

2. Plug the opposite end of the **C-thrue XS** connection cable to the connector on the right side of the **C-thrue** plugs panel (Fig. 40).



Fig. 40 C-thrue XS with C-thrue set up, step 2

6 HOW TO ACTIVATE SW LICENSE

Depending on Hardware configuration, **C-thrue Remote Desktop software** may need to be activated through a valid license (EID) by using the *Leica Client License Manager (CLM)* software; to do this please, refer to **Leica Geosystems Software Licensing Introduction & Installation User Manual**.



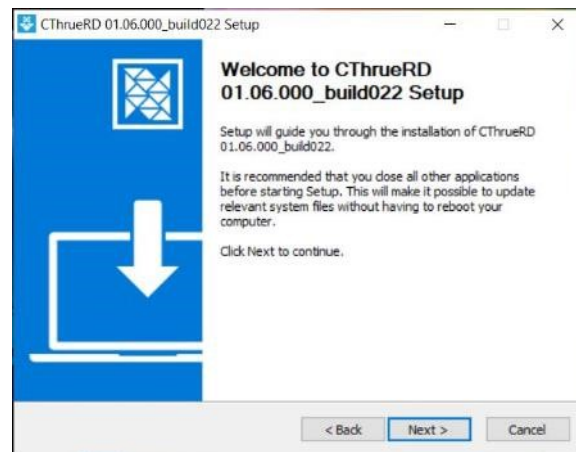
Note; Before starting the License Activation Procedure, make sure that CLM SW is installed into the PC.

Once the latest version of **C-thrue Remote Desktop software** has been downloaded from the *myDownload* area of *myWorld* (<https://myworld-portal.leica-geosystems.com>), User may proceed with the installation procedure as detailed below.

1. Select the **C-thrue Remote Desktop software** installer file being



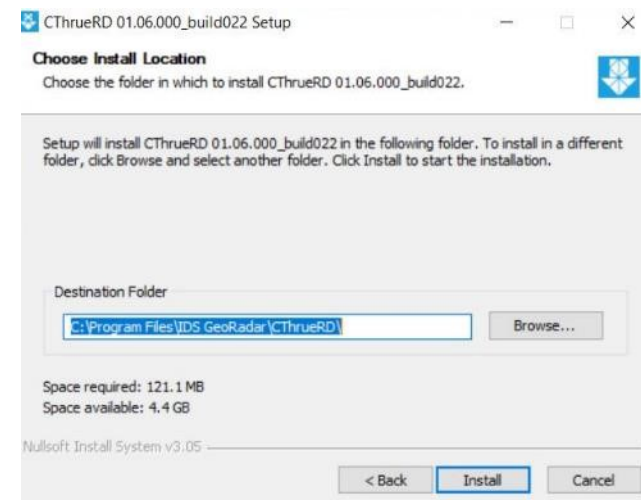
downloaded from *myWorld*, and right click on the mouse to “Run as Administrator”, press NEXT,



2. Accept the **Hexagon Geosystems License Agreement** and press I Agree,

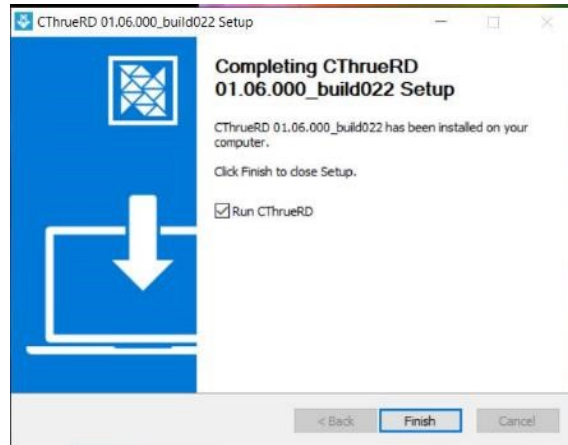




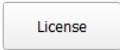
3. Select **C-thrue Remote Desktop software** destination folder for installation and press INTSALL,

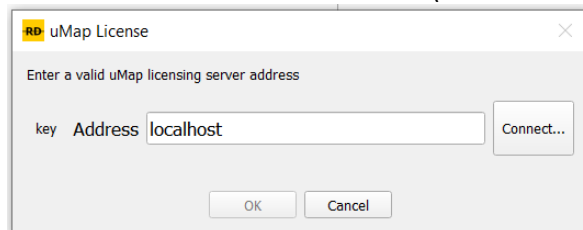


4. Start Installation by pressing INSTALL

- Press FINISH to complete the installation and run the SW



- Run **C-thruRD software**,
- Enter the Settings Menu of **C-thru Remote Desktop software** 
- Select the About tab 
- Press the License button 
- Enter the location where the license is installed
 - Localhost (installed locally)
 - Enter the IP address of the server (if installed on a server)



7 HOW TO WORK ON SITE WITH C-THRUE

As the **C-thrue** is turned on (Fig. 31) the Main Menu page shall be visualized on the screen (Fig. 41).




Fig. 41 C-thrue Main Menu Page

Starting from the Main Menu page, the complete workflow that can be carried out by using C-thrue, includes the following (Table 1):

PAR	DESCRIPTION	ICON
7.1	Customization of the Users Settings	
7.2	Single Scan Acquisition mode	
7.3	Grid Acquisition mode	
7.4	Explore Existing Survey	
7.5	Activate Laser (to be used with reflective bars)	
7.6	Activate the WiFi (to be used with Remote Desktop PC)	
7.7	Activate the EM Sensor (to be used to detect live power cables)	
7.8	Check the battery status	

Table 1 C-thrue workflow

7.1 How to customize Users Settings

To Enter the Settings Menu, press the  icon on the main menu page (Fig. 41), and the Fig. 42 shall pop up.

7.1.1 How to customize Radar Settings

From the menu illustrated In Fig. 42 menu, User can customize the following:

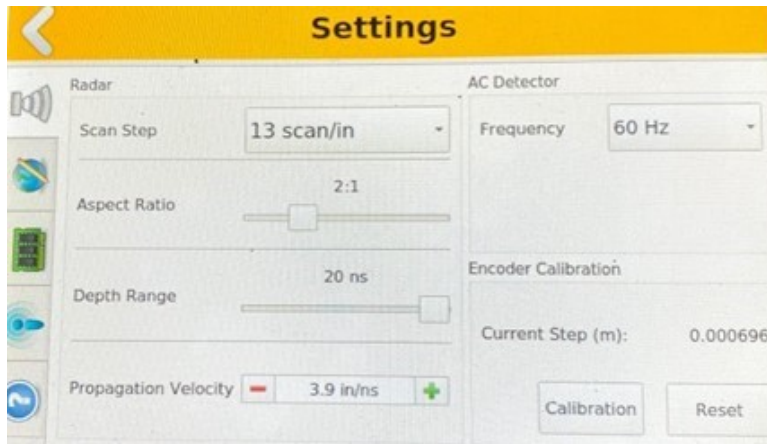


Fig. 42 Radar Settings menu

- **Scan Step** (using the drop-down),

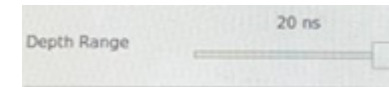


International measurement System	Imperial measurement System
3 Scan/cm	8 Scan/inch
4 Scan/cm	10 Scan/inch
5 Scan/cm	13 Scan/inch
8 Scan/cm	20 Scan/inch

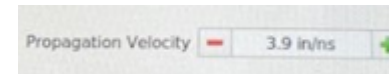
- **Aspect Ratio** (using the slider),



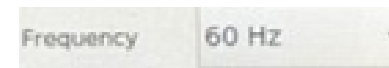
- **Depth Range** (using the slider),



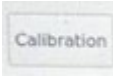
- **Propagation Velocity** (using the +/- buttons),

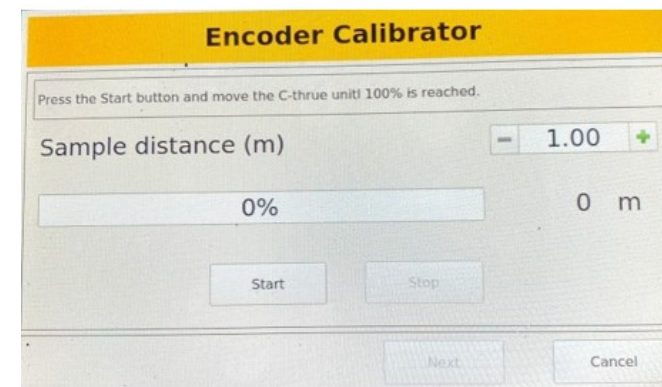


- **Frequency** of the EM Sensor when active (using the drop-down),

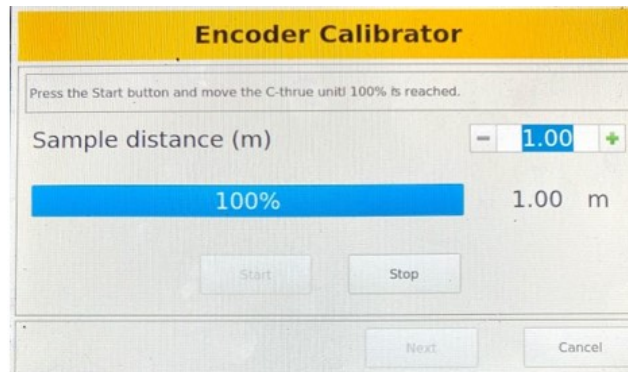


- Running the **Encoder Calibration**

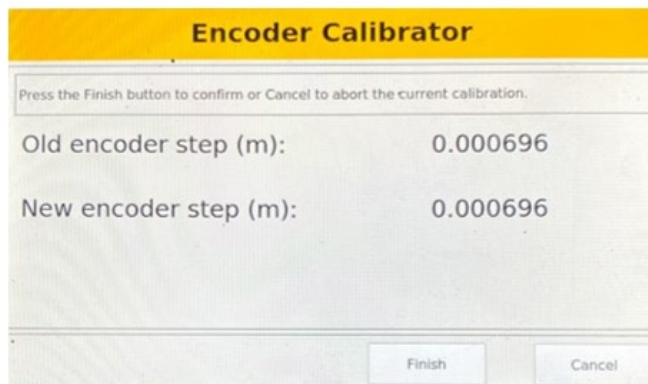
- **Press** 
- **Enter Sample Distance value (1m in the example)**
- **Press Start**




- **Run a known distance (1 m in the example)**



- **Press Finish to Apply new Encoder step**



7.1.2 How to customize International Settings


As the User presses the , Fig. 43 window shall pop up, and it is possible to Customize the following:

- **System of Measurements** (Imperial/Metric and cm/m),
- **Time**,
- **Language**.



Fig. 43 International Settings menu

7.1.3 How to customize Update Settings

As the User presses the , Fig. 44 window shall pop up.

