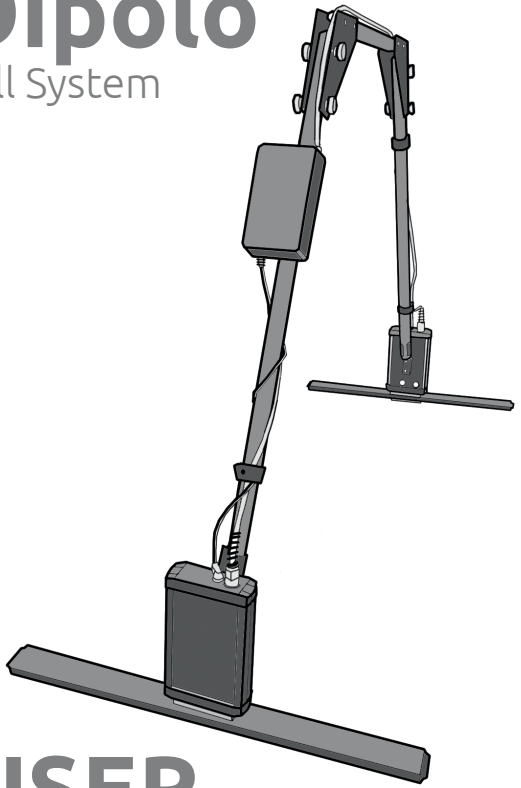
Dipolo

Full System



USER MANUAL

Ground Penetrating Radar

oerad

Safety Information

Thank you for purchasing this Oerad equipment. Please read this User Manual carefully before connecting, operating or adjusting this product.
Electromagnetic radiation from GPR systems manufactured by Oerad Tech Ltd do not constitute a safety or health hazard under normal operating conditions.

WARNING

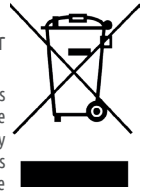
To reduce the risk of fire or annoying interference use only the recommended accessories and do not disassemble this product's modules. There are no user serviceable parts inside.

CAUTION

Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended by the manufacturer. Dispose of batteries according to the manufacturer's instructions.

Information on Disposal

For private households: Information on Disposal for Users of WEEE



This symbol on the product and/or accompanying documents means that used electrical and electronic equipment (WEEE) should not be mixed with general household waste. For proper treatment, recovery and recycling, please take this product to designated collection points where it will be collected free of charge. Alternatively, in some countries, you may be able to return your product to your local retailer upon purchase of an equivalent new product.
Disposing of this product correctly will help save valuable resources and prevent any potential negative effects on human health and the environment, which could otherwise arise from inappropriate waste handling.
Please contact your local authority for further details of your nearest designated collection point.
Penalties may be applicable for incorrect disposal of this waste, in accordance with your national legislation.

For professional users in the EU

If you wish to discard electrical and electronic equipment (EEE), please contact your dealer or supplier for further information.

For disposal in countries outside of the EU

This symbol is only valid in the European Union. If you wish to discard this product please contact your local authority or dealer and ask for the correct method of disposal.

Please note that the actual controls and components, menu items, etc. of your Ground Penetrating Radar may look somewhat different from those shown in the illustrations in this User Manual.

What Dipolo is

The Dipolo is an Ultra-Wideband (UWB) pulsed dipole Ground Probing Radar (GPR) for non-destructive imaging of subsurface structures. It comprises of a transmitter and receiver boards and antennae and a controller board. The Dipolo is designed and manufactured by Oerad Ltd.

What Dipolo is used for

The Dipolo has a wide variety of usages including but not limited to non-destructive archaeological surveys, underground water detection, road inspection, rock composition determination, cavities localization, ice thickness determination, geophysical research of underground layers, etc. It is designed to withstand the harsh conditions of outdoor surveys.

