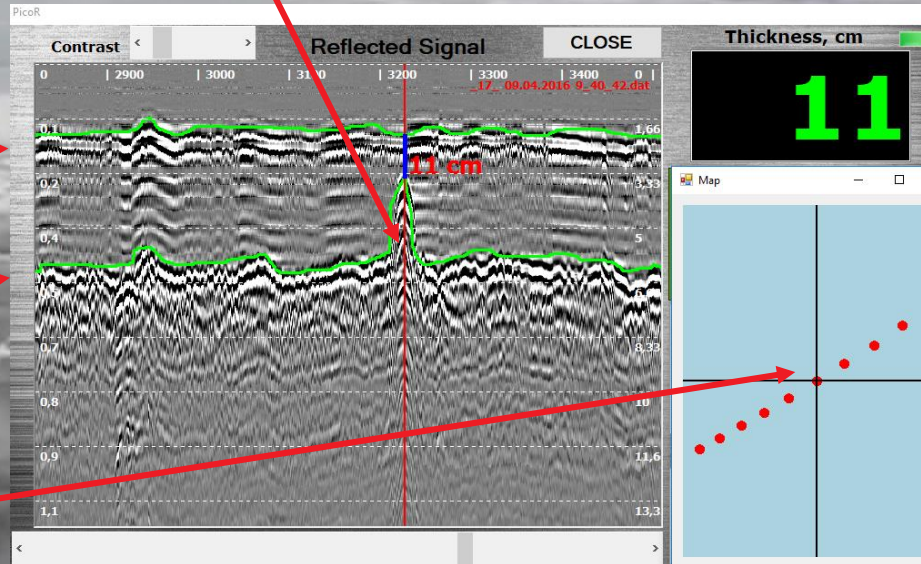


Don't miss that critical ice crack!

Ice surface

Ice bottom

*Dangerous place
on the map*



*Current ice
thickness*

PicoR-Ice GPR Ice and Snow Measuring System

By **ESTRA** company, Moscow, Russia
+7 903 735 9720, a@ledomer.ru, ledomer.ru/en

PicoR-Ice Measures Ice and Snow Thicknesses



- Ground Penetrating Radar (GPR) technology
- Continuous profile of ice thickness without constant ice drilling
- Real-time sensing, data processing, and display
- Saving measurement records, preparing reports
- Linking measurements to terrain: setting labels, GPS coordinates

Entire system fits in a single compact carrying bag with a folding shelf



PicoR-Ice Components

**GPR
transmit/receive
antenna module
PicoR-2**

**Cup of coffee
(not included)**

**Car
(not included)**

**Bike
mount on
the towbar**



**PicoR-Ice
software
(download)**



**Antenna module
PicoR-3**

GPS receiver

**2 m/4.5 m long
USB cable**

**Notebook
computer (not
included)**

Transforms a Personal Computer into a Personal GPR

Hand-held operation

GPS (positioning) receiver can be attached to shoulder and plugged into computer USB port.

Antenna module plugs into computer USB port.

Entire system is powered from the computer's battery.

The laptop computer is placed in a breast bag with a folding shelf

Antenna module is carried ~50 cm above the surface.



Transport mode operation



Antenna is attached forward on a car, hovercraft, snowmobile, or other vehicle.

Antenna module plugs into computer inside the vehicle, using a 4.5 m cable.

GPS receiver can be attached under the car glass or outside of vehicle.

Vehicle maintains a steady speed (less than 40 km/h) over the ice.

Antenna module remains ~20-50 cm above the surface.

Entire system is powered from the computer's battery.

PicoR software. Main functions. Screen Display

The screenshot displays the PicoR software interface. At the top left, there is a 'Contrast' slider and a 'Reflected Signal' label. A 'CLOSE' button is located at the top right. The main display area is a graph with a vertical axis labeled 'Thickness, cm' ranging from 0 to 0.8. The graph shows a signal that increases with thickness. Several text annotations with red arrows point to specific parts of the interface:

- This is where ice or snow thickness is displayed** points to the graph area.
- This lets you view a saved record later** points to the 'VIEW RECORD' button.
- This records data to a file (inactive until GPR starts)** points to the 'START RECORD' button.
- This allows to mark a place by putting a label on the record** points to the 'LABEL' button.
- This captures the screen image to a file** points to the 'PRINT SCREEN' button.
- This starts the GPR transmit and receive or to play record** points to the 'START' button.