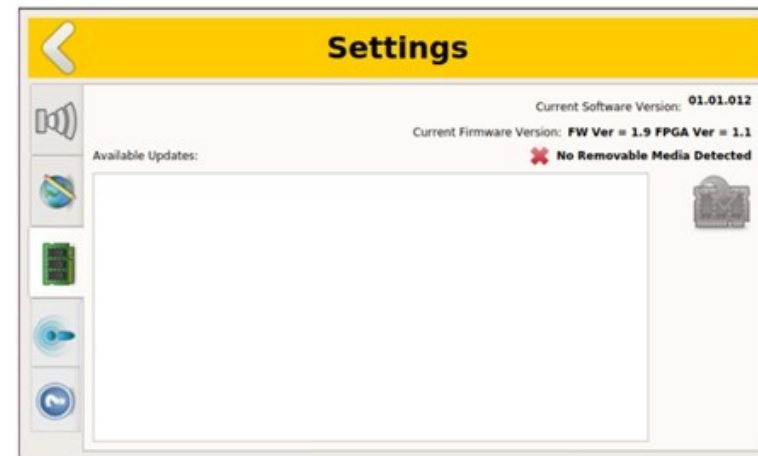



Fig. 44 Update menu

To update SW and FW version:

- Upload on a USB memory stick the *.zip file including the latest SW a FW version downloadable from *myWorld* website,
- Plug the USB memory stick on the USB port of Fig. 20,
- Select the file to be uploaded and run the update,
- Reboot the system.

7.1.4 How to customize Network and Survey Settings

As the User presses the  icon, the window of Fig. 45, shall pop up and it is possible to customize the following:

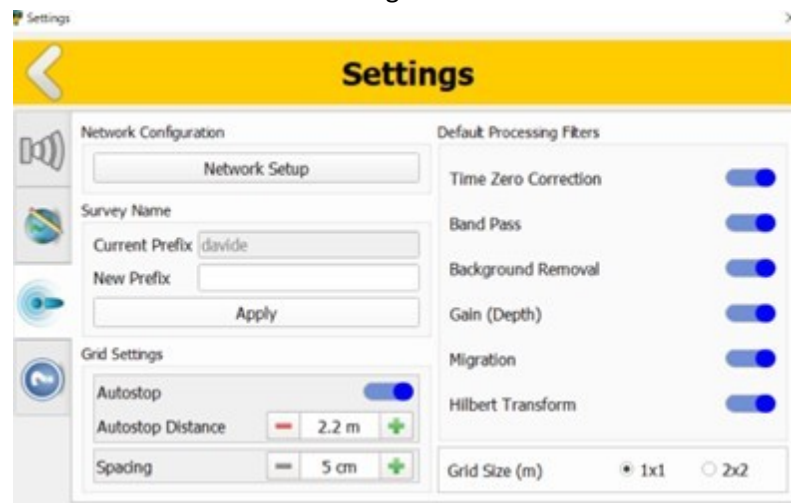


Fig. 45 Network and Survey Settings menu


- **Network configuration** (relates to naming of the RD connection of the WiFi features),



- **Survey naming prefix** (relates to the prefix to be given to each survey),

- **Grid Settings** (to activate the Autostop of the scan at a specified distance, and the spacing between scans),
- **Grid Size** (to define a 1mx1m or 2mx2m grid when collecting data in grid mode),
- **Default Processing Filter** (to activate or deactivate filters from the standard data processing).

7.1.5 How to check About Menu

As the User presses the  icon, the Fig. 46 window shall pop up and it is possible to verify the following software information:

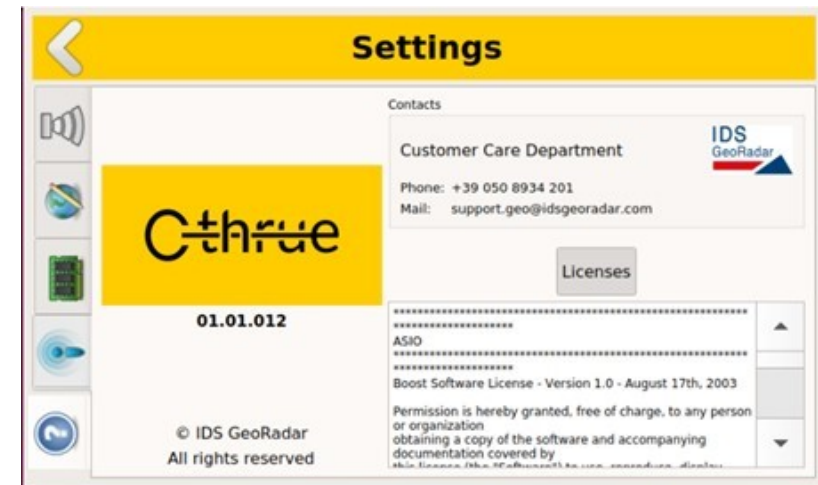



Fig. 46 About menu

- Software version,
- Technical support contact details,
- Software licenses Agreement.

7.2 How to work in Single Scan Mode



As the User presses the  icon, window of Fig. 47 shall pop up and the following operations can be carried out:

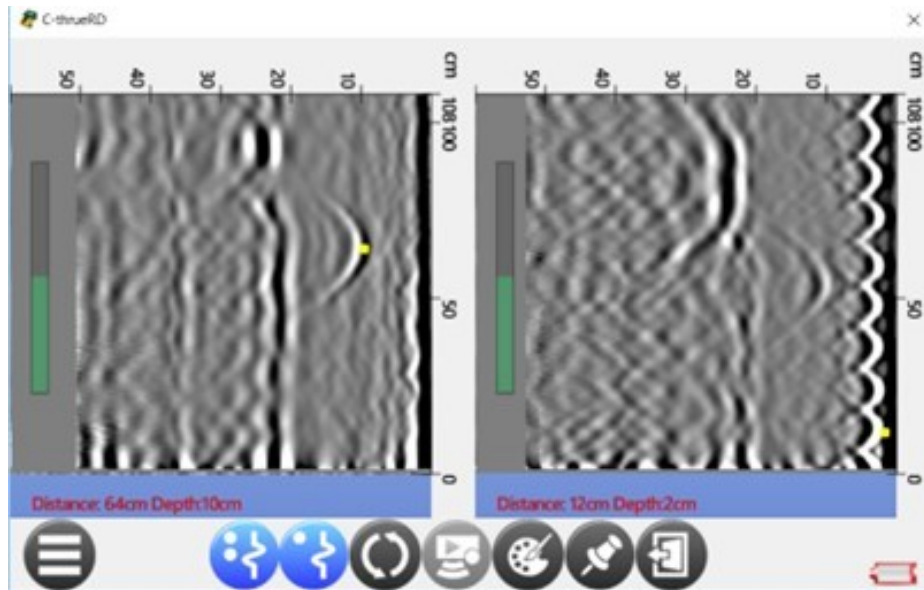





Fig. 47 Single scan mode window

- Press the Hamburger menu  to activate the following functions, below:

- Press the  icon to save a screenshot (.jpeg format) of the current view.
- Press the  icon and the Propagation Velocity window (Fig. 48) shall pop up, allowing to adjust the value of propagation velocity through the slider or the +/- icons. Also, dielectric constant can be adjusted.

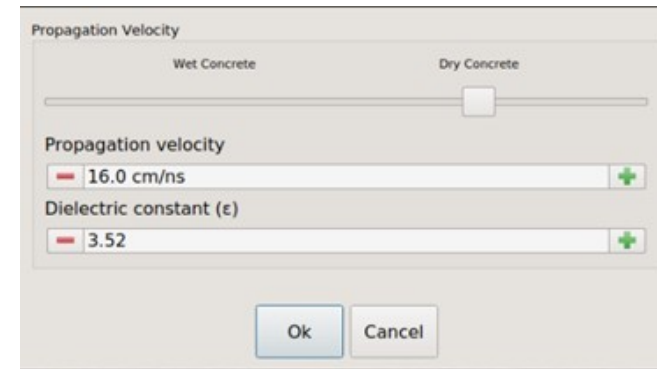




Fig. 48 Propagation Velocity window

- The  icon allows to erase the current swath.
- The  icon allows to display the information panel of a specific swath (Fig. 49).

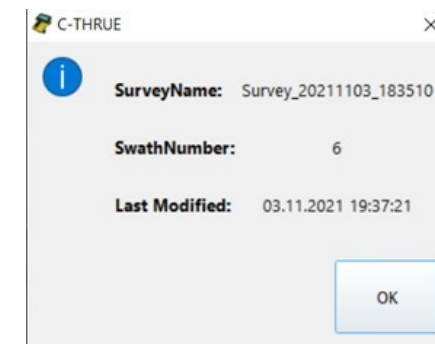











Fig. 49 swath information panel

- Press the  icon to start the acquisition and the  icon to stop it.

- The  icon allows to only show the shallow channel and the  icon the deep channel. Both icons enabled allows for the visualization of both B-scans, shallow and deep.
- The  icon allows to rotate the view on the screen.
- The  icon allows for a change of the colour palette of the B-Scans.
- The  icon enables the view of the targets being inserted.
- Press the  to stop the acquisition and exit the current menu.
- The slider  allows to vary the saturation of the colour bar (i.e. the colour palette of the B-scan).

During acquisition with **C-thrue**, it is possible to click with a finger on a specific point (e.g.: one hyperbola) of the B-scan, hence selecting a point. This shall prompt the User to the menu of Fig. 50.

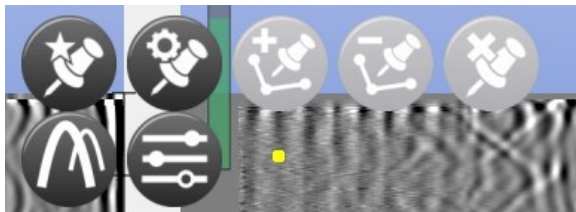




Fig. 50 select point menu

- The  icon allows adjusting the propagation velocity through a window like Fig. 48.
- The icon  brings to the window of Fig. 51 to adjust the processing menu (activate/deactivate filters).

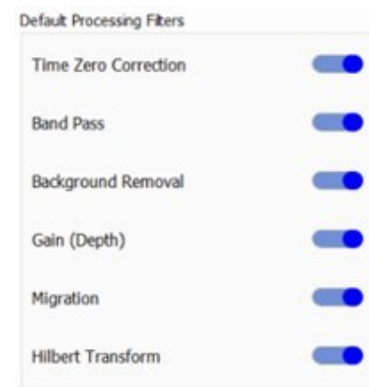






Fig. 51 data processing window

- The activation of the icon  allows to place a marker in that very point, by selecting from the list of Fig. 52. The same target type, connected to the previous one, can be added to the next hyperbola (by the icon ) or can be deleted (by the icon ) or the whole targets connected, of the same type, can be deleted by using the icon .

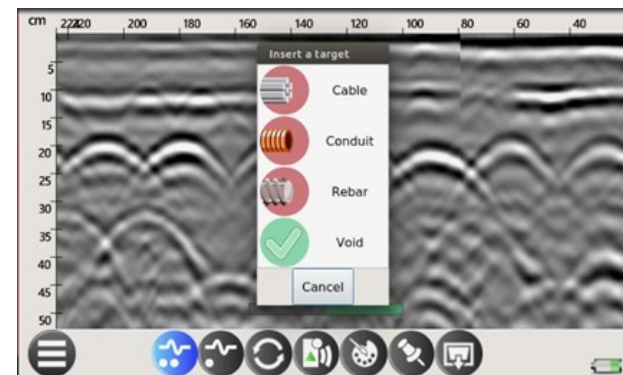



Fig. 52 targets type window

- The icon  allows the user to activate a function that automatically recognizes which kind of anomaly the user has selected before (between rebar and void category) and place one target marker from the previous list.

7.3 How to work in Grid Mode...

7.3.1 ...with laser enabled and reflective bars

To collect data in grid mode and reflective bars, follow the steps below:

- Install the (6) reflective bars on the surface to be surveyed, as shown in Fig. 53. The **C-thru**, shall be moved (parallel and perpendicular alternatively, in push or pull mode) inside the area defined by the reflective bars that as minor ticks each 5cm and major ticks each 10cm.