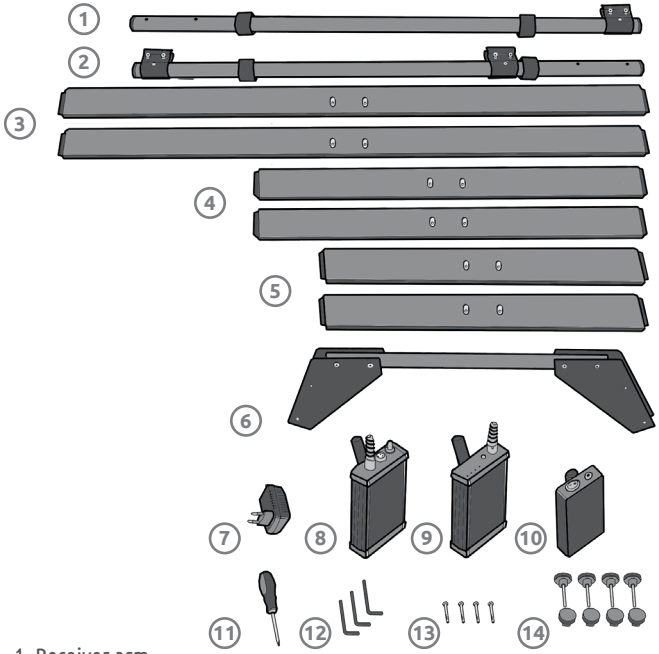
This user manual contains the following sections:

Contents

Technical Specifications

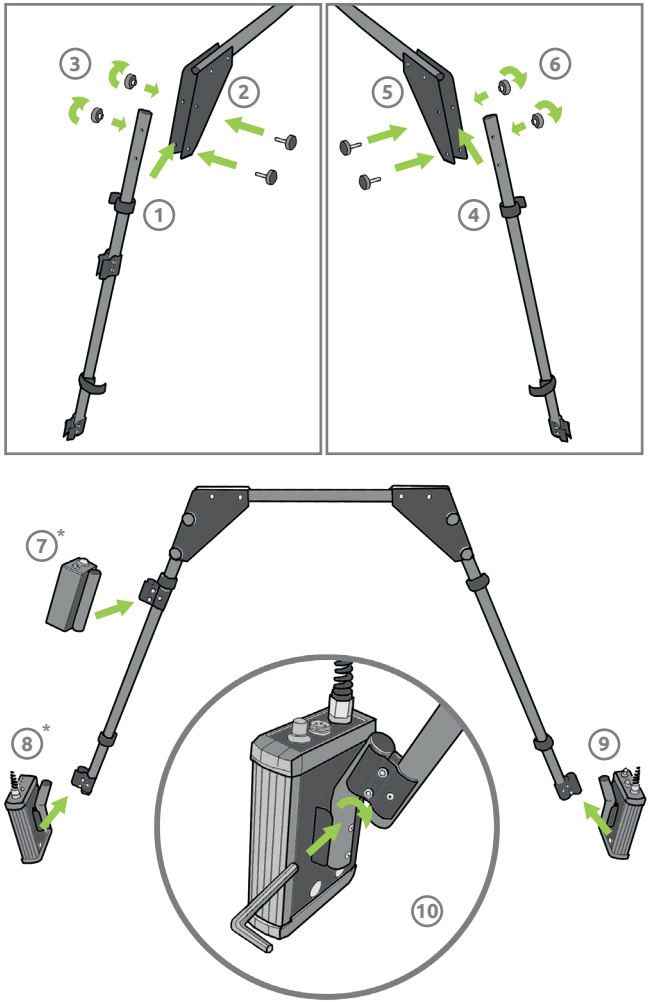
	100Mhz	300Mhz	500Mhz
Frequency Bandwidth	10MHz - 500MHz	10MHz - 500MHz	30MHz - 800MHz
Central Frequency	100 MHz	300 MHz	500 MHz
Vertical Resolution	0.5 m	0.3 m	0.2 m
Horizontal Resolution	0.5 m	0.3 m	0.2 m
Weight	2.5 kg	2.5 kg	2.5 kg
Size	75x110x78 cm	75x110x35 cm	75x110x25 cm
Pulse Length	10 ns	2.5 ns	2 ns
Pulse Rise Time	2 ns	2 ns	1.5 ns