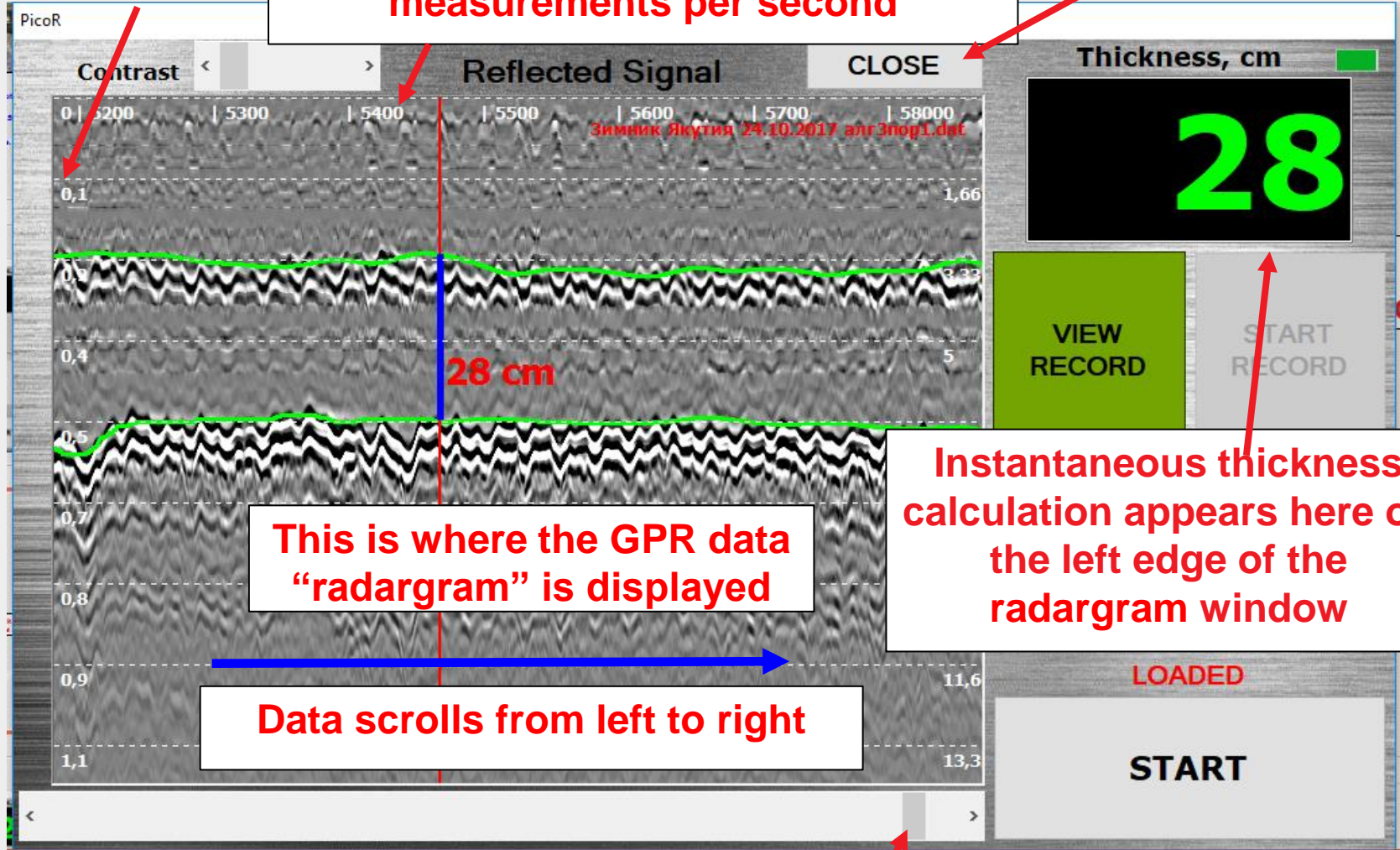
The control panel on the right side of the screen contains the following buttons: 'VIEW RECORD', 'START RECORD', 'PRINT SCREEN', 'LABEL', and 'START'. The 'START' button is highlighted with a blue border.

Screen Display

Thickness scale in meters

Scale with the number of measurements. Usually about 65 measurements per second

Close the program when finished



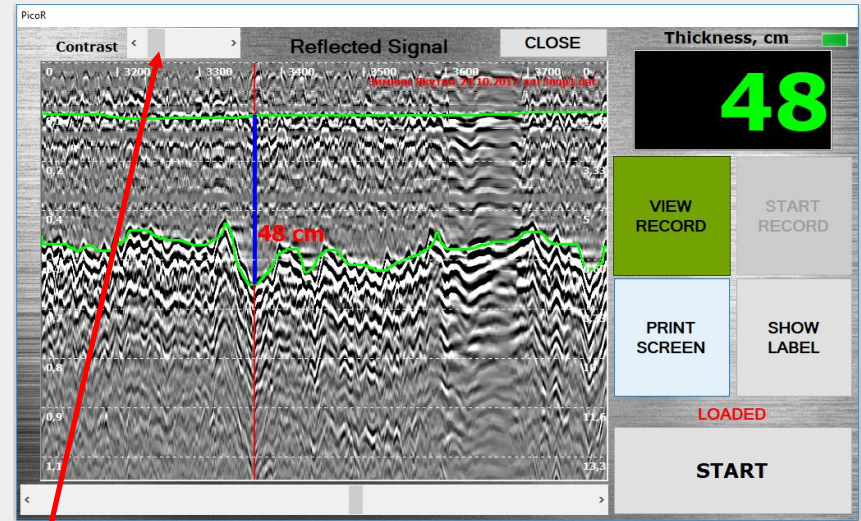
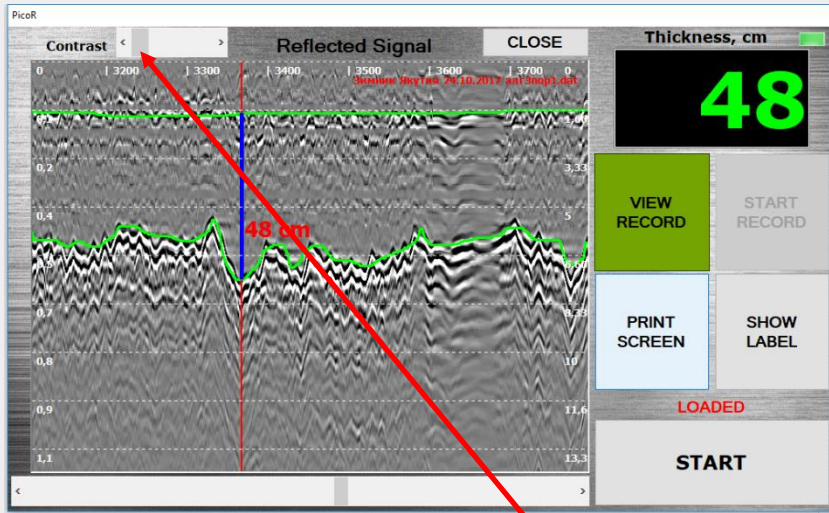
This is where the GPR data "radargram" is displayed

Instantaneous thickness calculation appears here on the left edge of the radargram window

Data scrolls from left to right

Slider to view the record

Display Contrast. Alter the Settings



Control display contrast with the slider bar. On the right - too much contrast, you can see a lot of noise

The screenshot shows the PicoR interface with a context menu open over the button pad. The menu options are: 'Parameters', 'Map', 'Layers and Labels', 'GPS settings', and 'About'. The 'Parameters' option is circled in red. Text overlays with arrows point to the button pad and the 'Parameters' option. The text reads: 'Right-click anywhere on the button pad' and 'Select "Parameters" or other options from the sub-menu'. The 'START' button is highlighted with a blue border.