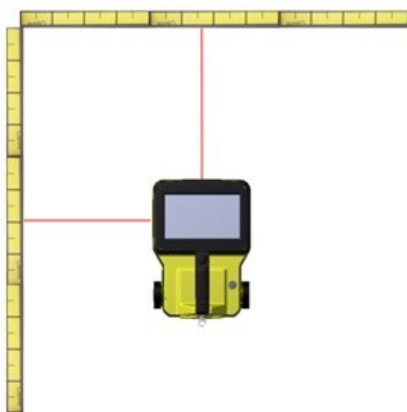




Fig. 53 installing reflecting bars

- Turn on the system by pressing the power button Fig. 31,
- Enable lasers by pressing the  icon, from the main menu page (Fig. 41).

- Select the  icon, from the main menu page (Fig. 41).
- The window of Fig. 54 shall pop up. Left panel displays position of the system and C-Scan view, right panel displays B-scan of shallow or deep channel.

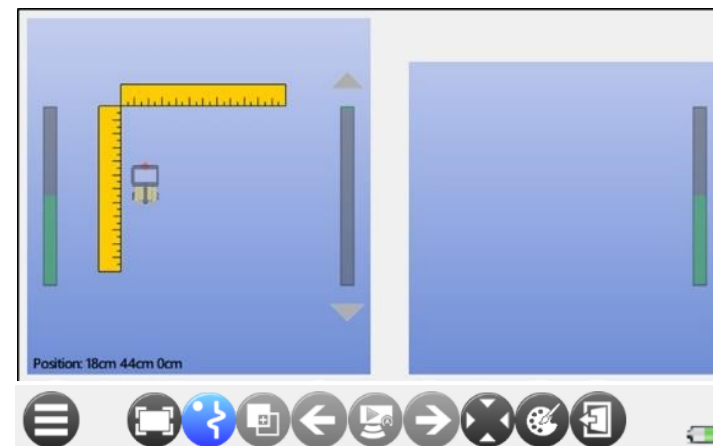









Fig. 54 grid scan mode window

- The use of icons       has been explained in 7.2.
- Press the  to visualize the grid on screen, with respect to actual **C-thru** position in relation to reflective bars (Fig. 55). And then start the data acquisition from here.

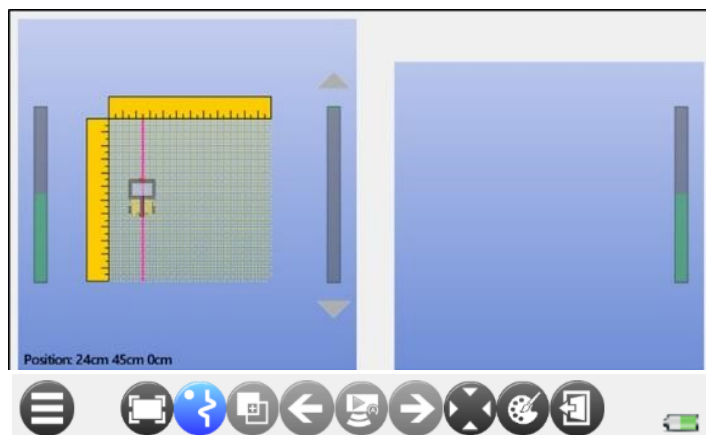

















Fig. 55 activating grid visualization

- In grid mode automatic  all lasers (3) are active.
- In locked mode , laser opposite to the reflective bar is disabled.
- In free mode  all lasers are disabled.
- Press start  and stop  (use the FCC dedicated button for US Customers) to collect of all the survey lines (both longitudinal and vertical) defined by the grid between reflective bars.



For FCC rules and regulations, there is an additional button under the handle. Hold this button during the acquisition, release at the end of it. The acquisition is stopped after about one second after the release of the button.

- The icon  is enabled to visualize the tomography in the C-scan panel (Fig. 56). The tomography view is the map obtained by the interpolation of the single acquisition lines. By pressing on the tomography, the icons   that shall allow the user to select the tomography relating to the shallow () , deep () , or both () channels at the same time.
- Activating the  icon allows to specify the depth of the tomography being visualized (use the right-side slider or the arrows up  and down , to adjust depth).
- Deactivating the  icon, shall allow for the visualization of the tomography of the whole volume.

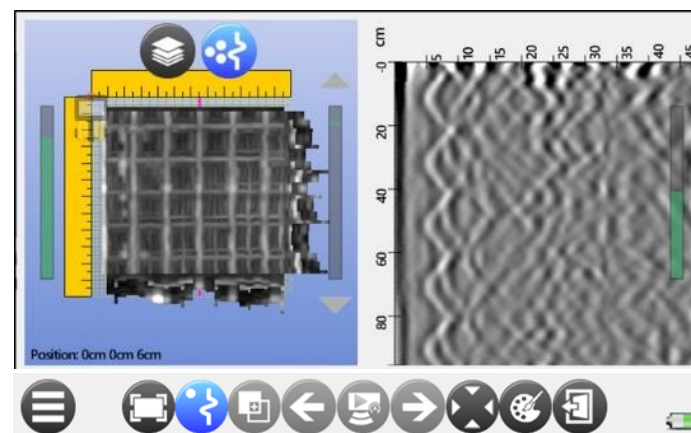



Fig. 56 visualization of the tomography (left panel) and B Scan (right panel)

- Activate the  to visualize the grid.

- The arrows icon  allows to visualize previous or next B-scans with respect to the current view.



In grid acquisition, the palette can be changed only if the merge swath is enabled.

- Use the  icon enable/disable the B-Scan view.

7.3.2 ...with laser disables and paper grid

To collect data in grid mode, without reflective bars and using paper grid, follow the steps below:

- Unfold the paper grid (two sheets) provided, and overlap the 6 holes in the lower and upper part, as shown in Fig. 57,

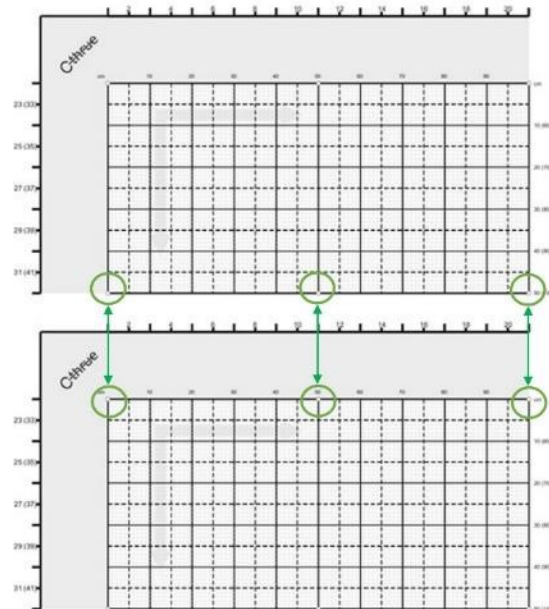


Fig. 57 paper grid set up, step 1

- The paper grid so obtained, shall define a 1x1metre area (Fig. 58),

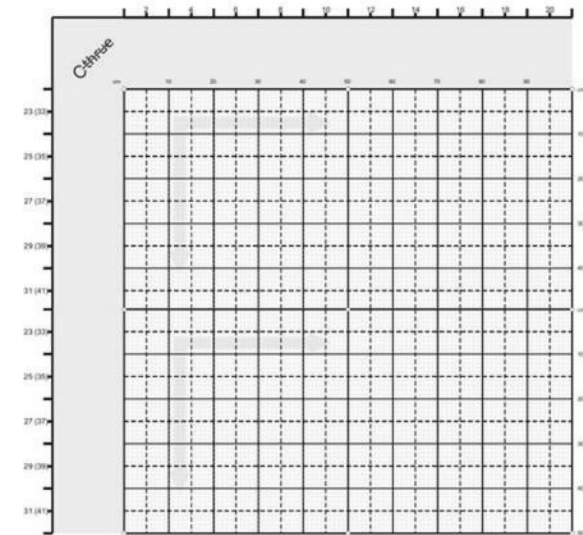




Fig. 58 paper grid set up, step 2

- Turn on the system by pressing the power button Fig. 31,
- Make sure laser icon on main menu is disabled ,
- Select the  icon, from the main menu page (Fig. 41).
- The window of Fig. 59 replicating the scheme of the paper grid shall pop up.

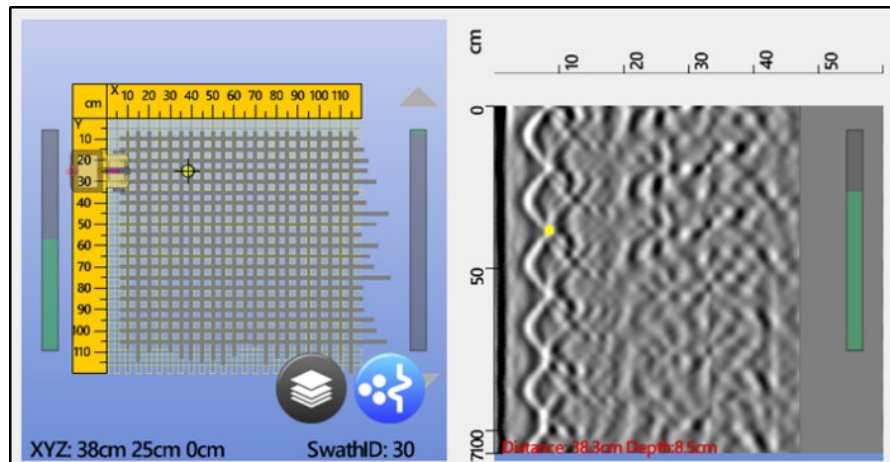


Fig. 59 paper grid acquisition mode screen



The Paper Grid is even released in inch format with a single covering area of 40x20 In and 40x40 In matching the two papers; the distance between the swaths is 2In.

All commands and tool described in previous paragraph 7.3.1, applies.

REMEMBER: The use of the paper grid only relies on the precision of the User during data acquisition. Hence, it is important to correctly position the system during data acquisition, for the results to be correctly positioned (i.e.: the tomography view, Fig. 62). This is particularly relevant with respect to the start point of longitudinal (Fig. 60), and transversal (Fig. 61) acquisition lines.

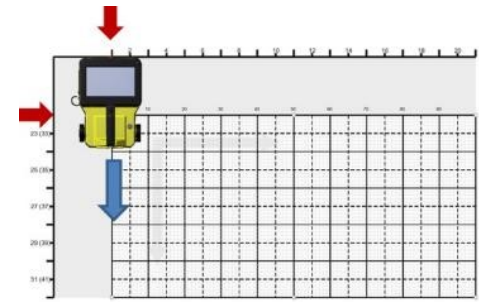


Fig. 60 acquisition of longitudinal lines in grid mode with paper grid

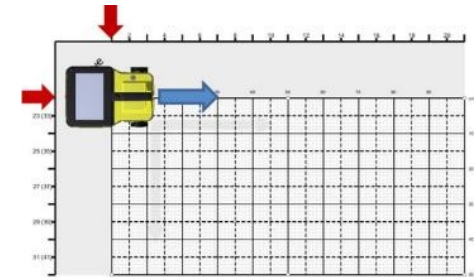


Fig. 61 acquisition of transversal lines in in grid mode with paper grid

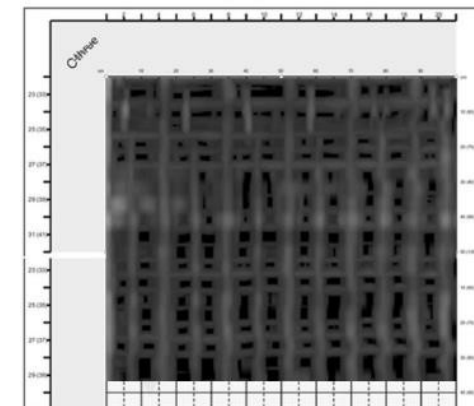



Fig. 62 alignment of the tomography in grid mode acquisition with paper grid

7.4 How to explore existing survey

As the User presses the  icon, the Survey Explore window of Fig. 63, shall pop up.