Operating Time Windows	75 ns / 150 ns
Dynamic Range	120 dB min
Pulse Repetion Frequency	75 kHz
Pulse Voltage	600 V
Average Tx Power	800 W
Power Consumption	270 mAh
Batteries	10/20 x 2.4Ah NiMH 1.2 V
Autonomy with One Charge	7h / 14h
Charge Time	5h / 10h
ADC Range	8 bits
Data Acquisition Rate	18.2 traces/second
Samples Per Trace	585
GPR Interface	UART over USB
Operating Temperature Range	- 5º C to 40º C
Water Resistance	IP 52

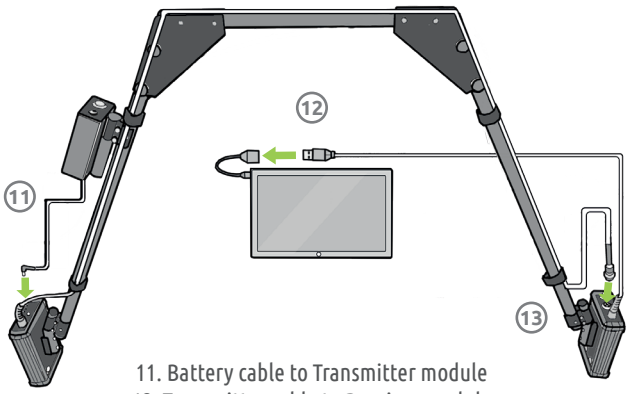


1. Receiver arm
2. Transmitter and battery arm
3. 2 x 100MHz antennas
4. 2 x 300MHz antennas
5. 2 x 500MHz antennas
6. Main frame
7. Battery charger
8. Receiver module
9. Transmitter module
10. Battery module (Ni-MH 2.4Ah)
11. Assembly tools - turnscrew
12. Assembly tools - hex keys
13. 4 x stainless steel bolts
14. 4 x bolts with caps

Assembly

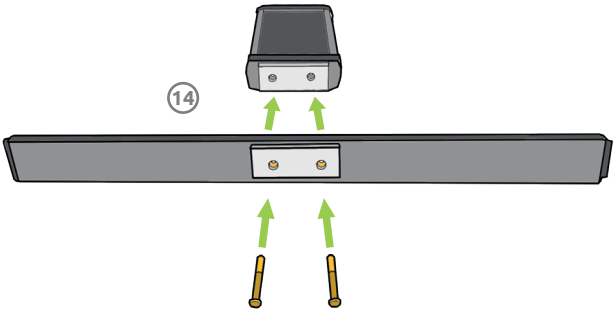


* Transmitter & Battery module must be placed on the same arm



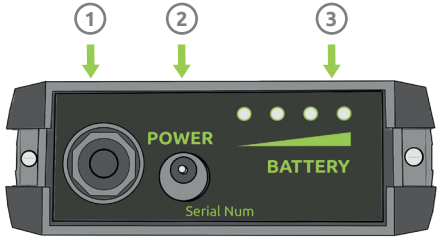
11. Battery cable to Transmitter module
12. Transmitter cable to Receiver module
13. Receiver cable to USB OTG to PC/tablet

• Velcro holders on the Dipolo arms help secure the cables' position

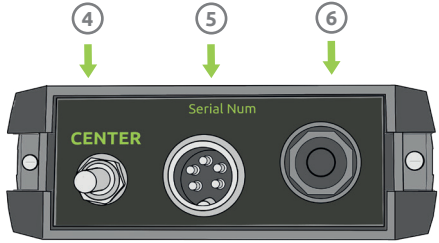


14. Attach antennas to the bottom of the Receiver & Transmitter modules. Make sure the bronze side of the antenna connectors are facing down.