Screen Display – Alter the Settings

Select from 6 algorithms

Processing parameters
Algorithm Algorithm 3

Universal algorithm for measuring the ice thickness in transport mode

Relative threshold, % of max 5

Adjust sensitivity to material change

Material of stratum Ice

Permittivity 3,19

Number of Interfaces 2

Select from 7 target materials, including ice, snow, and concrete

Adjust for dielectric qualities of target material

Device settings
Gain 3
Window size 0
Number of windows 1

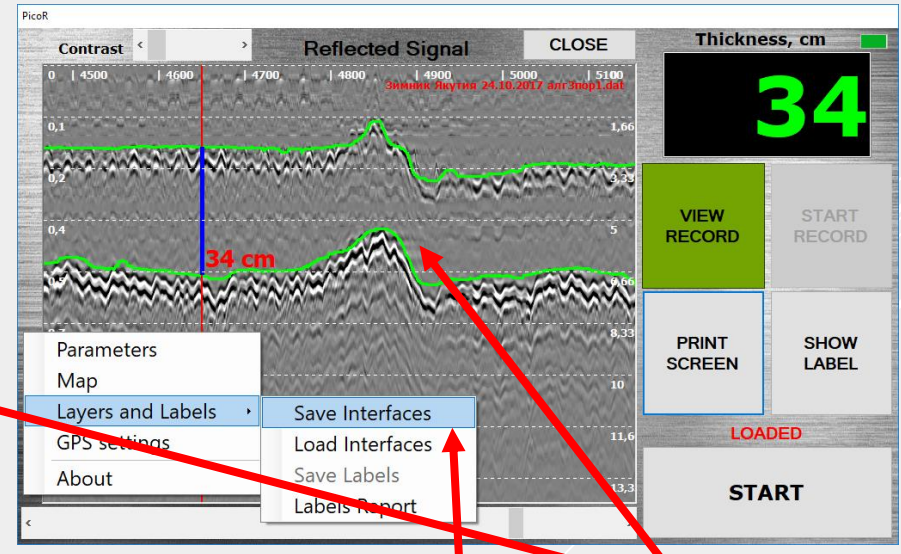
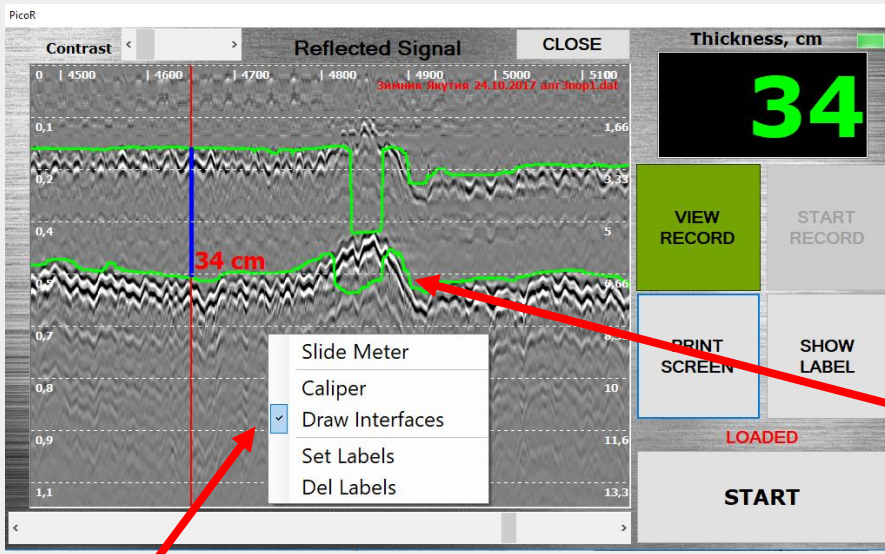
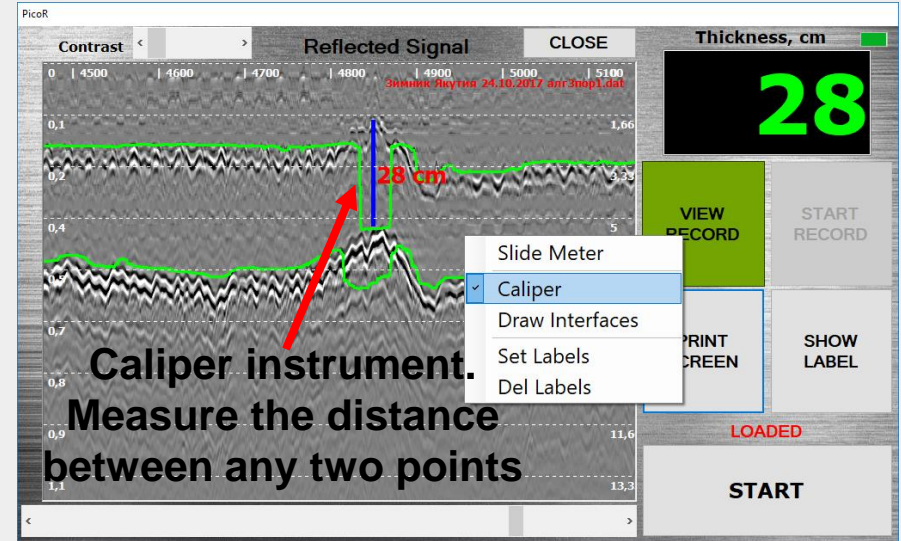
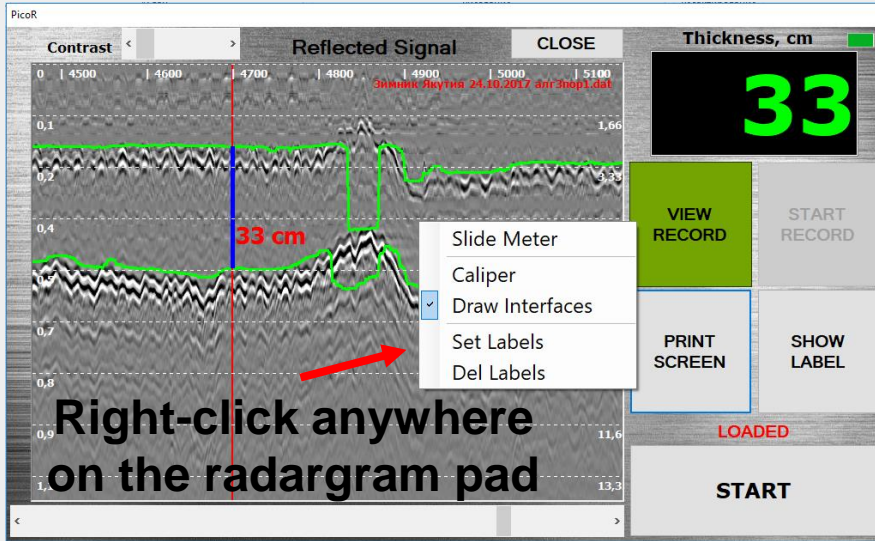
Adjust antenna gain, radargram window size, number of windows in stitch