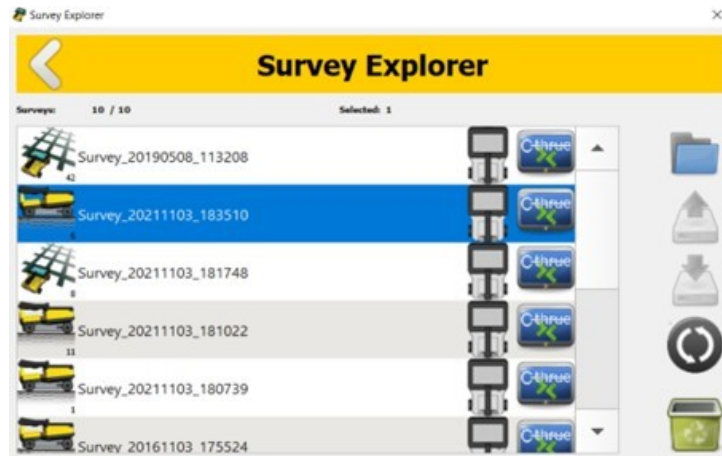







Fig. 63 Survey Explorer window



Once a survey is selected by the screen touch:

- Press  to open and review that survey.
- Press  to download that survey onto a USB memory plugged on the system.
- Press  to upload survey on to the C-thrue.
- Press the  icon to reload the survey list.
- Press  to delete.

7.5 How to activate Lasers

Lasers located in the front (one) and on the side (one on the left and one on the right side) of the **C-thrue**, are used in combination with reflective bars for positioning of the system with respect to a “virtual” grid.



To activate laser, follow the steps below:

- Turn on the system by pressing the power button Fig. 31,
- Press the  icon and wait for this to turn green  indicating that lasers are now active.

7.6 How to activate WiFi

Activating the WiFi on the **C-thrue** allows for the system to generate its own network to be used in combination with and external PC tablet for using the system with a Remote Desktop Connection. With this set up enabled, **C-thrue** functionality can be managed via an external PC.

To Activate the WiFi network, follow the steps below:

- Turn on the system by pressing the power button Fig. 31,
- Press the  icon and wait for this to turn green  indicating that WiFi is now active.

7.7 How to activate EM sensor

In **C-thrue** there is a built-in EM sensor used to detect Electromagnetic fields generated by buried live power cables; when it is active, a yellow line will appear overlapped to the radargram, as is shown in Fig. 64. When the **C-thrue** antenna passes over a live cable, a wave appears on the yellow line, whose peak is in correspondence of the buried, live cable.

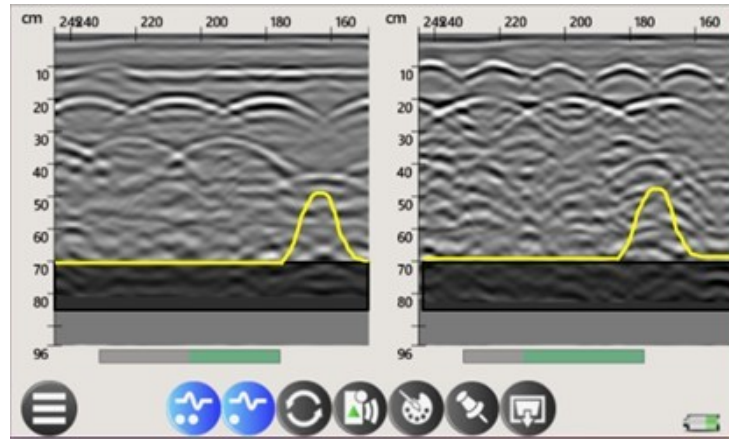




Fig. 64 Activation on EM sensor

To Activate the EM sensor, follow the steps below:

- Turn on the system by pressing the power button Fig. 31,
- Press the  icon and wait for this to turn active (from grey colour to yellow color of the icon).

7.8 How to check the battery status

In the lower right corner of the main menu (Fig. 41) there is a symbol  whose colour coding varies from green (charge) to Yellow (partially empty) to red (empty).

Also, on top of each battery, there is a button (green rectangle of Fig. 65) that, after the User presses it, starts a LED system whose levelling indicates the battery status of recharge.



Fig. 65 Battery status check

8 HOW TO WORK ON SITE WITH C-THRUE FULL CONCRETE SCANNER PACKAGE

The **C-thrue** full concrete scanner package (SAP code 6014777) includes additional items, with respect to the **C-thrue** concrete scanner (SAP code 868510), namely:

1. **C-thrue** remote handle (SAP code 875951), Fig. 8, and
2. **C-thrue** Augmented Reality kit (SAP code 6014775), Fig. 9.

The Augmented Reality kit includes:

1. 4 QR codes stickers
2. PC with pre-installed **C-thrue Remote desktop software** (SAP code 876235), and
3. **Augmented Reality software** (SAP code 876233).

This HW set up implies that, besides all the operations described in paragraph 6, the following additional workflow can be performed (Table 2):



PAR	DESCRIPTION	ICON
0	Use of the system with a remote handle	NA
8.2	Remote Desktop Connection (RDC)	
0	Augmented Reality features visualization	

Table 2 C-thrue full concrete scanner package workflow

8.1 How to use the C-thrue with Remote Handle


Use of **C-thrue** with the remote handle, includes the following:

1. Set up of the system as described in paragraph 5.2,
2. Turn on the system as illustrated in Fig. 30,
3. Select the type of survey to be carried out, from the main menu page Fig. 41,


4. Carry out the survey by using the Start/Stop/Enable buttons placed on the command panel of the handle located opposite to the hook system to the **C-thrue** (Fig. 21).

8.2 How to use C-thrue with Remote Desktop Connection

The Remote Desktop Connection (RDC) allows using **C-thrue** and all its functionalities through a software (**C-thrue Remote desktop**) installed onto an external PC tablet. Enabling of this function is done through the following steps:

1. Turn on **C-thrue** (Fig. 31), and Enable the **C-thrue** Wi-Fi (7.6),
2. Turn on the Tablet where the **Remote Desktop Connection** software is installed, press on the  icon at the lower right corner, and select the **C-thrue** generated network named **C-thrueRD-net** to pair the tablet and the **C-thrue**,

3. Start the Remote desktop connection software by the icon ,

and the window Fig. 66 shall pop up with the tab  showing information on:

- a. Connection Data,
- b. Component Version,
- c. Storage Data,
- d. Logs,
- e. **C-thrue** Serial Number,

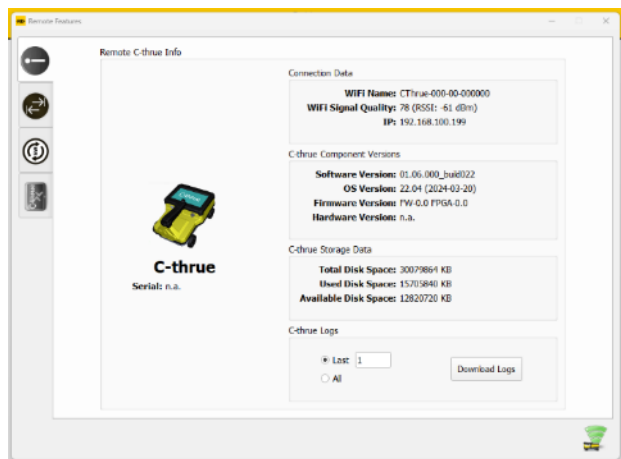


Fig. 66 C-thrue Remote Desktop main page

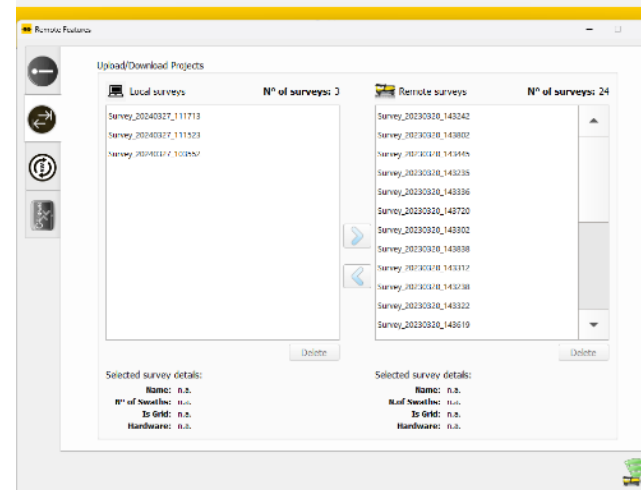





Fig. 67 the Project Tab


4.  icon shall appear if the wi-fi is enabled in one device, while in the other is still off.


6. The  tab (Fig. 68), portrays SW and FW version also allowing for the update of these.



To ensure devices correct communication, User should keep deactivated the PC "Public Network" Firewall from the PC Firewall & Network protection area.

5. The  tab (Fig. 67) where it is possible to visualize Survey stored both on the PC and on the **C-thrue** memory.

- a. Use the  icon to move Surveys from PC to C-thrue.

- b. Use the  icon to move one Survey from C-thrue to PC.

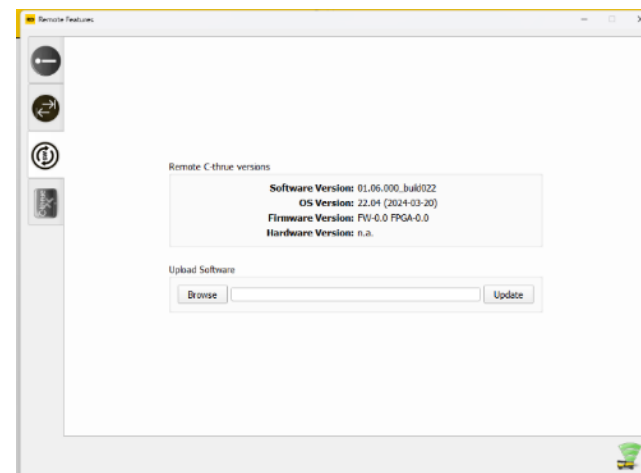




Fig. 68 the SW and FW version tab

7. The  tab (Fig. 69), is the panel to be used to connect the PC and the **C-thru** via WiFi and to use **C-thru** functions via the RDC.
8. Press the  to activate the RDC,

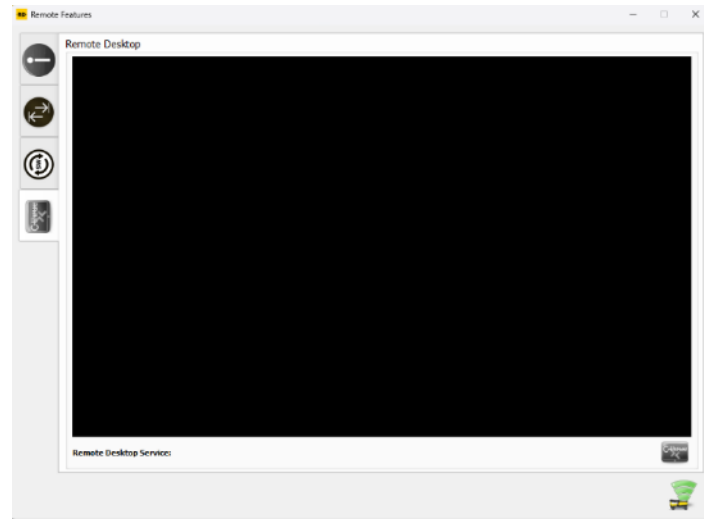



Fig. 69 the Remote Desktop connection tab (not connected)