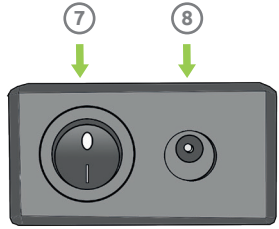
Hardware Inteface



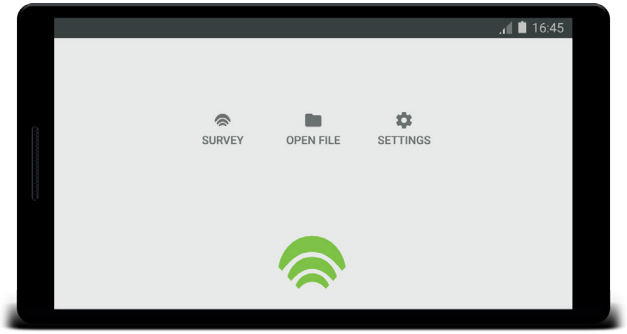
1. Transmitter data cable - connects to Receiver module
2. Socket for battery pack cable
3. Battery indicator



4. Wave centre toggle
5. Socket for transmitter data cable
6. Receiver USB data cable - connects to PC/tablet



7. Power switch - turns GPR on/off
8. Battery charger socket



General Information

- Make sure all cables are securely connecting the GPR and the tablet.
- Grant all permissions to Oerad App via your Android's 'Settings > Applications > Oerad > Permissions' menu.
- In order to avoid battery drainage and unnecessary signal transmission, turn off your GPR and disconnect it from your tablet when finished surveying.
- For further details on technical specification requirements, how to download, install and configure the Oerad App, please refer to the app's user manual available at https://oerad.eu .

Operating Modes

- Survey

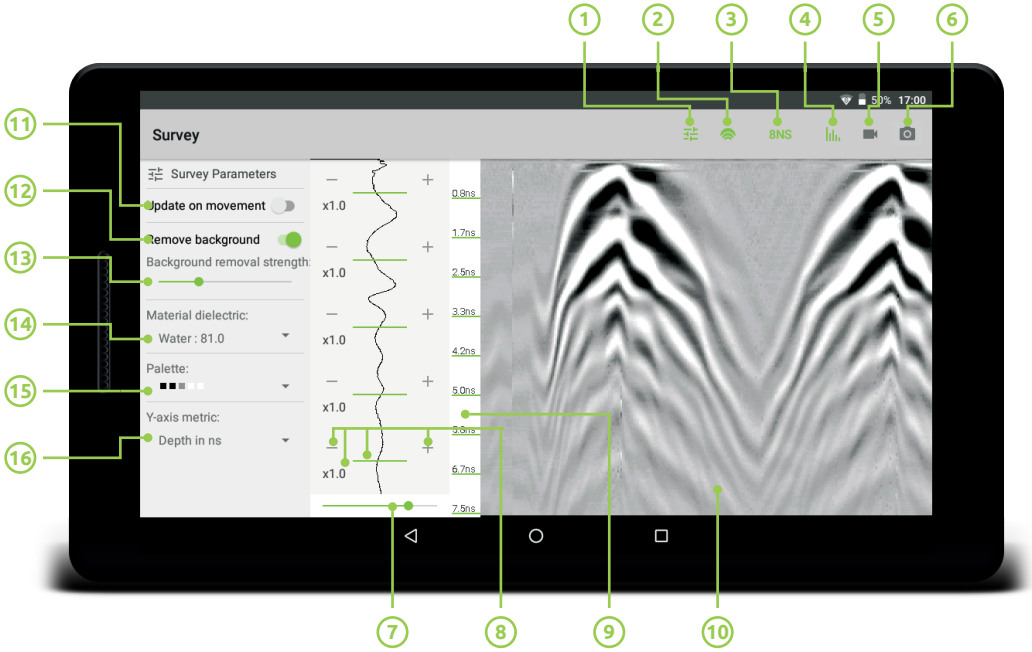
Visualize and filter survey data in real time. Record surveys & take screenshots.

- Open File

View recorded files and apply filters to file data.