Visualization settings
 Internet map loading
Highlight
Record Entirely

DEFAULT OK CANCEL

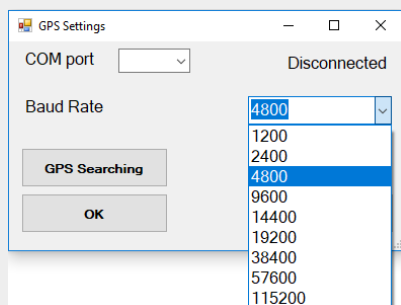
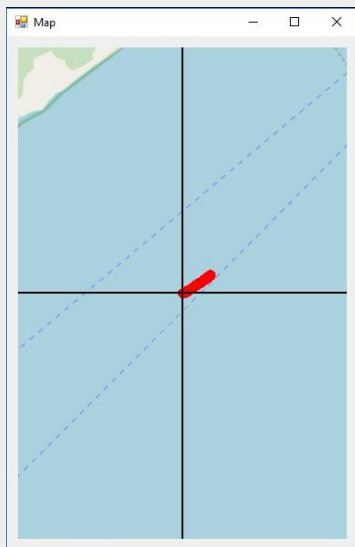
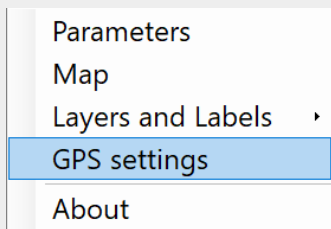
And more functions...

Screen Display – Alter the Settings in record mode



Draw Interfaces – very important and useful instrument! It allows to manually correct all errors of the automatic algorithm on the record and store the correct boundaries in a separate file. Just left-click near green line, hold and draw. Then correct boundaries can be loaded by function “Load interfaces”

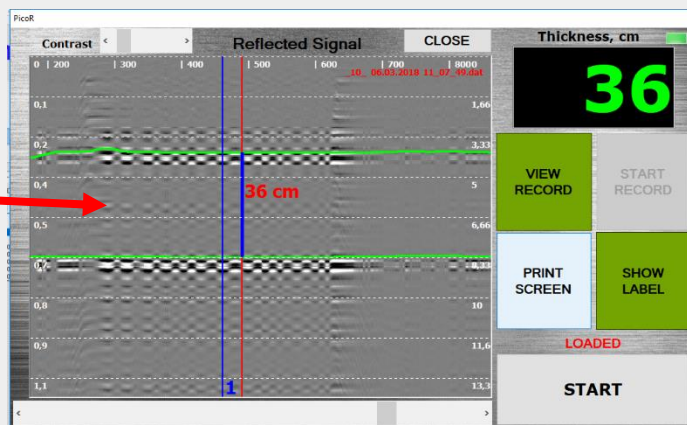
Binding to GPS coordinates. Calibration



Connect the included GPS receiver to the USB port, install the driver and use GPS settings. Then open map (loaded with internet available). After the start of the device, GPS coordinates (which are recorded in a text file) correspond to each ice thickness measurement. All records are saved in C:\UWB_logs folder: Filename.dat is a main data file, Filename.lab is a file of labels, Filename.gps is a GPS track, and Filename.del is a file of the selected borders.

Before performing work it is very important to calibrate the device!

1. It is necessary to measure the thickness by the device at a point.
2. Then drill a hole at this point and measure the thickness with a ruler.



If the values differ, you need to set the dielectric constant in the program so that the values match, using the formula:

