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OPERA DUO



***OPERA
DUO
v. 1.0 – User
Manual***

Pisa, February, 2014

KEYWORDS

GEORADAR, OPERA DUO, ANTENNA, RADAR MAP

SUMMARY

This manual contains a complete description of the Opera Duo radar system, detailing the assembly procedure, the correct use of the data acquisition software, the field work procedure and the general operating procedures of the system.

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Rev. 1.0

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(to be partially filled in by IDS, sent to Distributor/Customer and returned to IDS duly completed as indicated)		
	To be filled in by	References and dates
Distributor Purchase Order (if applicable)	IDS	
End Customer Purchase Order (if available)	Distributor/IDS	
Delivery Date certified by IDS	IDS	
Effective Date certified for Warranty (*)	Distributor/End Customer	

Distributor Name (if applicable)	IDS	
End Customer Name and full address	Distributor/IDS	
End Customer Representative (Name, Phone, Fax, e-mail address)	End Customer	
IDS seal and signature		
Distributor seal and signature (if applicable)		
End Customer seal and signature		

List of Products purchased and test certificate to be filled in by IDS (if the lines are not enough, please use additional sheet)

Order line item	Description	Q.ty	S/N	System Summary	Test Certificate date and reference to internal test report(**)

(*) In case the Customer/Distributor does not return the Warranty Registration Form duly filled in and signed to IDS the effective warranty date shall start 10 (ten) days after the delivery date as certified by IDS and written in the above form.

(**) By inserting a date in this field, IDS certifies that the item has been checked and calibrated as per IDS standard procedures and the item meets or exceeds all test specifications. The location of tests is Pisa – Italy.



CLEANING INFORMATION

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

The Opera Duo should be cleaned periodically using a damp cloth.

Do not use solvents or abrasive detergents.

Do not apply liquid directly to the electrical contacts of the various connectors. If a specific spray is used to clean the PC TFT 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.



BATTERIES REMOVAL INFORMATION

Laptop Batteries (X2):

Type: Li-ion

Characteristics: 7.2 V 3.4 Ah

Removal instructions:

1. Open the drawer with the symbol of the batteries;
2. Extract the battery pack pulling the tab.

Radar batteries:

Manufacturer: FIAMM FG21202 / SAFT MP176065

Type: Rechargeable lead acid / rechargeable lithium-ion

Characteristics: 12V & 12Ah / 15V & 6.8Ah

Removal instructions:

1. Disconnect the battery from the instrument:
 - a. pull the connector wings;
 - b. separate the connectors;
2. Remove the battery from the cover (optional) opening the strap.



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. When you decide to dispose of the equipment, contact IDS and follow the system that IDS has set up to permit the separate collection of the apparatus at its life end.

Adequate separate collection for its subsequent recycling, treatment and environmental friendly disposal contribute 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.

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1. INTRODUCTION

1.1 Purpose

This manual explains how to use an Opera Duo system.

1.2 Application Field

This system is dedicated to underground utilities localization and mapping and it is used for applications in the civil engineering field.

1.3 Trademarks

Windows 7 and Windows 8 are owned by the Microsoft Corporation.

Google is owned by Google Inc.

1.4 Reference

The applicable versions of the following documents are the ones officially released at the time of the emission of the present document.

1.4.1 Regulations

CONFORMITY TO EUROPEAN REGULATIONS

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

1999/05/EEC 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.



IMPORTANT NOTE FOR THE US CUSTOMERS

FCC ID: UFW-OPERADUO

This device complies 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.

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

IMPORTANT NOTE FOR THE CANADIAN CUSTOMERS

IC Certification Number: IC:8991A – OPERADUO

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.

NOTE IMPORTANTE POUR LES UTILISATEURS CANADIENS

Numéro de certification IC:8991A – OPERADUO

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.

RADIO-FREQUENCY EXPOSURE COMPLIANCE

This product operated is usually operated at least 1 m from the operator.