- Settings

Recording options. Set radar as Dipole and choose your preferred distance measurement units. Manage dielectric constants.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14
15
16
7
8
9
10
Survey
50% 17:00
8NS
Survey Parameters
pdate on movement
emove background
Background removal strength:
Material dielectric:
Water : 81.0
Palette:
Y-axis metric:
Depth in ns
x1.0
x1.0
x1.0
x1.0
0.8ns
1.7ns
2.5ns
3.3ns
4.2ns
5.0ns
5.8ns
6.7ns
7.5ns

1. Survey parameters toggle - open / close the parameters menu on the left.

2. Pause / Resume survey.

3. Time window toggle - toggles between the GPR short and long operational time windows.

4. Apply background removal filter. It is recommended to have this filter on.

5. Record a SEG-Y or ERAD file for later viewing.

6. Take a screenshot of the current scene, saved as JPEG.

7. Hardware gain controller at five levels. Used to amplify the signal when the material does not allow good signal penetration.

8. Software gain control at five zones of the wave. Allows amplifying the signal locally at points of interest and reducing the signal strength elsewhere to reduce noise. **-**: reduce amplitude; **+**: amplify signal; **x1.0**: amplification factor; **green bar**: amplification factor.

9. Y-Axis showing penetration depth expressed in nanoseconds or meters/feet.

10. Radargram streaming live data from the GPR. Double tap anywhere on it to pause/resume surveying.

11. Update radargram on movement is only applicable to devices supporting a distance measuring wheel.

12. Apply Background removal filter. It is recommended to have this filter on.

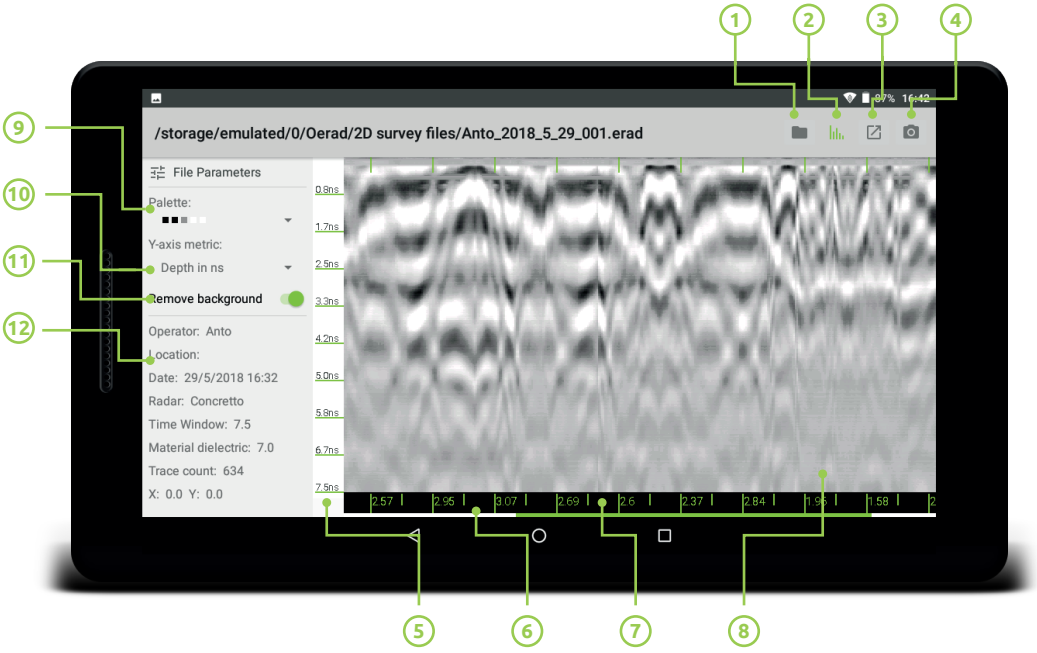
13. Background removal strength toggle. It is recommended to have it set higher when moving slower or over greater distances.