$$\epsilon = 3.19 \times \left(\frac{D_{device}}{D_{ruler}} \right)^2$$

Field Experience

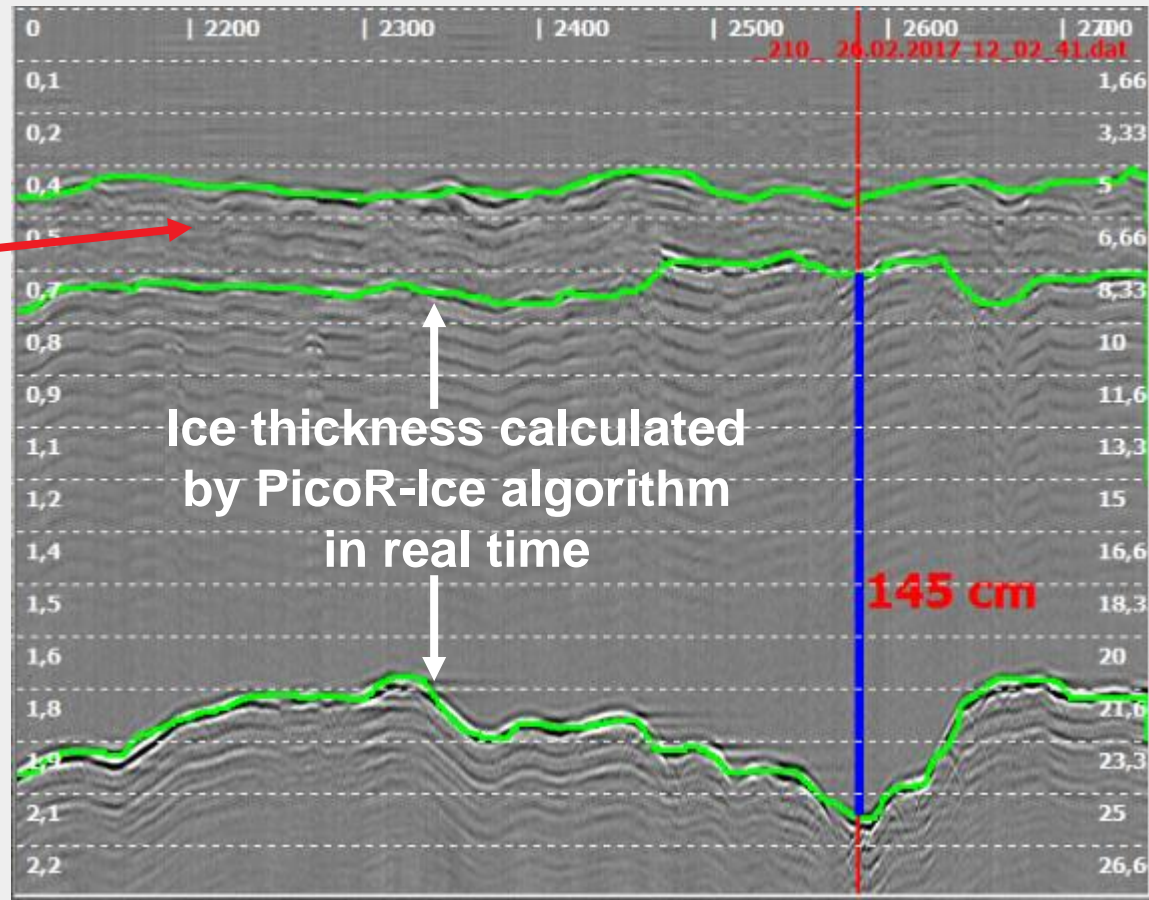


Manufacturer's Specifications

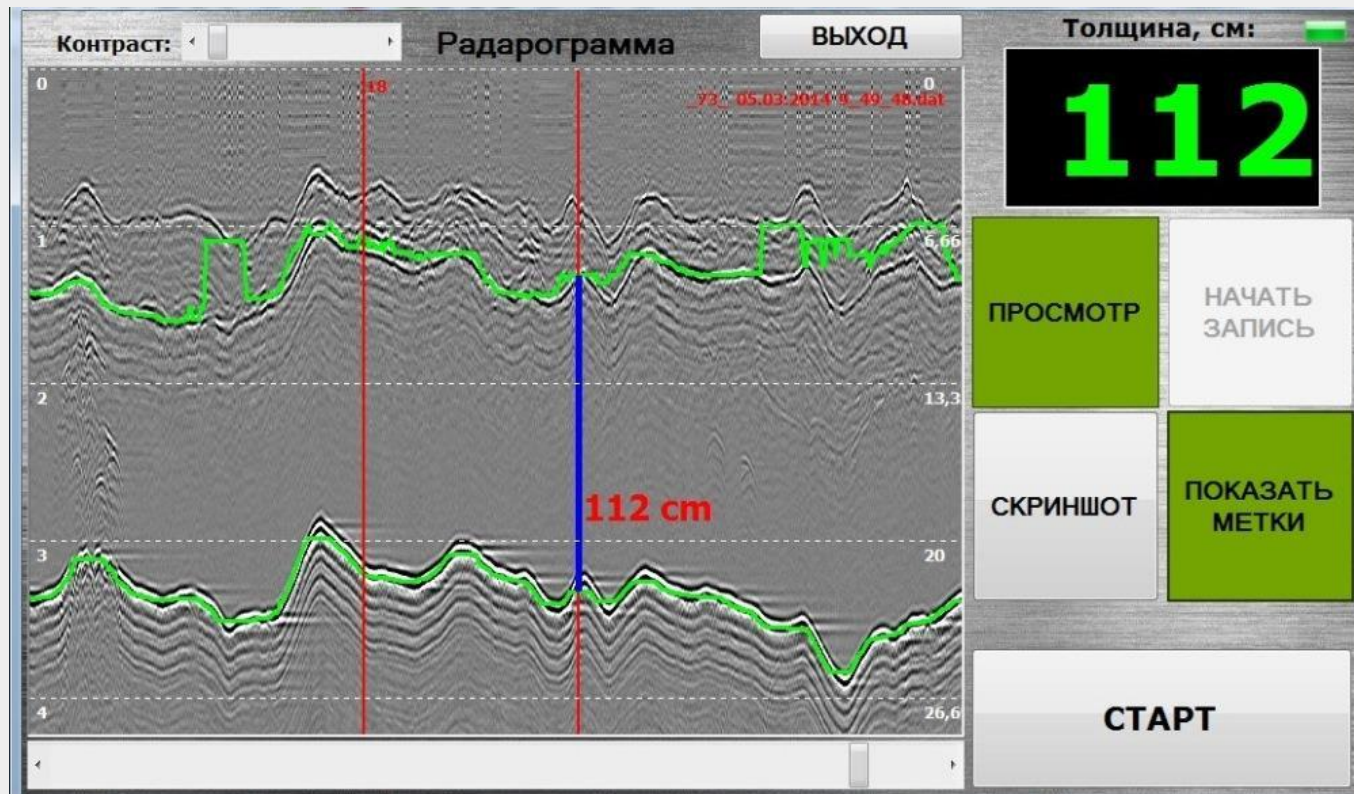
DESCRIPTION	SI	US/UK
Measured thickness for:		
Snow	5 to 200 cm	2 to 80 in.
Ice	5 to 300 cm	2 to 120 in.
Pavement	5 to 70 cm	2 to 28 in.
Ground (sand, loam)	5 to 100 cm	2 to 39 in.
Measurement accuracy	1 to 2 cm	0.5 to 1.0 in.
Transmit frequency	1700 MHz	
Measurements/second	30 to 60	
Max. Vehicle speed for measurement	40 km/h	25 mph
Antenna height above surface	20 to 50 cm	8 to 20 in.
GPS/GLONASS positioning support	Yes	
Antenna module dimensions	41 x 27 x 7 cm	16 x 11 x 3 in.
Antenna module weight	1.8 kg	4 lb.
Antenna module external interface	mini-USB	
Computer operating systems	Windows 7, 8, 10	

