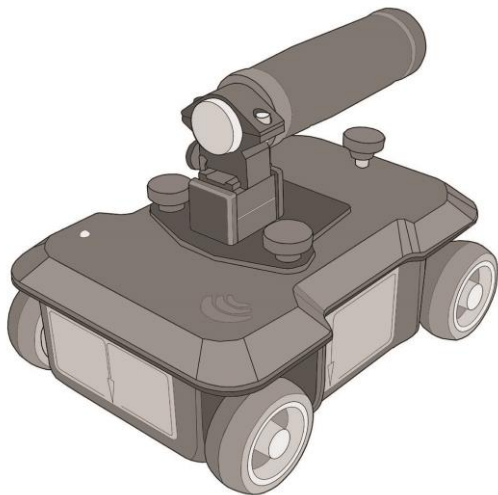


EZ Rad Pro Concreto

Full System



Terra Exploration Group

Austin, Texas

512-280-9600

www.TexGru.com

USER MANUAL

Wall Penetrating Radar



Safety Information

Thank you for purchasing EZ Rad Pro Concretto. Please read this User Manual carefully before connecting, operating, or adjusting this device. Electromagnetic radiation from GPR systems from Terra Exploration Group 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.

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.



What Concretto is

The EZ Rad Pro Concretto is an Ultra-Wideband (UWB) shielded pulsed Wall Probing Radar (WPR) for non-destructive imaging of subsurface structures. It is comprised of a transmitter and receiver boards and antennae, a controller board and a distance measurement device. The EZ Rad Pro Concretto system is designed and manufactured for Terra Exploration Group and is powered by Oerad Ltd.

What Concretto is used for

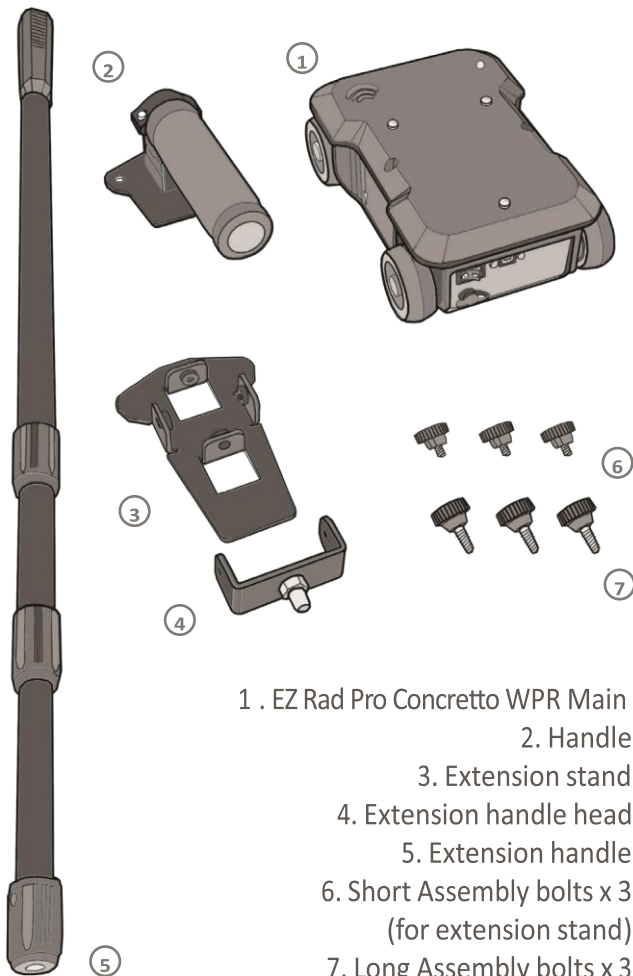
The EZ Rad Pro Concretto offers a wide variety of usages including but not limited to underground utility detection, non-destructive concrete structure analysis, rebar detection, road inspection, cracks and faults localization in concrete and asphalt structures, wire and pipe mapping in buildings, etc. It is designed to withstand the harsh conditions of construction sites.