Typical power density levels at a distance of 1 m or greater is below $1 \mu\text{W}/\text{cm}^2$ ($0.01 \text{ W}/\text{m}^2$) which are far below the levels specified by the current regulations.

Thus, this product pose no health and safety risk when operated in the normal manner of intended use.

CONFORMITÉ D'EXPOSITION AUX FRÉQUENCES RADIO

Le produit doit être à au moins un mètre de l'utilisateur lorsqu'en opération.

Le niveau de densité de puissance à une distance de 1 mètre et plus est de $1 \mu\text{W}/\text{cm}^2$ ($0.01 \text{ W}/\text{m}^2$), ce qui est nettement inférieur aux niveaux spécifiés par la réglementation en vigueur.

Ainsi, ce produit ne représente aucun risque pour la santé et la sécurité lorsqu'il est exploité dans les conditions d'utilisation prescrites.

1.5 Acronyms and Definitions

1.5.1 Acronyms

DAD: Digital Antenna Device

RADAR: RAdio Detection And Ranging

1.5.2 Definitions

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 a large investigation: typically an entire town or a large urban area.

Scan: a single movement of the antenna trolley 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.

Utilities: the objects the Detector Duo searches for, i.e. pipes supplying gas and water, electricity cables, etc.

2. OVERVIEW

2.1 Contents

This manual is divided into the following sections:

Chap. 1: Introduction.

Chap. 2: Overview.

Chap. 3: Hardware description.

Chap. 4: System assembly procedure.

Chap. 5: Software description.

Chap. 6: Preliminary site investigation.

Chap. 7: Working procedure.

Chap.8: GPS requirements.

Chap 9: On-line assistance.

2.2 Intended readership

The intended reader of this manual should be the technician in charge of using the system that has undergone the IDS training for Opera Duo.

3. OPERA DUO HARDWARE DESCRIPTION

The Opera Duo system is composed by the following parts:

- Opera Duo main body
- Laptop (with the Opera Duo software)
- Battery
- Battery charger
- Spray support (optional)
- GPS support (optional)

This chapter contains the description of those parts.

3.1 Opera Duo main body

The main body of the system consists of a trolley, foldable for easy transportation, available in two forms: 2 or 4 wheeled; it contains the following sub-components:

- Antenna
- Control unit
- Encoders
- Handle
- Wheels
- Laptop support

3.1.1 Antenna

The Opera Duo has a dual-frequency antenna, 250 and 700 MHz.

The 700 MHz antenna permits the user to see small shallow targets, up to a depth 2-3 meters depending on the soil conditions.

The 250 MHz antenna permits the user to see bigger targets situated deeper underground (up to 4-5 meters).

3.1.2 Control unit

The Control Unit, or DAD, is the central part of the system because it communicates with the antenna, the laptop and the encoder, making all the systems work together.

The DAD is lodged in the antenna box and has a power button on top of it to turn it on/off (see Fig. 3.1).

The characteristics of the Control Unit are:

Voltage: 12 V +/- 10%

Environment feature: IP 65

Absorbed power: 8 W

Operating temperature: -10/+40 °C



Fig. 3.1 – DAD power button

3.1.3 Encoders

The Opera Duo employs two encoders for acquisition distance measuring, each one is positioned inside one of the wheels.

This feature ensures that the distance is correctly registered even in rough terrain when, at times, only one wheel is touching the ground.

3.1.4 Handle

The Opera Duo handle is an ergonomic and adjustable handle bar (Fig. 3.2) that can be adjusted both in height and inclination (see paragraph 4.1).



Fig. 3.2 – Opera Duo handle

The Laptop support is mounted on the Handle bar (see paragraph 3.1.6).

The Handle bar also contains the Ethernet cable that goes to the laptop (Fig. 3.3).



Fig. 3.3 – Ethernet cable plug on the handle

3.1.5 Wheels

The Opera Duo comes in 2 and 4 wheeled versions (Fig. 3.4); the 2 wheeled version has tubeless tires while the 4 wheeled version has 2 tubeless tires in the rear and 2 solid tires in the front.