9. And the  tab (Fig. 70) shall pop up showing the **C-thru** Remote panel.

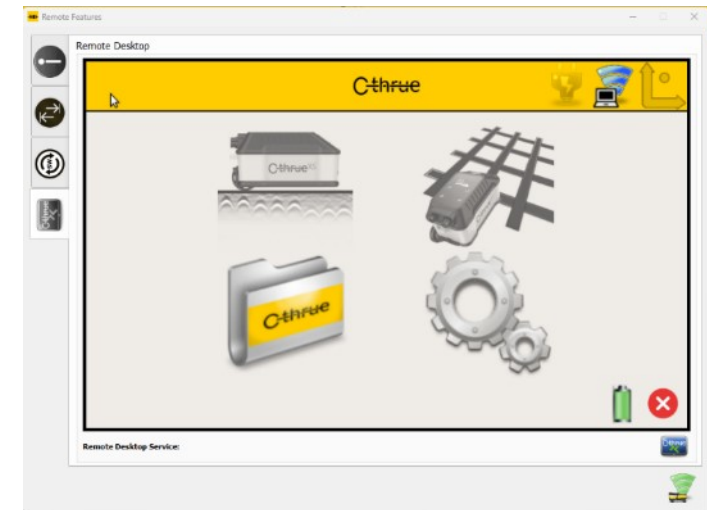


Fig. 70 the Remote Desktop connection tab (Connected)


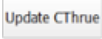
10. Press on the  icon and the Fig. 71 shall pop up.



Fig. 71 Settings menu





11. Adjust *date and time* and then press  to synchronize devices.

12. Customize all the Network and Survey Setting as described in Paragraph 7.1.4.
13. System is now ready for the use on site (Fig. 72).



Fig. 72 C-thru full concrete scanner package workflow

14. In the Survey Explorer window (7.4), it is possible to verify the status of the project synchronization between tablet and **C-thru**. Details of the possible synchronization variable are illustrated in Table 3.

SURVEY STATUS	ICONS	POSSIBILITIES TO IMPORT/EXPORT IN BOTH DEVICES	RELATED ICONS FOR THE IMPORT/EXPORT BETWEEN DEVICES	FINAL STATUS OF THE ICON AFTER THE ACTION
The survey is present only in the C-thru memory		Only import in C-thru remote desktop	 	



















The survey is present only in velta desktop		Only export in C-thru system.	 	
The survey is present in both devices, with the same status		Both import and export	 	
The surveys is present in both device, but the one in C-thru device is the latest modified one.		Both import and export. The user can import the latest modification in C-thru remote desktop, or he can discard the latest operation in C-thru clicking export, and come back to the original or previous version	 	
The surveys is present in both device, but the one in C-thru remote desktop device is the latest modified one.		Both import and export. The user can export the latest modification in C-thru remote desktop, or he can discard the latest operation in C-thru clicking import, and come back to the original or previous version	 	

Table 3 C-thru and tablet synchronization status

By the end of the survey the tomography view of the area following the

Grid data acquisition, should be saved by pressing the  icon, if this should be visualized through the AR functionalities.

15. Then press the  icon, to generate time slices of the tomography just collected.
16. Time slices shall be saved with naming *slices.xml* into the tablet directory named `C:\Documents\C-thrueRD\Data\Survey_Name\Slices`

8.3 How to use C-thrue with Augmented Reality kit

As a **C-thrue** survey in grid mode has been collected, concrete scanner data can be visualized on a PC table screen where the **Augmented Reality** software is installed. To do this, follow the steps, below:

1. Place the QR code stickers in the exact position where data has been collected, respecting the order indicated in Fig. 73; reference points are referred to the reflective bars (top left, top right, bottom left, bottom right),

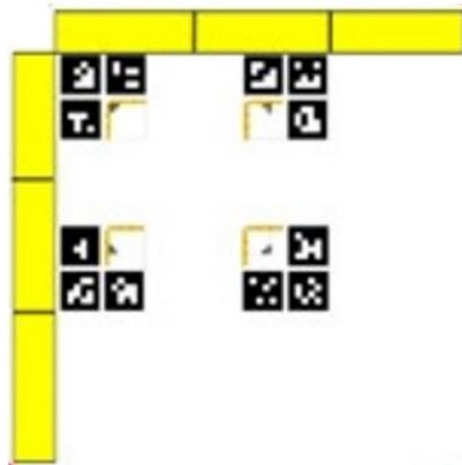


Fig. 73 positioning the QR code


2. Turn on **C-thrue Augmented Reality SW**  installed into the PC tablet, and the window of Fig. 74 shall pop up,



Fig. 74 Augmented Reality software main page

3. Press the Hamburger menu icon  on the top left corner, and the window Fig. 75 shall pop up,



Fig. 75 AR Open Survey menu

4. Customize the view by using:

- a. Metric Units
 - b. Language
5. The About menu prompts the User to the Software information.
 6. Press Open Survey and point at the directory where the *slice.xml* file previously saved (point 16 of Paragraph 8.2),
 7. Point the tablet camera towards the area where the QR code were installed, previously (Fig. 76),

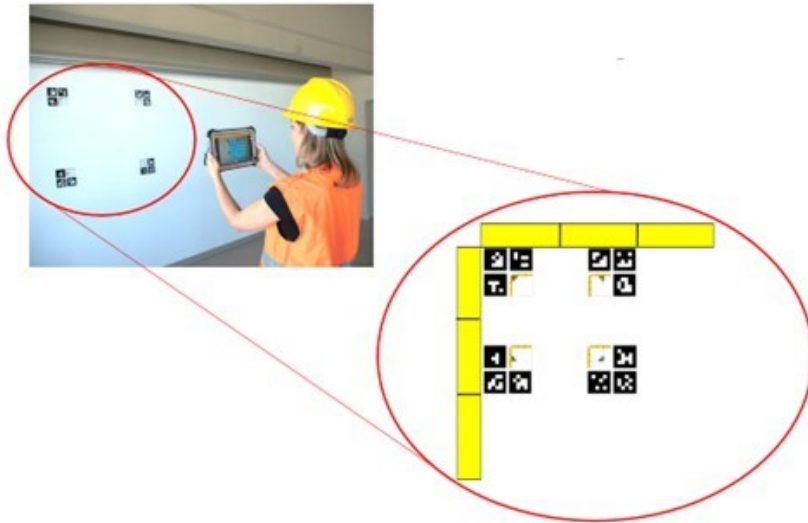


Fig. 76 visualizing the C-thru survey with Augmented Reality

8. **C-thru** data relating to the survey collected at that location where the tablet is aiming to, are visualized on the tablet screen (Fig. 77). It is possible to customize the view through the following tools:
 - a. Transparency slider,
 - b. Palette selector,
 - c. Collapsed/expanded view,
 - d. Depth slider,

- e. VV or HH channel tomography view,
- f. Screenshot, to save an image of the current view.

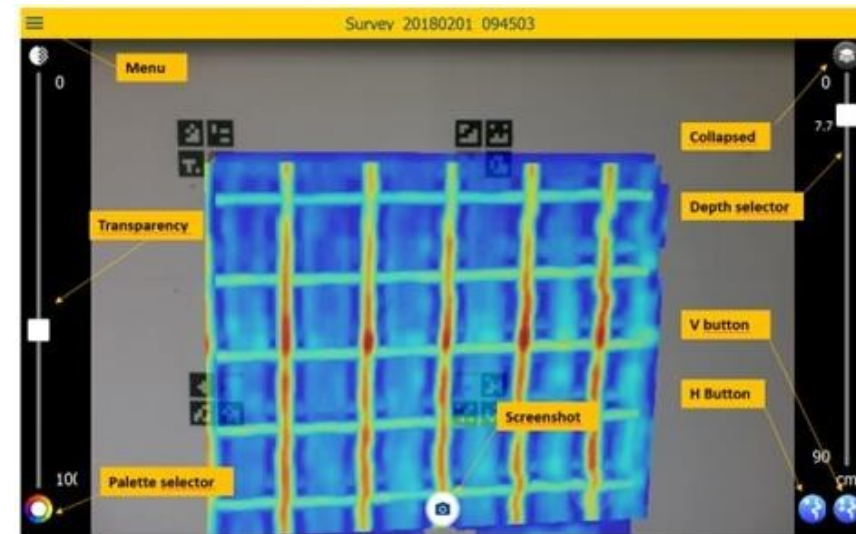


Fig. 77 AR software image

9 HOW TO WORK ON SITE WITH C-THRUE XS

C-thrue XS, can be use in two modes as described in paragraph 5.3:

1. **C-thrue XS Stand-alone**, or
2. **C-thrue XS with C-thrue**.

Regardless the configuration deployed on site, the User can carry out the following workflow (Table 4):






PAR	DESCRIPTION	ICON
9.1.1	Customization of the Users Settings	
9.1.2	Single Scan Acquisition mode	
9.1.3	Grid Acquisition mode	
9.1.4	Explore Existing Survey	
	Activating the WiFi connection (to be used only for RDC with C-thrue)	


Table 4 C-thrue XS workflow

9.1 How to work on site...C-thrue XS stand-alone

As **C-thrue XS** is set up as described in Paragraph 5.3.1, follow the steps below:

1. Turn on the PC tablet plugged to **C-thrue XS** and where the **C-thrueRD** software is installed,
2. Make sure the IP address of the PC, is set to static **192.168.201.199**,
3. The **status LED** (B in Fig. 24) shall blink in **white color**, indicating that the **C-thrue XS antenna** is powered though the PC.



4. Press the  to turn on the **C-thrueRD** software, and the SW main page shall pop up Fig. 78,

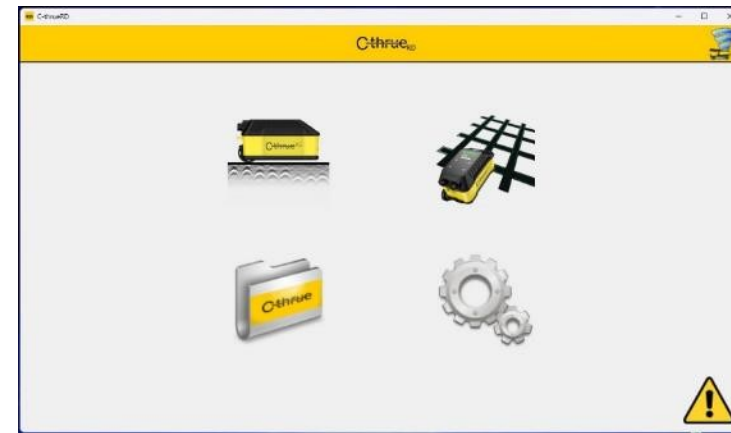




Fig. 78 C-thrueRD main page (with C-thrue XS)

5. The icon  at the lower right corner indicates the Tablet and the antenna are not yet connected,
6. After a few seconds, the main page shall turn into Fig. 79 with the icon  indicating the connection between antenna and Tablet, and the **Status LED** on the **C-thrue XS** antenna shall turn into **blue color**.