This user manual contains the following sections:

- I. Contents
- II. Technical Specifications
- III. System Parts
- IV. Assembly
- V. Hardware Interface
- VI. Software Interface
- VII. Startup & Calibration
- VIII. Survey
- IX. Read File
- X. Working Conditions
- XI. Glossary
- XII. Dielectrics Cheat Sheet

Technical Specifications

Frequency Bandwidth	200-4000 MHz
Central Frequency	2000 MHz
Pulse Duration	7.5/14 ns
Dynamic Rangw	120 dB min
Horizontal Resolution	.001m
Vertical Resolution	.001m
Pulse Repetition Frequency	1 MHz
Pulse Length	600 ps
Pulse Energy	30 V
Pulse Rise Time	200 ps
Peak Transmission Power	3 W
Power Consumption	110 mAh
Batteries	10x900mAh NiMH 1.2 V
Charge Working Time	8 h
Charge Time	1.5 h
ADC Range	8 bits
Data Acquisition Rate	18 traces/second
Samples per trace	585
GPR Interface	UART over USB
Operating Temperature	23-104 F
Water Resistance	IP 52
Size	5.7x7.8x3.1 inches
Weight	2.2 lbs



1 . EZ Rad Pro Concreto WPR Main Module

2. Handle

3. Extension stand

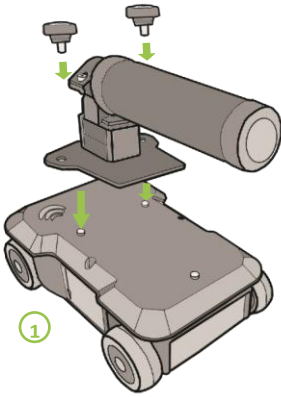
4. Extension handle head

5. Extension handle

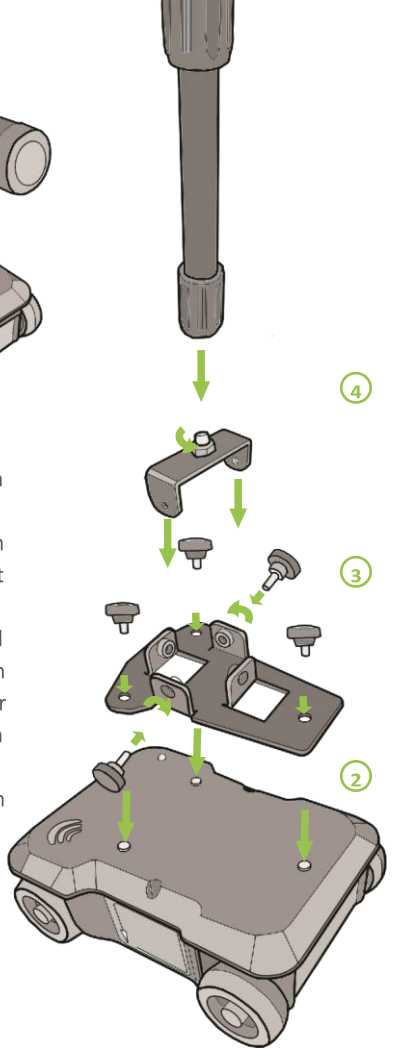
6. Short Assembly bolts x 3
(for extension stand)

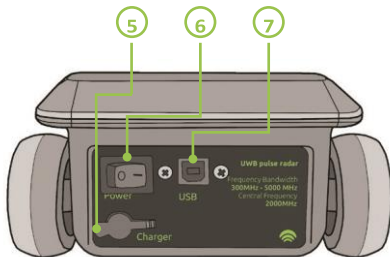
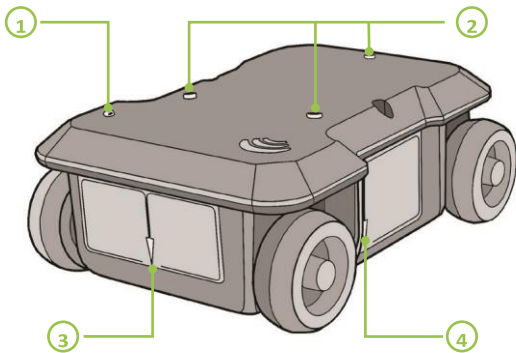
7. Long Assembly bolts x 3
(for extension handle)

Assembly



1. Secure handle position with two short bolts.
2. Secure handle extension stand with three short bolts.
3. Attach extension head to the handle extension hand either vertically or horizontally. Secure with two long bolts.
4. Attach extension handle.