The tubeless tires have to be inflated to a pressure of 2 bars.



Fig. 3.4 – Two and four wheeled versions of the Opera Duo

3.1.6 Laptop support

The inclination of the Laptop support can be adjusted to achieve the best viewing angle for the user (Fig. 3.5).



Fig. 3.5 – Laptop support

3.2 Laptop

The system can be provided with a laptop Panasonic CF-H2 (see Fig. 3.6), with the software already installed; however the user can operate Opera Duo with any laptop respecting the following recommended requirements:

Processor: i5 1.7 GHz

RAM: 2 GB Screen resolution: 1024 X 768

Operative system: Windows 7 or Windows 8

Hard disk: 40 Gb shock-proof

Serial port RS 232 (only used with the GPS)

USB port

Ethernet port



Fig. 3.6 – Panasonic CF-H2

3.3 Battery

The battery used by an Opera Duo system provides power to the Control Unit and, from there, to the Antenna, the Encoder and, if present, the Spray support; the battery does not provide power to the laptop or the GPS, if present.

The Opera Duo battery is a 12 V / 12 AH rechargeable lead battery (see Fig. 3.7).



Fig. 3.7 – Opera Duo battery

3.4 Battery charger

The battery charger is composed of two parts: a small cable to connect the battery to the charger and the battery charger itself, to be connected to the electricity mains at AC 110/220 (see Fig. 3.8).



Fig. 3.8 – Battery charger

The battery can be charged whilst connected to the system or after having been removed. Note that, in either case, the radar cannot be turned on during the battery charging.

3.5 Spray support

The Spray support can be easily attached to the radar main body and contains a cable to be connected to a socket in the upper part of the antenna lodging (see Fig. 3.9).



Fig. 3.9 – Spray support

The support must be used with a vertical spray spot marker (see Fig. 3.10).



Fig. 3.10 – Example of vertical spray spot marker

The Spray support is provided with a storage bag that can also contain an additional spray can (see Fig. 3.11).



Fig. 3.11 – Spray support storage bag

3.6 GPS support

The GPS support is composed of two parts that have to be mounted on the radar main body and holds the GPS pole (see Fig. 3.12).



Fig. 3.12 – GPS Support in the storage bag

4. ASSEMBLY PROCEDURE

The procedure to assemble the Opera Duo is very simple and can be performed by one person.

To assemble the system follow these steps:

1. Unfold the radar main body (paragraph 4.1);
2. Connect the laptop (paragraph 4.2);
3. Insert the battery (paragraph 4.3);
4. Mount the Spray support (optional, paragraph 4.4);
5. Mount the GPS support (optional, paragraph 4.5).

4.1 Unfold the radar main body

To unfold the Opera Duo main body place it to on the ground, press the central handle button and raise the rudder to the desired angle (Fig. 4.1).



Fig. 4.1 – Unfold the Opera Duo

The user can also adjust the height of the handle bars and laptop support using the two vertical buttons in the upper part of the rudder (Fig. 4.2).