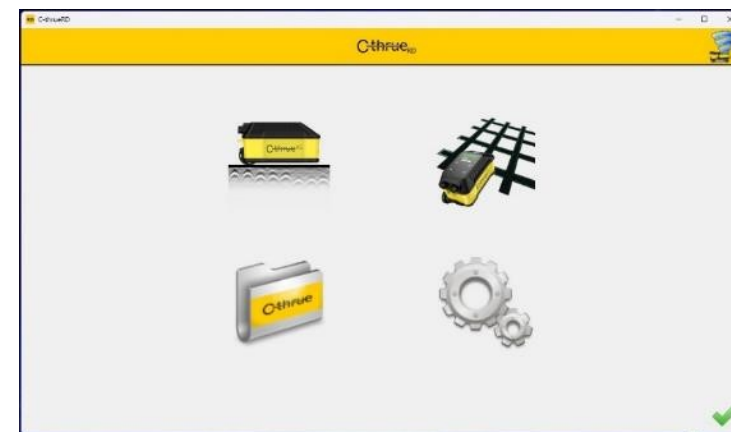



Fig. 79 C-thrueRD main page (with C-Thrue XS connected)

7. **C-thrue XS** is now ready to work.

9.1.1 How to customize Users settings

To customize Users Setting, follow the steps below:

1. Press the  on the Main Page menu Fig. 79, and the window shall pop up.

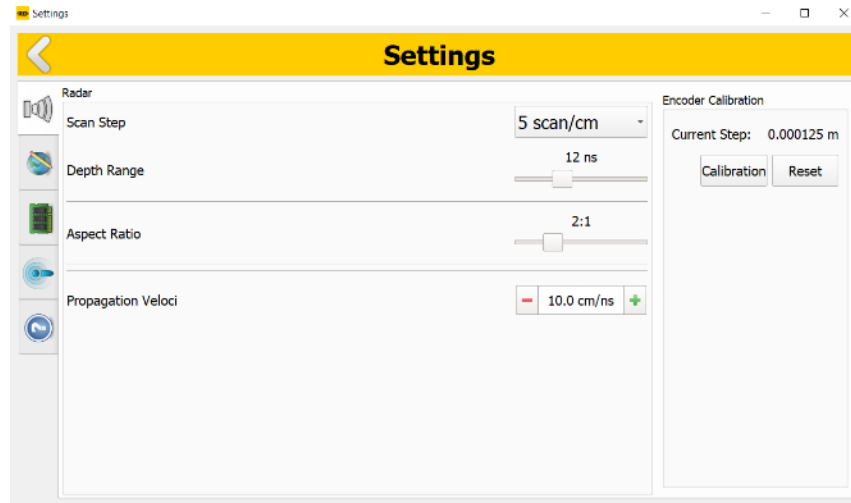



Fig. 80 Settings Window

2. To customize Setting, User should proceed as already described in 7.1 illustrating functionalities of **C-thrue**.

9.1.2 How to work in Single Scan acquisition mode

To work in single line acquisition mode, follow the steps below:

1. Press on the  icon, on the main page menu Fig. 79, and the window Fig. 81 shall pop up.
2. To work in Single Line Mode, User may refer to the steps illustrated in 7.2 illustrating the functionalities for **C-thrue**.

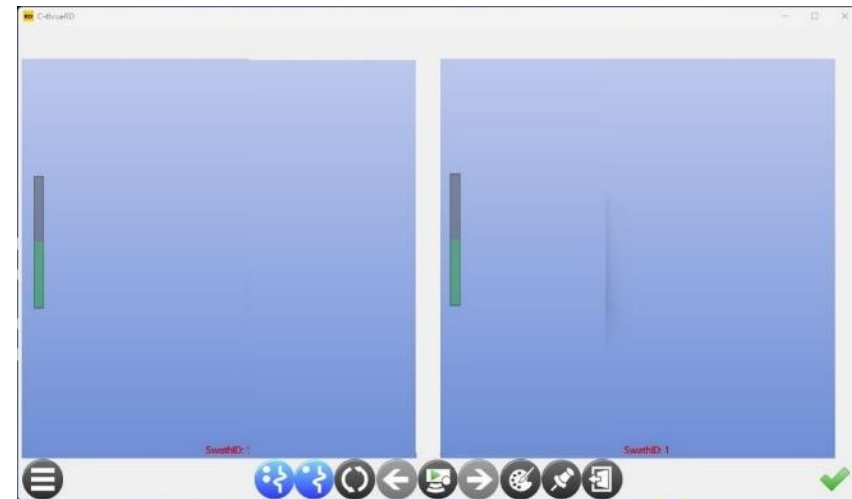



Fig. 81 Single Scan acquisition mode window

9.1.3 How to work in Grid acquisition mode

To work in Grid acquisition mode, follow the steps below:

1. Unfold the paper grid (two sheets) provided, and overlap the 6 holes in the lower and upper part, as shown in Fig. 57,
2. The paper grid so obtained, shall define a 1x1metre area (Fig. 58),
3. Press on the  icon of the main page menu Fig. 79, and the window of Fig. 82 shall pop up.

All commands and tools described in previous paragraph 7.3.1, applies.

REMEMBER: The use of the paper grid only relies on the precision of the User during data acquisition. Hence, it is important to correctly position the system during data acquisition, for the results to be correctly positioned (i.e.: the tomography view, Fig. 62). This is particularly relevant with respect to the start point of longitudinal (Fig. 60), and transversal (Fig. 61) acquisition lines.

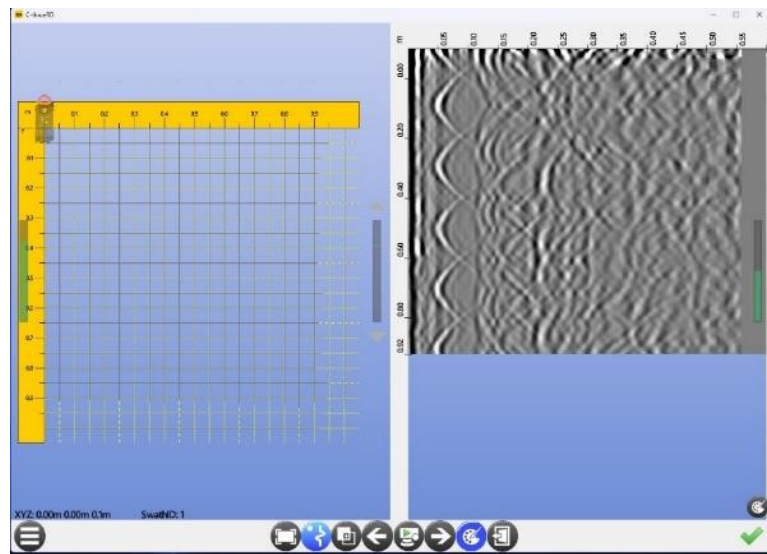






Fig. 82 Grid Acquisition mode window

9.1.4 How to Explore existing Survey

To Explore the Existing Survey, follow the steps below:

1. Press on the  icon, on the main page menu Fig. 79, and the window Fig. 83, shall pop up.
2. Press  for multiple surveys selection,
3. Press  to Open a survey,
4. Press  to export Surveys logs.

Other functions are the same as illustrated in 7.4.

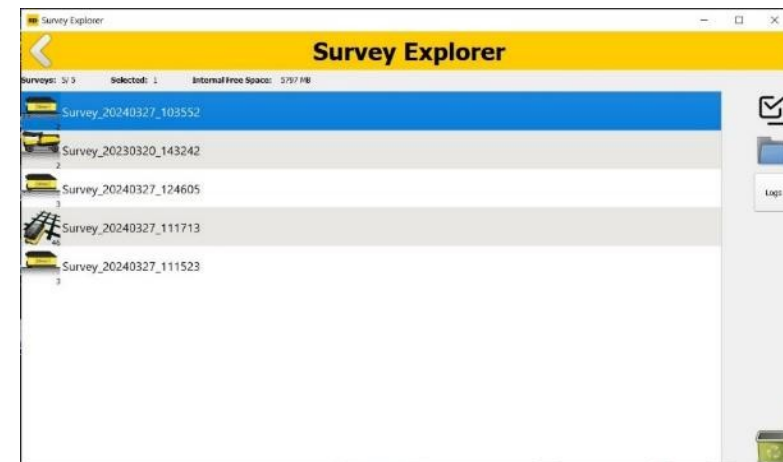


Fig. 83 Survey Explorer window

9.2 How to work on site...C-thrue XS with C-thrue

As **C-thrue XS** is set up as described in Paragraph 5.3.2, follow the steps below:

1. Turn on the **C-thrue** (Fig. 31) and the system main page shall pop up on the system touchscreen Fig. 79

From here, all functions described in 9.1 can be performed.

10 CARE AND TRANSPORT

10.1 Cleaning Information

Before cleaning any of the external parts of the apparatus, make sure that all cables and wires have been unplugged, including the power supply cable. If a damp cloth is used, make sure it is not wet, to avoid any damage to the electrical components of the equipment. Wait until the equipment is totally dry before reconnecting the cables.



CAUTION: DAMAGE TO ELECTRICAL COMPONENTS

If a damp cloth is used while cleaning the system or part of it, make sure that this is not wet, to avoid any damage to the electrical components of the equipment

PRECAUTION: Before cleaning any of the external parts of the apparatus, make sure that all cables and wires have been unplugged, including the power supply cable.

The **C-thru** and accessories should be cleaned periodically using a damp cloth.



NOTICE: If the system is dirty, connectors and encoders may not work properly.

Precautions:
After a field work, check the conditions of the system and clean it if necessary.

Do not use solvents or abrasive detergents.



CAUTION: DAMAGE TO ELECTRICAL COMPONENTS

Consider only cleaning products appropriate for electrical components.

PRECAUTION: Verify if the cleaning products are compliant with electronic devices.

Do not apply liquid directly to the electrical contacts of the various connectors.

If a specific spray is used to clean the PC monitor, make sure it is not flammable; in any case, do not spray it directly on the screen, instead, spray it onto the cleaning cloth.



CAUTION: DAMAGE TO ELECTRICAL COMPONENTS

Flammable spray could damage the electronic devices, as controller laptop.

PRECAUTION: Verify if the cleaning products are compliant with electronic devices.

10.2 Battery Removal Information

Remove batteries from the product and the charger before storing.

- After storage recharge batteries before using.
- Protect batteries from damp and wetness. Wet or damp batteries must be dried before storing or use.
- A storage temperature range of $-20\text{ }^{\circ}\text{C}$ to $+50\text{ }^{\circ}\text{C}$ / $-4\text{ }^{\circ}\text{F}$ to $+122\text{ }^{\circ}\text{F}$ in a dry

environment is recommended to minimize self-discharging of the battery.

- At the recommended storage temperature range, batteries containing a 40% to 50% charge can be stored for up to one year. After this storage period the batteries must be recharged.

As for the Laptop Batteries please, do refer to the PC manufacturer user's manual.

10.3 Periodical Check

The Operator should periodically check the status of the antenna sledge, shells, all cables, any rotating part, and any (potentially) consumable part. The system must not be used in case of any malfunctioning or broken part, as this may cause other parts to be damaged and/or malfunction consequently.



NOTICE: The Sledges should be periodically checked out to verify their status, and should be removed and replaced, when needed. Prior starting any survey, the status of the sledge should be verified for integrity.

Precautions:

If the antenna shell is exposed, even partially, because of the sledge being consumed, the sledge must be replaced immediately.