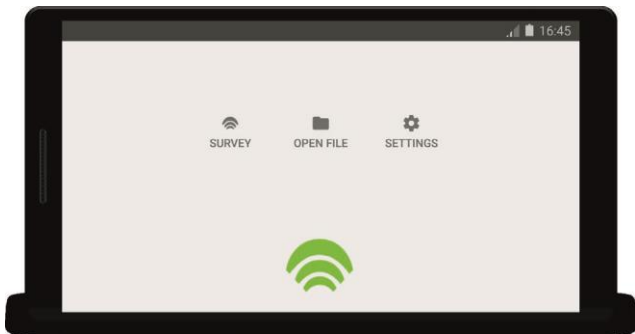


1. Battery level indicator:

- Green - battery full;
- Yellow - battery medium level;
- Red - battery getting low;
- Red blinking - you need to recharge your WPR.

2. Sockets for handle and extension handle stand.

3. Indication of horizontal center of emitted wave.
4. Indication of vertical center of emitted wave.
5. Charger socket with waterproof cap.
6. Power switch.
7. USB Data cable socket.



General Information

Make sure all cables are securely connecting the GPR and the tablet.

Grant all permissions to Oerad Power App via your Android's 'Settings > Applications > Oerad > Permissions' menu.

To avoid battery drainage and unnecessary signal transmission, turn off your GPR and disconnect it from your tablet when finished surveying.

Operating software is pre-installed in the included Android tablet computer and is ready for operation.

Operating Modes

Survey

Real time data visualization and recording. Live filter application.

Open File

Viewing recorded files and filter application to files.

Settings

Recording options. Set radar as Concretto and choose your preferred distance measurement units. Manage dielectric constants.

Startup

- Assemble your system as shown in the Assembly section of this user manual.
- Attach all cables to GPR and Android device.
- Start up the Oerad Powered Android app.
- Press the power switch on the GPR. Your GPR is running when the power level diodes light up.

Calibration

- Prepare a 1- or 2-meter-long flat surface marking its beginning and end.
- Place GPR at beginning and start it up.
- Navigate to the Calibration menu in the Oerad Powered app via settings or on its initial startup screen.
- Press Start and allow the Oerad Powered App access to the USB device if prompted.
- When you reach the end of the measured surface press Stop and then Save
- Your distance measuring wheel is now calibrated.
- The step indicator shows you how many steps in the wheel encoder have been registered. If this value does not change when moving, reconnect the GPR and turn the power switch off and on again.