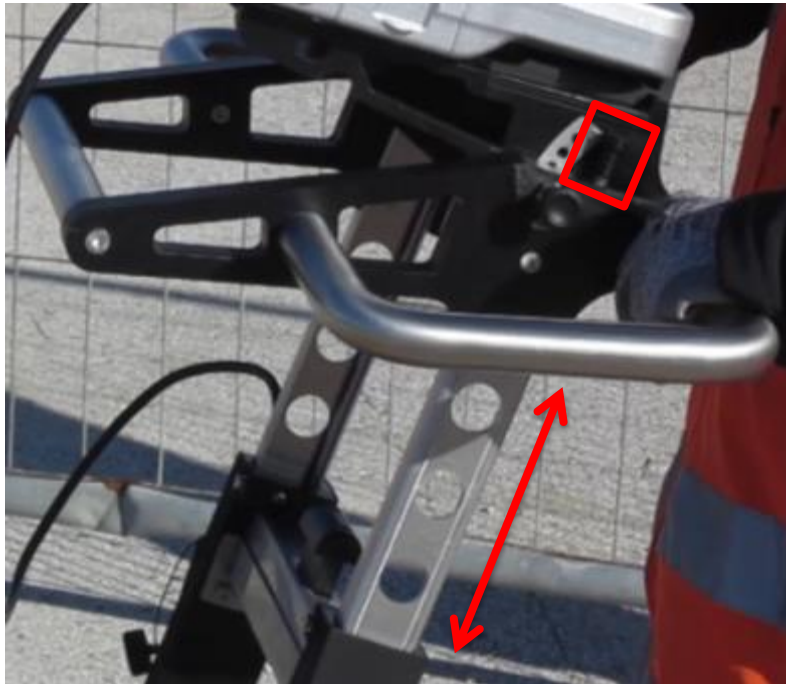


Fig. 4.2 – Handle bar and laptop support height regulation buttons

The inclination of the laptop support can be changed opening the two horizontal locks on its sides (Fig. 4.3).



Fig. 4.3 – Laptop support inclination regulation

In the 2 wheeled version, the antenna movement has to be unlocked by putting the front lever in the left position (Fig. 4.4); if the lever is in the central position the antenna will have limited mobility, useful for rough terrain; while the right position is used for the transportation of the folded system.



Fig. 4.4 – Antenna locking lever for two wheeled version

In the 4 wheeled version, the antenna can be slightly raised from the ground by pulling the strap shown in Fig. 4.5.



Fig. 4.5 – Antenna height regulation

4.2 Connect the laptop

The laptop support on the radar main body is complete with Velcro strips; to attach the laptop to the support press down until the Velcro strips on the support are securely attached to the Velcro strips on the laptop (see Fig. 4.6).



Fig. 4.6 – Velcro strips on the Laptop and Laptop support

The CF-H2 laptop provided with the radar already has the Velcro strips attached; if another laptop is used instead, the user should attach the Velcro strips (provided with the radar) to this laptop.

Once the laptop is in place the user must connect the Ethernet cable (Fig. 4.7).



Fig. 4.7 – Ethernet connection

4.3 Insert the battery

To connect the battery open the dedicated compartment by turning and pulling the metallic ring (Fig. 4.8), slide the battery inside with the plastic connector facing the front of the radar (Fig. 4.9) and then close the compartment.



Fig. 4.8 – Battery compartment



Fig. 4.9 – Battery connection

4.4 Mount the Spray support

The Spray support is an optional component to hold and command the spray to mark targets on the ground.

It can be mounted on either side of the antenna, following these steps:

1. Open the locks in the lower part of the spray support (Fig. 4.10);



Fig. 4.10 – Spray support locks

2. Fix the spray support to the radar main body, inserting first the upper part and then the lower (Fig. 4.11);



Fig. 4.11 – Spray support fixing

3. Close the locking system in the lower part of the spray support;
4. Connect the Spray cable to the dedicated connector (Fig. 4.12);
5. Insert the spray can into the support with the dispenser facing downward (**Error! eference source not found.**).



Fig. 4.12 – Spray support cable connection



Fig. 4.13 – Spray can insertion

4.5 Mount the GPS support

The GPS support is composed of two metallic parts whose purpose is to hold the GPS pole. This pole is not provided with the radar.

To mount the GPS support follow these steps:

1. Insert the upper part of the support into the two dedicated holes (Fig. 4.14);



Fig. 4.14 – GPS support upper part insertion

2. Screw the lower part to the Opera Duo main body using the two knobs, in this way the two parts will be fixed together (Fig. 4.15).



Fig. 4.15 – GPS support lower part fixing

4.6 Encoder calibration

The first time the system is used the metric wheels have to be calibrated; this operation can also be repeated every time a difference between real and measured distance is noted.

First the user should inflate the tires to a pressure of 2 bars, then proceed with the wheel calibration using the proper software tool (see paragraph **Error! Reference source not found.**).