Gulf of Ob – Ice thickness measured during heavy equipment convoy

Additionally, the sensor picked up this observed snow layer

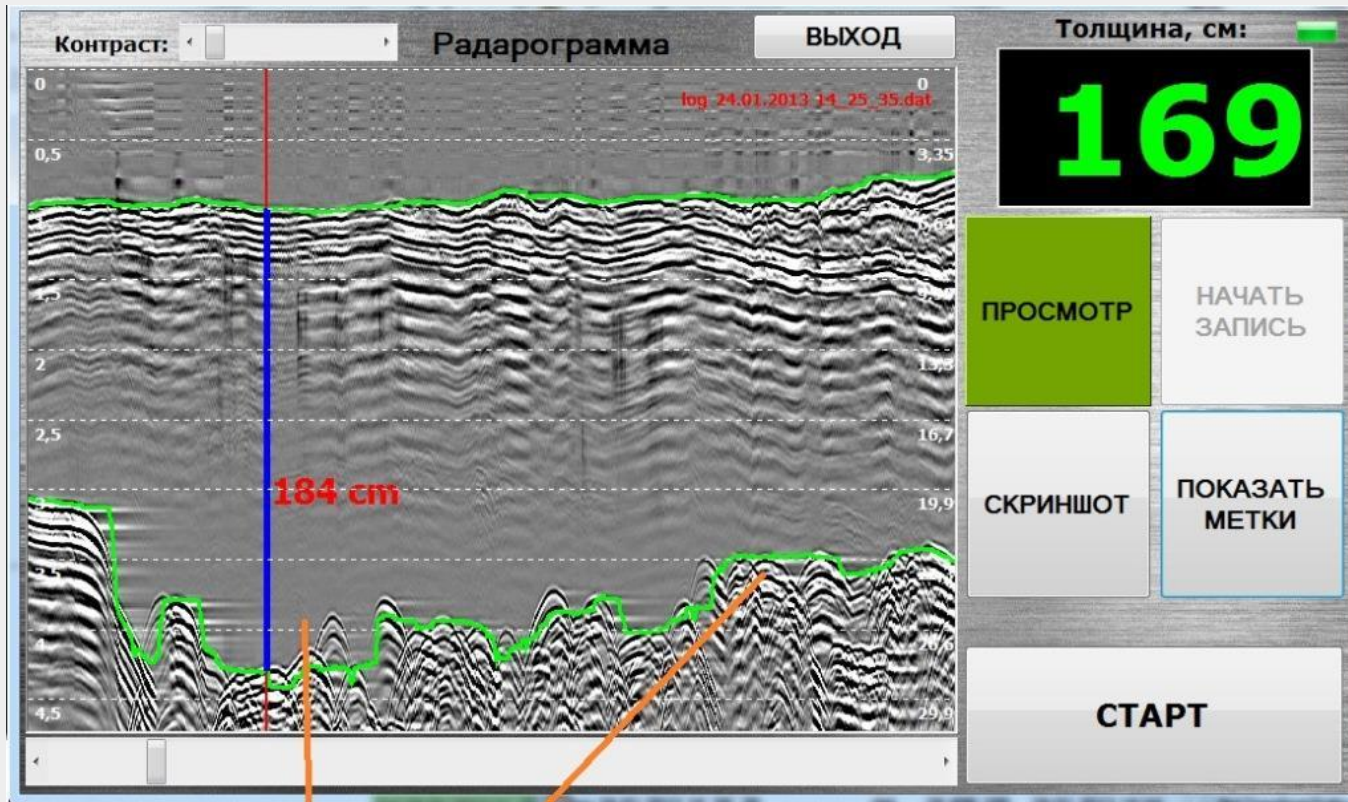


Ob River – Ice thickness profile from car-mounted antenna



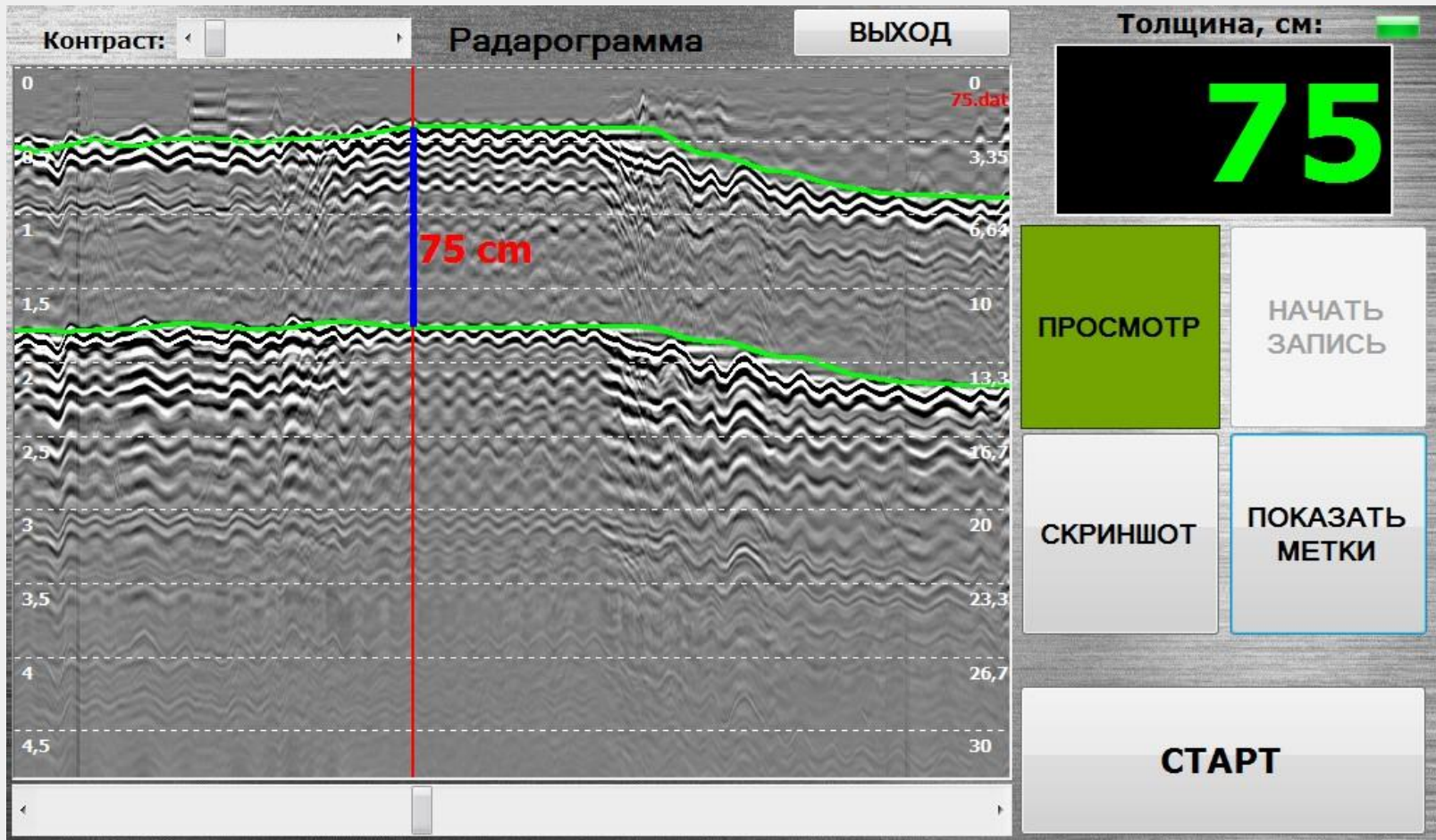
Ice thickness is 112 cm, a layer of snow up to 40 cm thick is clearly visible from above. Shaking along the road does not interfere with the operation.