Calibrate Wheel Menu

Calibrate Wheel

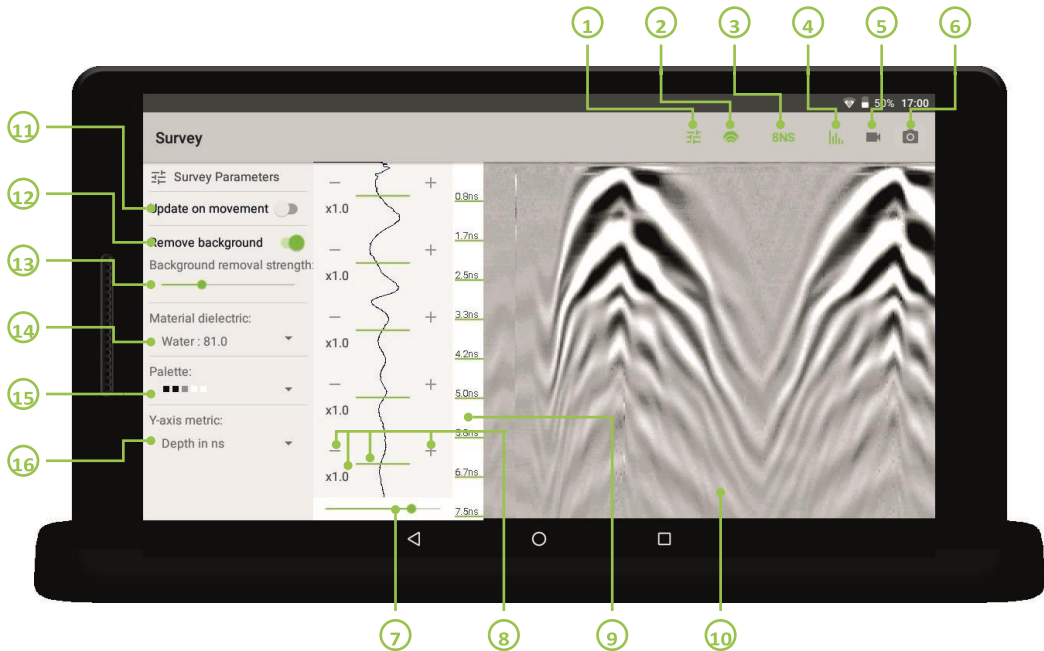
Connect your radar, press START and move it along a flat distance of length:

- 1 meter
 2 meters



CANCEL SAVE

Survey



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

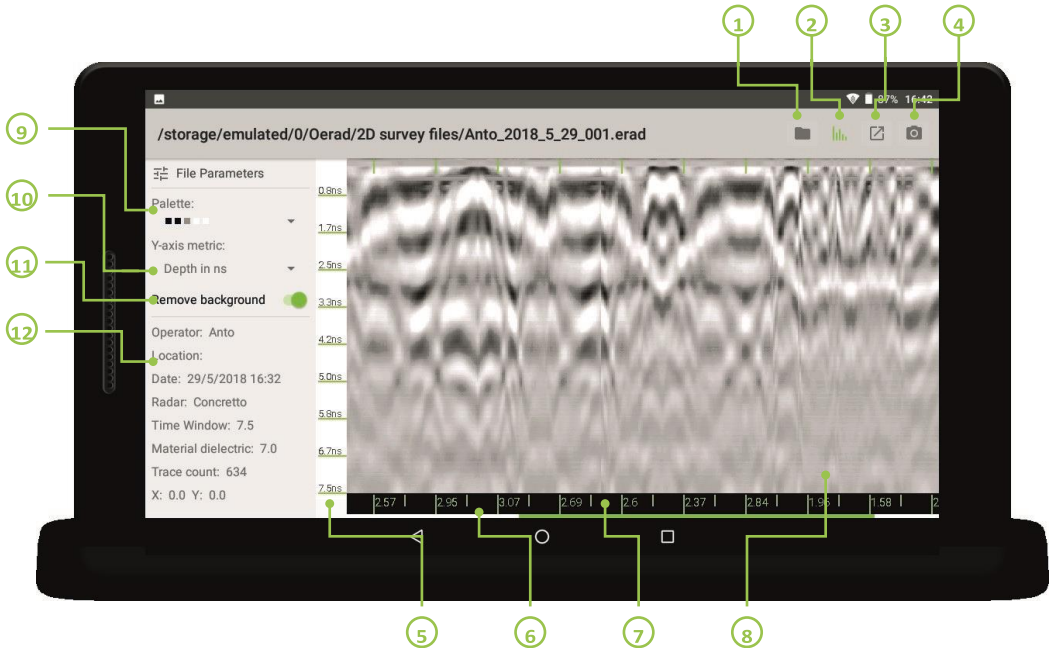
higher when moving slower or over greater distances.

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.