NOTICE: All the cables and connectors should be verified at each use of the system

Precautions:

In case of any damage of cables or connectors, immediately inform IDS GeoRadar to follow up on removal and replacement.



NOTICE: All the connectors on the antenna and the accessories, must be plugged at any time either by the corresponding cable plug, or by the connector cap, when not in use. This is to prevent dust or water ingress, that may damage the connector itself and its functionality.

Precautions:

Verify the connectors status before running a survey.

10.4 Proper system use and transport/shipping

Always use the system as indicated in this manual, by following instructions.

When not in use, the system should always be transported and/or shipped by using the hard case with which the system is delivered. Transporting and/or shipping the system outside this packaging or by using other shipping boxes may cause the system, or part of it, to be damaged.



CAUTION: MECHANICAL DAMAGE OF THE SYSTEM

Transporting and/or shipping the system outside its original packaging or by using other shipping boxes may cause the system, or part of it, to be damaged.

PRECAUTION: The system should always be transported and/or shipped by using the hard case with which the system is delivered.

11 IDS GEORADAR SUPPORT

11.1 myWorld

myWorld platform of Leica Geosystems offers a wide range of services, information, and training material. With direct access to *myWorld*, the User can access all relevant services. The availability of services depends on the instrument model.

SERVICE	DESCRIPTION
myProducts	Add all IDS GeoRadar products that you and your company own and explore your world of Leica Geosystems. View detailed information on your products and update your products with the latest software and keep up to date with the latest documentation.
myService	View the current service status and full-service history of your products in IDS GeoRadar service centres including detailed information on the services performed on your system.
mySupport	Create new support requests for your products that will be answered by your local Support Team. View the complete history of your support requests and view detailed information on each request in case you want to refer to previous support requests.
myLearning	Welcome to the home of Leica Geosystems online learning! There are numerous online courses – available to all customers with products that have valid CCPs (Customer Care Packages).
myTrustedServices	Add your subscriptions and manage users for Leica Geosystems Trusted Services, the secure software services, that assist you to optimise your workflow and increase your efficiency.
mySmartNet	HxGN SmartNet is the GNSS correction service built on the world's largest reference station network, enabling GNSS-capable devices to quickly determine precise positions in the range of one-to-two-centimetre accuracy. The service is provided 24/7 by a highly available infrastructure and professional support team with more than 10 years of experience reliably delivering the service.
myDownloads	Downloads of software, manuals, tools, training material and news for IDS GeoRadar products.

11.2 How to manage return for Service

On occasions, your GPR may need to be returned to factory for repairs. These events, depending on circumstances, may be handled under maintenance or warranty conditions.

IDS GeoRadar, implements an internal ticket system to handle the repair of its Products worldwide. In this respect, for the global IDS Customer Support to be able to troubleshoot in case of need, it is necessary identifying the GPR system first hence, it is mandatory providing information including Serial number and Product Number of the system or part of it that need repair. This information may be found on a label placed on top of the system (e.g.: inside the battery housing, on top of the antenna, on the side of the rudder, on top of the SCU, etc....). An example of this label is illustrated in Fig. 84.



Fig. 84 Example of IDS GeoRadar systems label

In any event, the workflow to follow up on a support request is:

1. Contact, by using the local Support mailing list, your local representative of IDS Customer Support, or enter a support case into the *mySupport* page of *myWorld*, Indicating the following:
 - a. Type of System or part of it (defined by Product Number or Article number, that is PN 859224 in Fig. 84)

- b. Serial Number (SN 020-23-000543, in Fig. 84)
 - c. Type of issue
2. The local Representative of IDS Customer Support or the Central IDS Customer Support shall follow up on the case by a first level, remote troubleshooting to assess the system and the possible issue.
3. If a further, direct assessment of the system is necessary, the system shall be returned for analysis. Based on this, a repair under warranty or maintenance conditions, may be carried out. Depending on cases and the type of possible repair, return may be towards the local Representative of IDS or to the IDS GeoRadar main factory.
4. Prior return of the goods, wait for the IDS logistic office to provide a reference number for the return case and shipping instructions.
5. As the system reaches IDS repair premises, this is analyzed to find the root cause of the issue, and repaired **ONLY** after signed approval of the quotation, in case where the warranty does not apply. The status of the repair may be checked onto the *mySupport* page of *myWorld*.
6. At the end of the repair, the system is shipped back to the shipping address indicated at the beginning of the procedure, and this is conducted based on contractual agreements.



NOTICE: The above, is meant solely as a broad indication of the workflow for the return of a system for repair.

Precautions: Please, refer to the Contractual Terms and Conditions for more detailed information.

APPENDIX A DISCLAIMER

1. General

- i. The present Disclaimer applies to all products designed, produced and distributed by IDS GeoRadar S.r.l., its Subsidiaries, Affiliated and authorized Distributors (the “Products”). IDS GeoRadar S.r.l. reserves full ownership and intellectual property rights of any “Information” contained in this Disclaimer including Trade Marks and Graphics. No part of this Disclaimer may be used or reproduced in any forms without the prior written agreement of IDS GeoRadar S.r.l.
- ii. In the event that any provision of this Disclaimer may be invalid, unlawful or incapable of being enforced by a rule of law, all other provisions shall, nonetheless, remain in full force and effect. Failure to either enforce or exercise any right, privilege, or legal remedy at any time, any provision contained in this Disclaimer, shall not be deemed a waiver of such provisions or right, remedy, or privilege.
- iii. This Disclaimer shall be interpreted, governed, construed and enforced in accordance with the laws of Italy. User/Buyer hereby consents to the exclusive jurisdiction of Pisa.

2. Initial Precautions for Setting-up and Use of the Products.

- i. The User/Buyer, for setting-up and using the Products, shall consult the official documentation provided by IDS GeoRadar S.r.l. for the Products (“Reference Documentation”) and carefully ascertain the compliance with national laws and requirements, which may limit or even forbid their use.
- ii. For Products which shall operate by circulation in Public Areas/Roads, with or without moving traffic, Buyer/User shall verify the approval of local authority and/or site’s owner according to their specific procedures. IDS GeoRadar S.r.l. shall not be liable for any direct, indirect, special, incidental or consequential damages or injuries, including without limitation, lost revenues or lost profits,

resulting by un-authorized use of the Products in Public Areas/Roads.

iii. Buyer/User further warrants:

- that these Products are not being used, in the design, development, production or use of chemical, biological, nuclear ballistic weapons. Buyer/ User will defend, indemnify and hold IDS GeoRadar S.r.l. harmless against any liability (including attorney’s fees) for non-compliance with the terms of this article.
- That, if IDS GeoRadar S.r.l. requires that Buyer/User shall carry out a training with reference to some Product categories, no operation or use of the Products shall be started before its designated Operator/s has got the User Certificate, as defined by IDS GeoRadar S.r.l. specific procedure which the Buyer confirms to know and accept.

iv. For Products which include specific “Operational” software with automatic data processing and analysis “Tools”, e.g. the IBIS Products and Hydra Products, User shall be aware that the results provided by these “Tools” may be not error free. User that completely relies on the outcomes provided by these Tools only, does it at his own risk.

v. In no event IDS GeoRadar S.r.l. shall be liable for special, direct, indirect, incidental, exemplary, punitive or consequential damages including, but not limited to, loss of profits or revenue, caused by the use of the Products, either separately or in combination with other products or relied upon the results provided by the above “Tools”.

3. Disclaimer for the “Use” of the Products.

- i. The User shall follow the instructions provided by IDS GeoRadar S.r.l. in its official “Reference Documentation” for the Product, in particular the User’s Technical Manual which contains all the specific steps and recommendations for a correct setting-up and use of the Product.

- ii. In no event IDS GeoRadar S.r.l. shall be liable for special, direct, indirect, incidental, exemplary, punitive or consequential damages including, but not limited to, loss of profits or revenue, caused by the missed or incomplete observance of the instructions and prescriptions for the use of the Products, either separately or in combination with other products, including but not limited to the following main aspects:
 - a. Use of IDS GeoRadar S.r.l. Products outside its limitation of use, without proper and adequate scientific/technical knowledge or without specific training.
 - b. Use of results/outcomes of the measurements performed by the Product aimed to safety aspects without using adequate control procedures and assessment by skilled personnel.
 - c. Opening of the Equipment (for HW Products) without express written authorization of IDS GeoRadar S.r.l.;
 - d. Unauthorized changes and additions to the Products.
 - e. Use of the Products connected to suspected non-working equipment or with equipment (mainly PC) having characteristics not in compliance with the required specifications of IDS GeoRadar S.r.l. not expressly authorized by IDS GeoRadar S.r.l.;
 - f. Poor or faulty operation of the electrical and telecommunication networks not directly managed by IDS GeoRadar S.r.l. or its delegates.
 - g. Poor or faulty operation Software/Hardware of the third parties connected with IDS GeoRadar S.r.l. Equipment.
 - h. Poor or faulty operation of the Products due to Software Virus which infected the Products after their delivery.
 - i. Use of the Products which have encountered suspected manumissions, accidents, electrostatic shocks, flashes, fire, earthquake, flooding or other natural disasters or unexpected events.
- j. Use or storage of the Products outside the limits of the “Operational Temperature Range” specified by IDS GeoRadar S.r.l.

APPENDIX B TECHNICAL SPECIFICATIONS


C-thru	
SYSTEM SPECIFICATIONS	
Antenna Center Frequency	2.0 GHz
Maximum measured e.i.r.p. in air (Wi-Fi switched off)	0.042 mW
Number of Antennas	4
Antenna Polarization	Horizontal and Vertical
Number of Radar Channels	2
Scan Interval	Up to 10 scans/cm
Depth Range	Up to 80 cm (up to 31.5 in.)
Display modes	B-Scan and C-scan (radar tomography)
Positioning system	“Virtual Pad” (based on 3 High safety - Class 1 laser sensors with reflective bars)
AC Power Conduits Detection	EM sensor integrated (50/60 Hz)
Battery	Li-ion battery, 15V, 3.2Ah, 2-hour runtime
Data Storage	32 GB
Connectivity	USB, Wi-Fi
Wi-Fi Module	Frequency Range: 5.15GHz-5.85GHz* Output Power: about 4 mW (802.11ac / 5GHz protocol) Antenna gain: 4.9 dBi **Use subject to local regulations
ENVIRONMENTAL SPECIFICATIONS	
Operating Temperature	-20°C to +50°C (-4°F to +122°F)
Storage Temperature	-40°C to +60°C (-40°F to +140°F)
Environmental	IP65

MECHANICAL SPECIFICATIONS	
Dimensions (length x width x height)	285mm x 200mm x 160mm (11,2in x 8,6in x 6,3in)
Weight	2.4 kg (5 lb) with battery
Display	7.0 inches TFT multi-touch
SOFTWARE FEATURES	
C-thru software	<ul style="list-style-type: none"> • Quick start-up. • Real time radar data acquisition, processing and visualization in B-Scan. • Real time feature marking, management and editing tool. • Rebar/Void automatic discrimination. • VirtualPad - Positioning & navigation system. • Visualization of C-scan (radar tomography). • Real time diagnose of radar and the other devices. • Metric and imperial units.