Gulf of Ob – Ice thickness profile from ATV-mounted antenna



Frozen to bottom

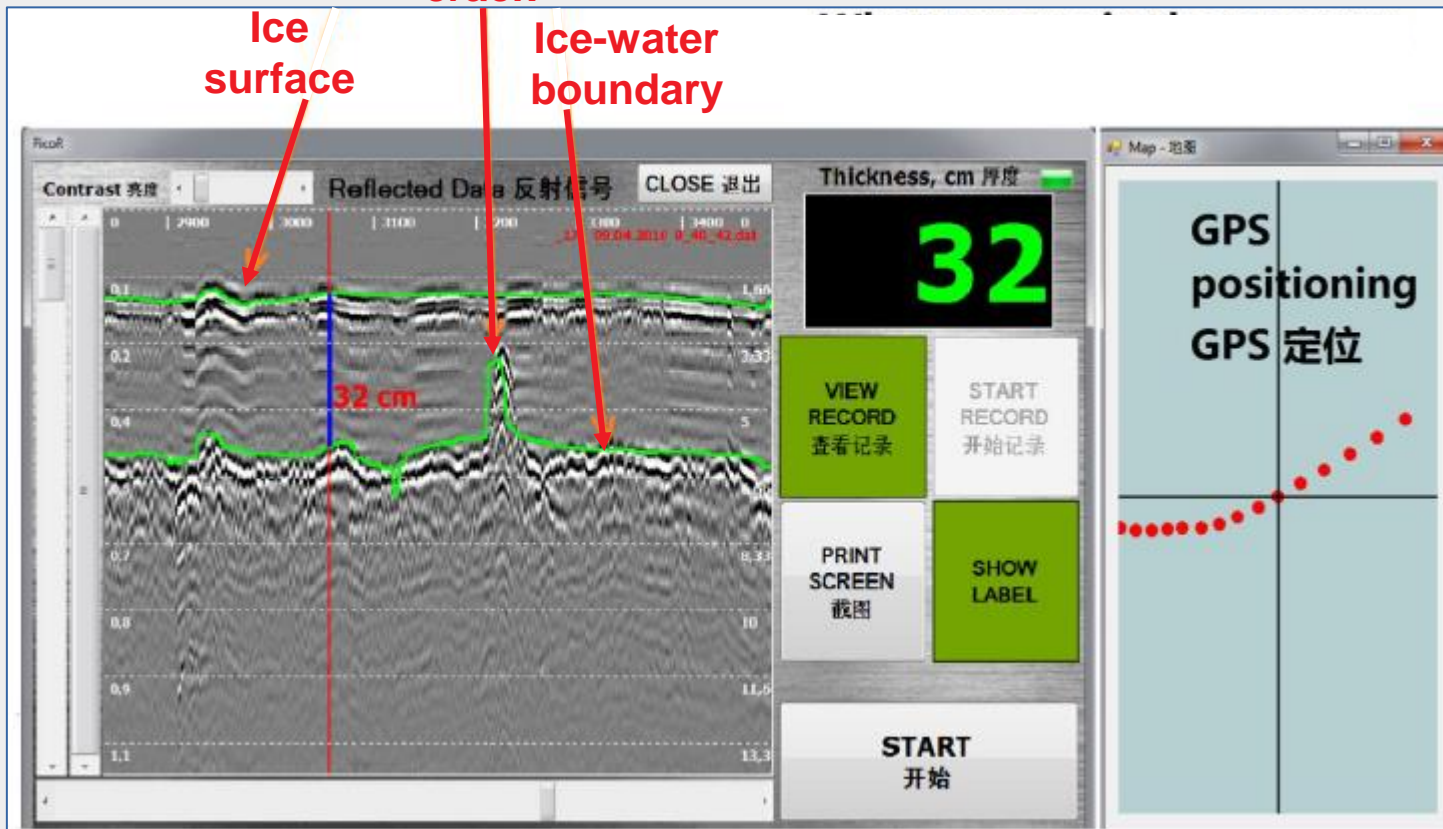
Lena River, Yakutia, profiled from automobile



Ice thickness of 75 cm; boundaries clearly defined by the algorithm. Depression at right may be due to snow layer.