14. Material dielectric helps calculate the penetration depth based on the surveyed material.

15. Change palettes to optimize anomaly detection.

16. Switch between nanoseconds or meters/feet as penetration depth measurement units.

Read File


1
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9
10
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/storage/emulated/0/Oerad/2D survey files/Anto_2018_5_29_001.erad
File Parameters
Palette:
Y-axis metric:
Depth in ns
Remove background
Operator: Anto
Location:
Date: 29/5/2018 16:32
Radar: Concretto
Time Window: 7.5
Material dielectric: 7.0
Trace count: 634
X: 0.0 Y: 0.0
0.8ns
1.7ns
2.5ns
3.3ns
4.2ns
5.0ns
5.8ns
6.7ns
7.5ns
2.57
2.95
3.07
2.69
2.6
2.37
2.84
1.95
1.58
5
6
7
8

1. Open new file. Files generated by Oerad are usually located in main storage in folder Oerad.

2. Apply background removal filter. It is recommended to view files with this feature turned on.

3. Export file to SEG-Y file format.

4. Take a screenshot of the current scene, saved as JPEG.

5. Y-Axis showing penetration depth of the recorded file in ns or in meters/feet.

6. Progress bar showing your current position within the file.

7. X-axis showing distance data when files are recorded with a distance measuring wheel. This feature is not yet available to Dipolo systems.

8. Radargram of the recorded sounding data. Tap and swipe right to navigate to the end of the file. Tap and swipe left to navigate to the beginning of the file.

9. Change palette of displayed file.

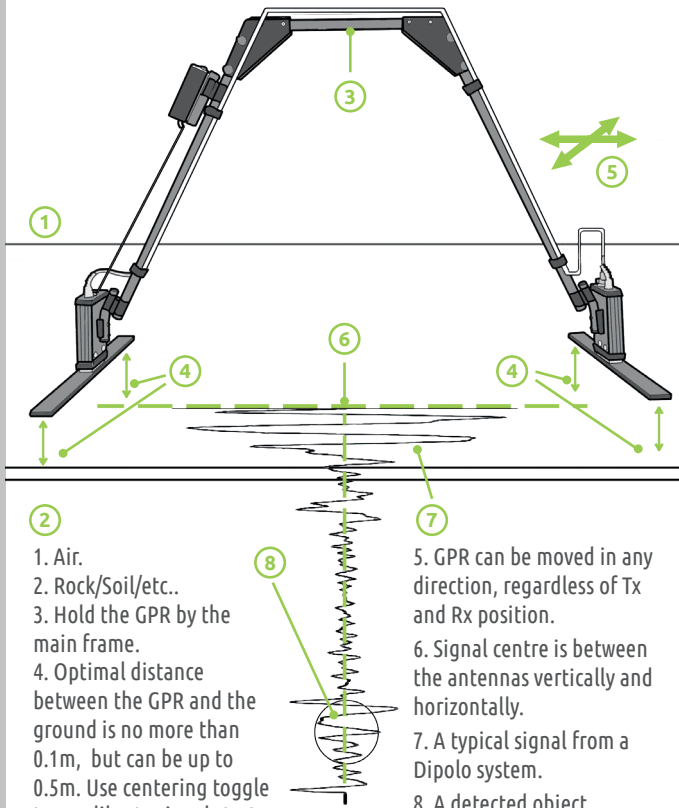
10. Change the penetration depth measurement unit displayed in the Y-axis.

11. Apply Background removal filter. It is recommended to view files with this feature turned on.

12. General information about recorded file. Includes: Operator, Location, Date of record; Dielectric constant of surveyed material; Device used for surveying; Time window at time of survey; Trace count in file; X & Y for files recorded with a distance measuring device.

Read File

Working Conditions



1. Air.
2. Rock/Soil/etc..
3. Hold the GPR by the main frame.
4. Optimal distance between the GPR and the ground is no more than 0.1m, but can be up to 0.5m. Use centering toggle to recalibrate signal start.

5. GPR can be moved in any direction, regardless of Tx and Rx position.
6. Signal centre is between the antennas vertically and horizontally.
7. A typical signal from a Dipolo system.
8. A detected object.

- Objects such as cellular towers, power lines or other EM wave emitting devices may cause interferences in the signal. This may result in radargram deterioration.
- Because of the emission pattern of the dipole antennas, trees,buildings or other big structures may be detected.
- Humidity in a material has a direct impact on penetration depth.

