Ramac/GPR 1GHz Overview and system description

Content

1 Introduction

This document provides an overview of the operation of the Malå GeoScience Ground Penetrating Radar "Ramac/GPR 1GHz transducer". Pulse generator circuit diagrams as well as module internal photographs are contained in separate documents.

2 Overview

Ramac/GPR 1GHz is an ultra-wide band transducer intended for geophysical surveying and non destructive testing. In use the system performs time domain reflectometry by radiating a radio frequency impulse with a repetition rate of 100kHz from a transmitting dipole. Transitions between materials exhibiting different wave impedances through which the electromagnetic wave travels cause the wave to be reflected. These reflections are received by the receiving dipole and sampled inside the antenna units. Results may be presented in real time on the PC connected to the system and recorded on a hard disk on the same PC for later analysis. A rechargeable batteries powers the system.

The system may be dragged along the ground by a simple pull handle or it may be mounted on a trolley incorporating a distance encoder.

UWB transducer:	The shielded transducer comprises, on the transmitter side, an impulse generator, a transformer and an antenna element. On the receiver side there's a similar antenna and transformer, a preamplifier and a sampler head. The sampler head is mounted inside a fully shielded metal box and electromagnetic absorbing materials surround both the antennas. On the perimeter of the absorbing materials there are metallic shields. The box also contains AD-converter and optoconverters for trigger signals and data output
Distance encoders:	The distance encoders are commonly used for positioning each sampled wavelet with respect to its neighbors. It's mounted on the antenna or on the trolley and connected to the data acquisition unit.
Battery pack:	The 1GHz is powered from an external battery pack. Different types and power ratings are available.

3 Technical Description of 1GHz Module

General

A block diagram of a shielded transducer is shown in figure 1 below.

All sides of the transducer, except the bottom, are metal shielded. A d-sub connector on top of the transducer provide the necessary power from the battery.

No rf-signals leave the transducer trough connectors. All signals to and from the unit is through optical fibers

Operation

On the transmitter side high voltage, DC-power, transmitter trig signal as well as ground reference are directly fed to the impulse generator on top of the antenna element. When a trig condition is received via the optical fiber, a charge storage capacitor is de-charged trough a set of avalanche transistors and current limiting resistors. The impulse created during this discharge is fed, via a 1:4 balun (not shown in the figure below) to the antenna element. The antenna element is situated on an electromagnetic absorbing material and resistively loaded at its endpoint.
On the receiver side DC-power, receiver trig signal and ground reference is fed to the sampler head located in a shielded cavity in the upper part of the antenna. DC-power and ground reference is fed to the preamplifier located on top of the antenna element. The antenna element is identically mounted as on the transmitter side.

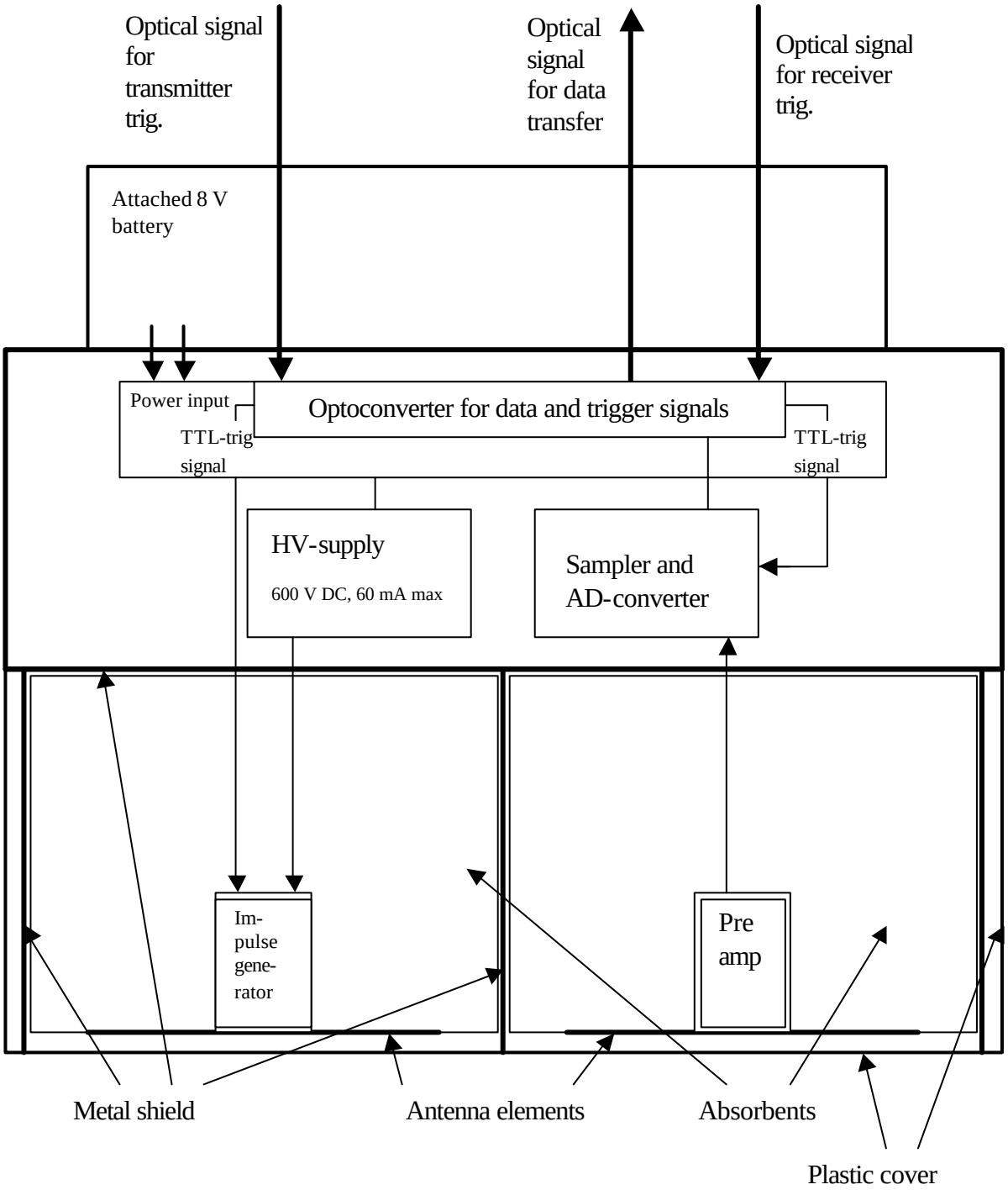

Figure 1. Block schematic of the 1GHz antenna.

Incoming signals are fed from the antenna element to the preamplifier, 18dB low noise, via a 1:1 balun (not shown on the figure above). From the preamplifier the signal is fed to the sampler head via a semi-rigid transmission line.

A trig condition on the receiver fiber causes the sampler head to sample the analog level of the signal arriving from the preamplifier. The sampled signal is fed to the AD-converter and then to the optoconverter and through the fiber to a data acquisition unit.