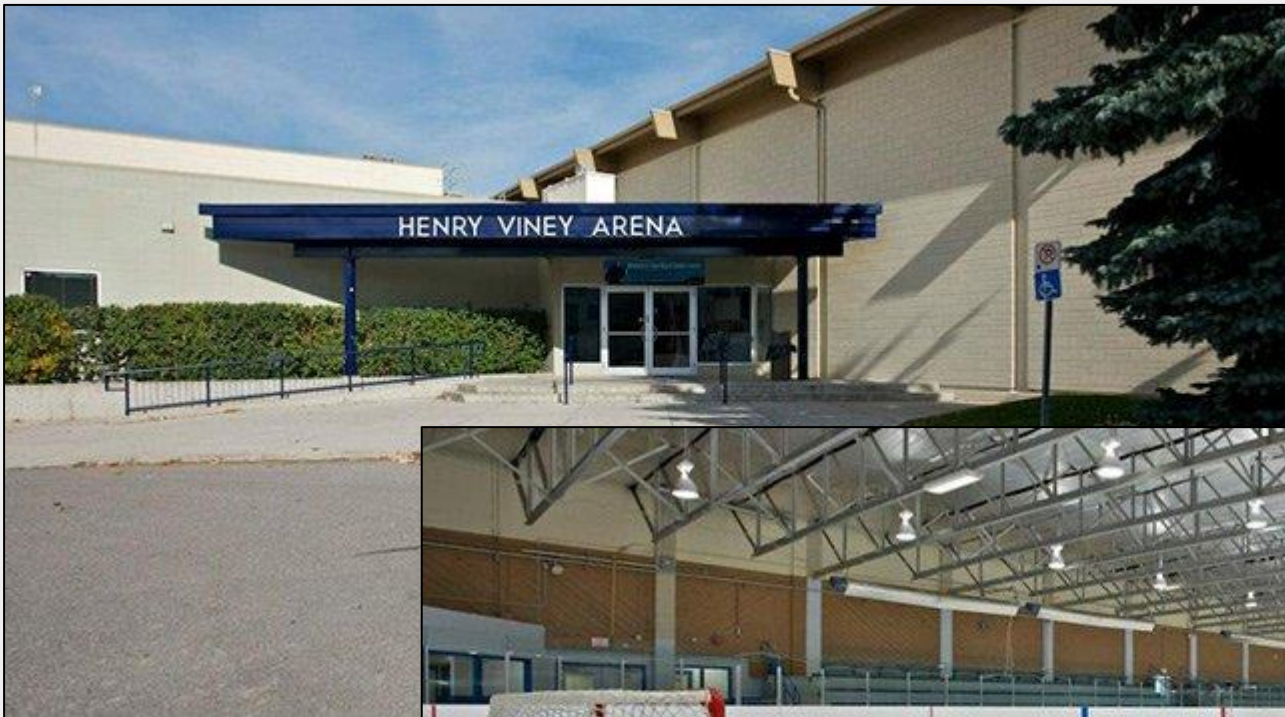
Songhua River, Heilongjiang, profiled from hovercraft

Sub-surface crack
A significant crack in the lower part of the ice cover was detected.



GPS receiver was attached and position map was displayed in this example.

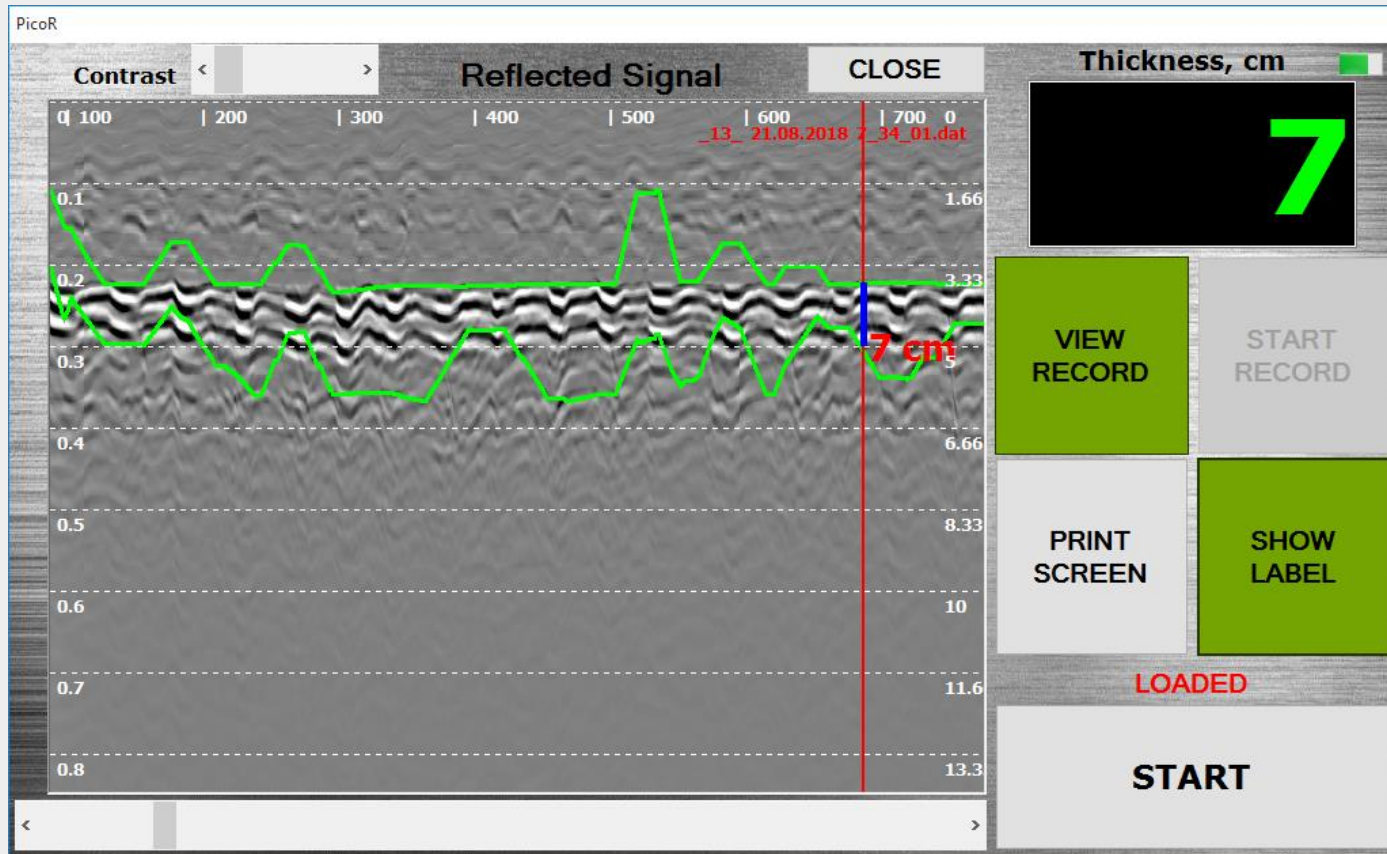
Henry Viney Ice Arena, Calgary, 21 August 2018



**Ice – 12 months per year
at a community hockey
arena.**

Henry Viney Ice Arena, Calgary

21 August 2018



Exactly what one expects at a carefully maintained ice rink – 7 cm (3 in.) thick ice toward centre ice (15 cm/6 in. along boards).

PicoR-Ice in Summary

Compact!!

Low Cost

Connectivity with personal computers

A “Personal GPR”

No hazardous batteries

NEW!!

The PicoR-3 antenna module

1200 MHz frequency for deeper sub-surface penetration

For measurement of thick snow covers (over 2 m)