GPR Glossary

Hz - Hertz, measurement unit for frequency.

Radio Wave - Electromagnetic wave with frequency ranging from 30Hz to 300GHz. For GPR from 10MHz up to 3GHz.

Radar - A system that uses radio waves to detect objects. Main components & signal flow: Transmitter ->Transmission antenna -> Receiver Antenna -> Receiver data processor.

Frequency Bandwidth - The spectrum of the radar's transmitted radio waves' frequencies.

Central Frequency - Trasmitted waves at peak power (usually the centre of the frequency spectrum).

UWB - Ultra Wide Band radar that transmits over a frequency bandwidth > 500MHz.

GPR & Time-domain GPR - State-of-the-art high resolution radar with low power consumption.

Survey Sounding - The act of using GPR technology for object detection/determination.

Radargram - Image produced by a radar.

SEG-Y - General purpose file format for recording geophysical data from 1973.

ERAD - Oerad's open radar format optimized for small data storage.

Time Window - Operational window of the receiver antenna.

Penetration Depth - Theoretical maximum depth achieved during a given time window and a material's dielectric constant.

Dielectric Constant - Measure of a material's ability to store electrical energy in an electric field.

Attenuation - Reduction in GPR signal amplitude caused by energy dissipation in a material.

Dynamic Range - Ratio b/n the max amplitude signal recordable by GPR and its noise floor.

GPR Trace - Sequence of sample points collected by the receiver that indicate time variation of the amplitude of the recorded signal (in a given time window).

Resolution - Smallest detectable difference/object in a surveyed material/soil/wall.

Gain - Signal amplification.

Background Removal - Adaptive cancellation of the effects of a surveyed material.

DC Drift - Low frequency noise causing the signal to drift from the centre line.

Pulse - Energy packet emitted from the transmitter antenna. Its properties are length, power and rise time - a measurement of how fast a pulse achieves peak power.

Dielectrics Cheat Sheet

Material	Dielectric Constant	Max Depth at 75ns in meters	Max Depth at 150ns in meters
"Average soil"	16	2.81	5.63
Agricultural Land	15	2.90	5.81
Air	1	11.25	22.50
Asphalt	3 - 5	6.49 - 5.03	12.99 - 10.06
Basalt (wet)	8	3.98	7.95
Clay (dry)	3	6.50	12.99
Clay (wet)	8 - 15	3.97 - 2.90	7.95 - 5.81
Coal	4 - 5	5.62 - 5.03	11.25 - 10.06
Coastal sand (dry)	10	3.56	7.12
Concrete	6 - 8	4.59 - 3.98	9.19 - 7.95
Dolomite	6.8 - 8	4.31 - 3.98	8.63 - 7.95
Glass	5 - 10	5.03 - 3.56	10.06 - 7.12
Granite	5 - 8	5.03 - 3.98	10.06 - 7.95
Limestone	7 - 9	4.25 - 3.75	8.50 - 7.50
Marsh	12	3.25	6.50
Pastoral Land	13	3.12	6.24
Plexiglass	3.4	6.10	12.20
Polar Snow	1.4 - 3	9.50 - 6.50	19.02 - 12.99
Polyethylene	2.25	7.50	15.00
Pure Ice	3.2	6.29	12.58
PVC	3	6.50	12.99
Quartz	4.3	5.43	10.85
Sand (dry)	3 - 6	6.50 - 4.59	12.99 - 9.19
Sand (wet)	25 - 30	2.25 - 2.05	4.50 - 4.10
Sandstone (wet)	6	4.59	9.19
Shale (wet)	7	4.25	8.50
Silt (wet)	10	3.56	7.12
Water	81	1.25	2.50

The max depth of EM waves in the frequency range 10MHz - 1GHz:

$$D = \frac{\frac{C}{\sqrt{\varepsilon}} \cdot t}{2}$$

where D - max depth; t - time window; Ɛ - dielectric constant.

Notes

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