C-thrue XS	
SYSTEM SPECIFICATIONS	
Sensor Frequency	2.0 GHz
Number of Antennas	4
Antenna Polarization	Horizontal and Vertical
Number of Radar Channels	2
Scan Interval	Up to 14 scans/cm
Depth Range	Up to 100 cm (up to 39.4 in.)
Display modes	B-Scan and C-scan (radar tomography)
Positioning system	Integrated wheel encoder
Connectivity	Ethernet to PC or C-thrue
Power	USB 3.0 or C-thrue
ENVIRONMENTAL SPECIFICATIONS	
Operating Temperature	-20°C to +50°C (-4°F to +122°F) - IEC 60068-2-1/IEC 60068-2-1
Storage Temperature	-40°C to +60°C (-40°F to +140°F)
Environmental	IP65- IEC 60529 / EN 60529
Rough Handling Shock	CEI EN 60068-2-64: 2012
Drop	1m (39.4 in.) - CEI EN 60068-2-31: 2011
MECHANICAL SPECIFICATIONS	
Dimensions (length x width x height)	145mm x 83mm x 80mm (5.7in x 3.2in x 3.1in)
Weight	0.450 kg (0.9 lb)
SOFTWARE FEATURES	
C-thrue software	<ul style="list-style-type: none"> Real time radar data acquisition, processing and visualization in B-Scan and C-Scan. Real time feature marking, management and editing tool.

	<ul style="list-style-type: none"> Rebar/Void automatic discrimination. Visualization of C-scan (radar tomography). Real time diagnoses of radar. Metric and imperial units. Available in more than 20 languages. Encoder Calibration.
ACCESSORIES SPECIFICATIONS	
C-thrue XS External Controller	Remote control and representation of results in Augmented Reality.
C-thrue XS Handle	<ul style="list-style-type: none"> Aluminum telescopic pole - 1.8 m (6 ft). Remote Control buttons

Exposure to Radio Frequency (RF) Signals:



The product is designed to be handheld and the minimum distance between the user and any radiating elements is about 100 mm.

SAR evaluation is not required because the output power value is less than exemption limit at such separation distance.

APPENDIX C C-THRUE / C-THRUE-XS CONFORMITY TO EUROPEAN REGULATION

CONFORMITY TO EUROPEAN REGULATIONS

The equipment conform to the following requirements set by EC regulations, including subsequent modifications, and to the legislation set by the member states that implement these regulations:

2014/053/EU Radio Directive

Warning: this equipment is destined for use in industrial environments (Class A apparatus). In residential, commercial and light industry environments, this apparatus may generate radio interference: in this case, the user may be required to operate while taking appropriate countermeasures.

The apparatus is sensitive to the presence of external electromagnetic fields, which may reduce its performance.

Receiver test according to EN 302 066 v. 2.1.1

The unit has been tested according to the provision of the EN 302 066 v. 2.1.0. Specifically, for the receiver test (that tests the influence of an interferer signal to the device), the following performance criterion has been used (see ETSI TS 103 361)
Performance criterion: The difference D between the Rx signal noise (increased by an interferer) and the maximum input signal for the Rx in the linear region of operation

Level of performance: $D_{min} > 30 \text{ dB}$



APPENDIX D IMPORTANT NOTICE FOR US CUSTOMERS

FCC ID: UFW-CTHRUE / FCC ID: UFW-CTHRUEXS

These devices comply with part 15 of the FCC Rules:

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

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.

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 47 U.S.C. § 301 and could subject the operator to serious legal penalties.

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 detailed operational areas to the FCC Office of Engineering and Technology who 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 of operation, and the FCC ID number and other nomenclature of the UWB device. This material shall be submitted to the following address:

*Frequency Coordination Branch., OET
Federal Communications Commission
445 12th Street, SW
Washington, D.C. 20554
ATTN: UWB Coordination*

(d) Users of authorized, coordinated UWB systems may transfer them to other qualified users and to different locations upon coordination of change of ownership or location to the FCC and coordination with existing authorized operations.

(e) The NTIA/FCC coordination report shall include any needed constraints that apply to day-to-day operations. Such constraints could specify prohibited areas of operations or areas located near authorized radio stations for which additional coordination is required before operation of the UWB equipment. If additional local coordination is required, a local coordination contact will be provided.

(f) The coordination of routine UWB operations shall not take longer than 15 business days from the receipt of the coordination request by NTIA. Special temporary operations may be handled with an expedited turn-around time when circumstances warrant. The operation of UWB systems in emergency situations involving the safety of life or property may occur without coordination provided a notification procedure, similar to that contained in CFR47 Section 2.405(a)-(e), is followed by the UWB equipment user.

Note:

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 instruction manual, 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.

Notice: Use of this device as a Through-wall imaging system system is prohibited by FCC regulations.

APPENDIX E IMPORTANT NOTICE FOR CANADIAN CUSTOMERS

Canadian Requirements of RSS-220 for Hand-held Antennas

IMPORTANT NOTE FOR THE CANADIAN CUSTOMERS

IC: 8991A-CTHRUE / IC: 8991A-CTHRUEXS

This device complies with the requirements of IC Standard RSS-220

This In-wall Radar Imaging Device shall be operated where the device is directed at the wall and in contact with or within 20 cm of the wall surface.

This In-wall Radar Imaging Device shall be operated only by law enforcement agencies, scientific research institutes, commercial mining companies, construction companies, and emergency rescue or firefighting organizations.

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

NOTE IMPORTANTE POUR LES UTILISATEURS CANADIENS

IC: 8991A-CTHRUE / IC: 8991A-CTHRUEXS

Cet appareil est conforme aux exigences de la norme RSS IC-220

Cet appareil de radar de structure (murs, poutres, dalles...) ne doit être utilisé qu'en contact avec la structure ou à 20 cm maximum décollé de cette structure.

Cet appareil de radar de sol ne doit être utilisé que par les forces de l'ordre, les instituts de recherche scientifiques, les sociétés minières, les sociétés de construction, et les organisations de secours d'urgence ou de combat du feu.

Cet appareil contient des émetteurs/récepteurs sans licence qui sont conformes aux RSS sans licence d'Innovation, Sciences et Développement économique Canada. Son fonctionnement est soumis aux deux conditions suivantes : Cet appareil ne doit pas provoquer d'interférences. Cet appareil doit accepter toute interférence, y compris les interférences susceptibles de provoquer un fonctionnement indésirable de l'appareil.

CANADIAN REPRESENTATIVE

Company Name : Leica Geosystems Ltd

CN Number : 3177B

Contact Name : Dwayne Louviere

City : SCARBOROUGH, Ontario M1W3S2

Telephone No : +1 416 497 2463

Email : dwayne.louviere@leicaus.com

Canadian Requirements of RSS-220 for Ground Antennas

IMPORTANT NOTE FOR THE CANADIAN CUSTOMERS

IC: 8991A-CTHRUE / IC: 8991A-CTHRUEXS

This device complies with the requirements of IC Standard RSS-220

This Ground Penetrating Radar Device shall be operated only when in contact with or within 1 m of the ground.

This Ground Penetrating Radar Device shall be operated only by law enforcement agencies, scientific research institutes, commercial mining companies, construction companies, and emergency rescue or firefighting organizations.

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

NOTE IMPORTANTE POUR LES UTILISATEURS CANADIENS

IC: 8991A-CTHRUE / IC: 8991A-CTHRUEXS

Cet appareil est conforme aux exigences de la norme RSS IC-220

Cet équipement géoradar doit être utilisé que lorsqu'il est en contact ou à moins de 1 mètre du sol.

Cet équipement géoradar doit être utilisé que par des organismes d'application de la loi, des instituts de recherche scientifique, des sociétés minières commerciales, des

entreprises de construction et de secours d'urgence ou les organisations de lutte contre les incendies.

Cet appareil contient des émetteurs/récepteurs sans licence qui sont conformes aux RSS sans licence d'Innovation, Sciences et Développement économique Canada. Son fonctionnement est soumis aux deux conditions suivantes : Cet appareil ne doit pas provoquer d'interférences. Cet appareil doit accepter toute interférence, y compris les interférences susceptibles de provoquer un fonctionnement indésirable de l'appareil

APPENDIX F OPENSOURCE LIBRARY


C-thrue Remote Desktop SW makes use of the following Open Source libraries

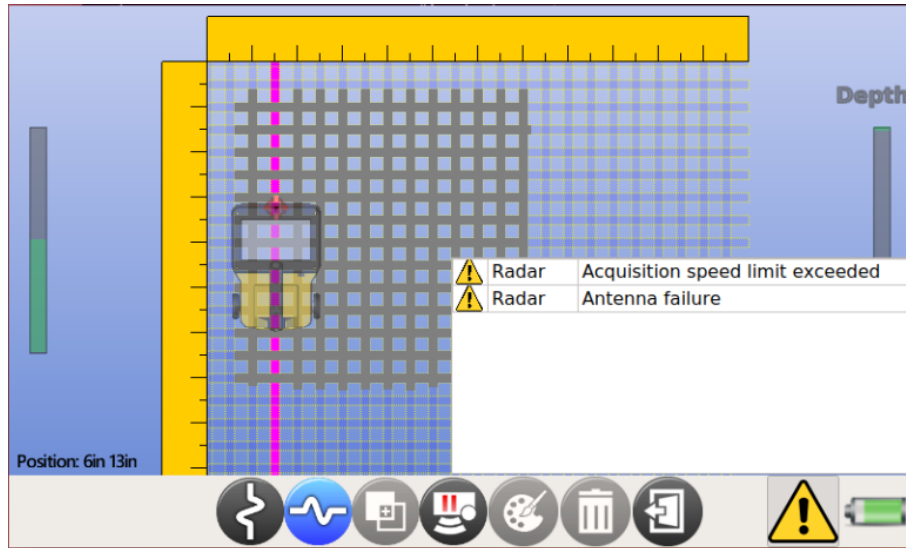
- ***libusb-1.0.22***
- ***qt-everywhere-opensource-src-5.9.0***

Source codes are available at the following web page <https://idsgeoradar.com/about-us/compliance-standards/open%20source%20data> . If User wishes to amend the above-mentioned libraries, User has to produce new binary files and copy them in the installation software path.


APPENDIX G TROUBLESHOOTING


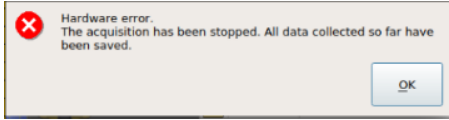






If an error or malfunction occurs, a pop-up icon, in the bottom right of the

touchscreen, will appear . Clicking on the icon, the user can visualize the error/warning message:



Here below the list of possible messages, and applicable troubleshooting:

System's part	Error message	How the error is showed	Troubleshooting
Radar	Acquisition speed limit exceeded	 Radar Acquisition speed limit exceeded	The user has moved the radar too fast. Please go slowly

Radar	Antenna failure	 Radar Antenna failure  	One of the antenna is not working. Switch off and on the system. If the error persist, please contact IDSGeoRadar Customer Care service
Laser	Positioning system error	 LaserT... Positioning system error 	The user should turn off and on the system; if the problem persists contact the IDS GeoRadar customer care.
Battery	Low battery	 Low battery Shutting down... OK  Low battery Please shutdown the system and replace the battery OK 	Please recharge the battery. In case the error persists after the charging, a replacement of the battery is necessary.

APPENDIX H CONTACTS

The IDS GeoRadar Support team is available to answer any question about:

- general enquiries
- request of advertising material
- technical issues
- As well as listening to your suggestions too.

Please, feel free to contact us at:



IDS GeoRadar S.r.l.

via Augusto Righi, 6/6A/8
Ospedaletto - 56121
Pisa, Italy



(39) 050 8934 122



(*GEO BU* Customer Technical Support)
support.geo@idsgeoradar.com