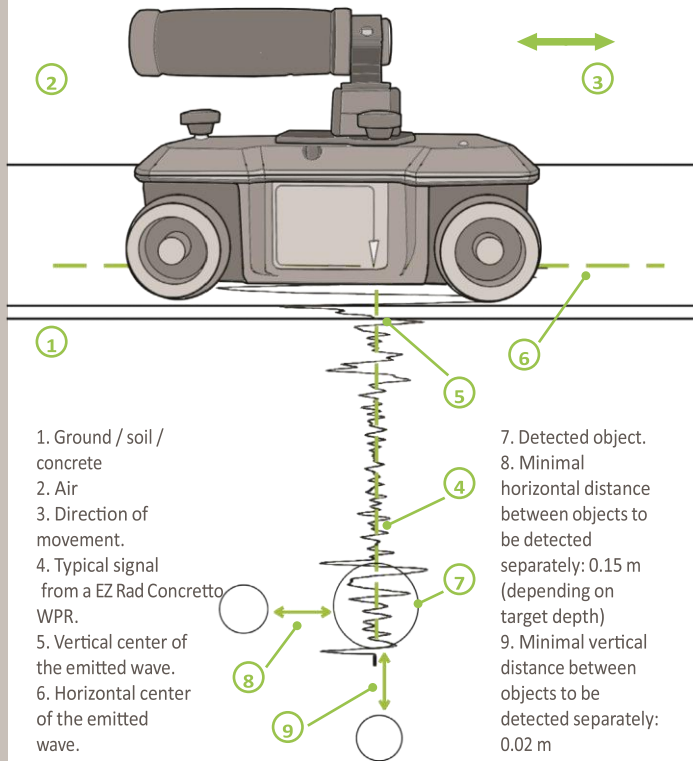
Read File



1. Open new file. Files generated by Software are usually located in main storage in folder.
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 shows distance data when files are recorded with a distance measuring wheel.
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.

Working Conditions



- Objects such as cellular towers, power lines or other EM wave emitting devices may cause interferences with the signal. This may result in radargram deterioration.
- Concretto is suitable for levelled materials and terrains where the back wheels can touch the surface simultaneously.
- Concretto needs to be calibrated to be used with distance measuring enabled. It can also be used with time-domain signal update, i.e. without a wheel.

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 - Transmitted waves at peak power (usually the center of the frequency spectrum).

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

WPR & Time-domain WPR - 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 - 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 between 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 the surveyed material.

DC Drift - Low frequency noise causing the signal to drift from the center 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 7.5ns in meters	Max Depth at 14ns in meters
"Average soil"	16	0.28	0.53
Agricultural Land	15	0.29	0.54
Air	1	1.13	2.10
Asphalt	3 - 5	0.65 - 0.50	1.21 - 0.94
Basalt (wet)	8	0.40	0.74
Clay (dry)	3	0.65	1.21
Clay (wet)	8 - 15	0.40 - 0.29	0.74 - 0.54
Coal	4 - 5	0.56 - 0.50	1.05 - 0.94
Coastal sand (dry)	10	0.36	0.66
Concrete	6 - 8	0.46 - 0.40	0.86 - 0.74
Dolomite	6.8 - 8	0.43 - 0.40	0.81 - 0.74
Glass	5 - 10	0.50 - 0.36	0.94 - 0.66
Granite	5 - 8	0.50 - 0.40	0.94 - 0.74
Limestone	7 - 9	0.43 - 0.38	0.79 - 0.70
Marsh	12	0.32	0.61
Pastoral Land	13	0.31	0.58
Plexiglass	3.4	0.61	1.14
Polar Snow	1.4 - 3	0.95 - 0.65	1.77 - 1.21
Polyethylene	2.25	0.75	1.40
Pure Ice	3.2	0.63	1.17
PVC	3	0.65	1.21
Quartz	4.3	0.54	1.01
Sand (dry)	3 - 6	0.65 - 0.46	1.21 - 0.86
Sand (wet)	25 - 30	0.23 - 0.21	0.42 - 0.38
Sandstone (wet)	6	0.46	0.86
Shale (wet)	7	0.43	0.79
Silt (wet)	10	0.36	0.66
Water	81	0.13	0.23

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

$$D = \frac{\frac{c}{\sqrt{\epsilon}} \cdot t}{2}$$

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