LONG DISTANCE RADIO (LDR)
USER MANUAL

Version 0.002

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Revision History

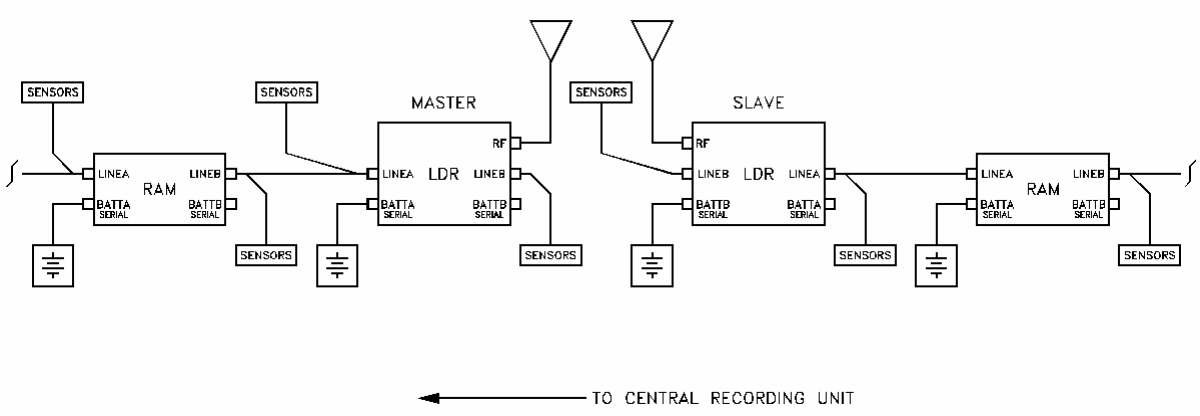
VERSION	DATE	AUTHOR	CHANGES
0.000	March 31, 2008	HH	BEGIN DRAFT
0.001	October 27, 2008	HH	Add a statement per FCC PART 15.19 and PART 15.21
0.002	October 29, 2008	HH	Change page 12 all Operating Frequencies to Preset

1 OVERVIEW

The purpose of this radio system is to provide a rugged VHF data link between various components of the ARAM seismic data acquisition system. Emphasis is placed on the “Vibroseis” market, where mobile excitation source equipment needs to be connected with the greater data acquisition network and the Central Recording Unit (CRU). The actual seismic spread can cover over 100 square kilometers over many different types of terrain, making the need for a long distance, (24km line of sight), radio that is very robust. Typically the vibrators operate in groups of 4, and each vibrator generates about 125kbits/sec of information, making the overall payload bandwidth at least 500kbits/sec.

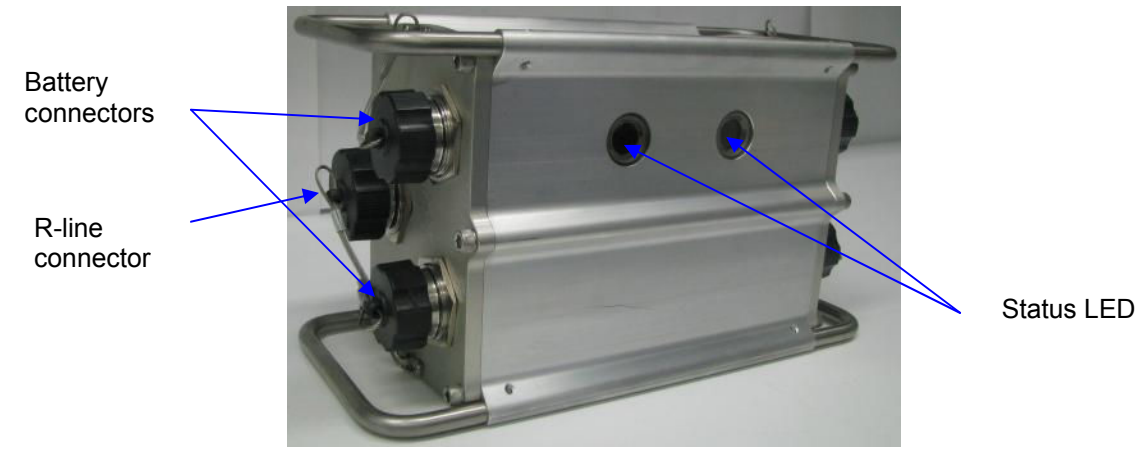
2 HIGH LEVEL SYSTEM ARCHITECTURE

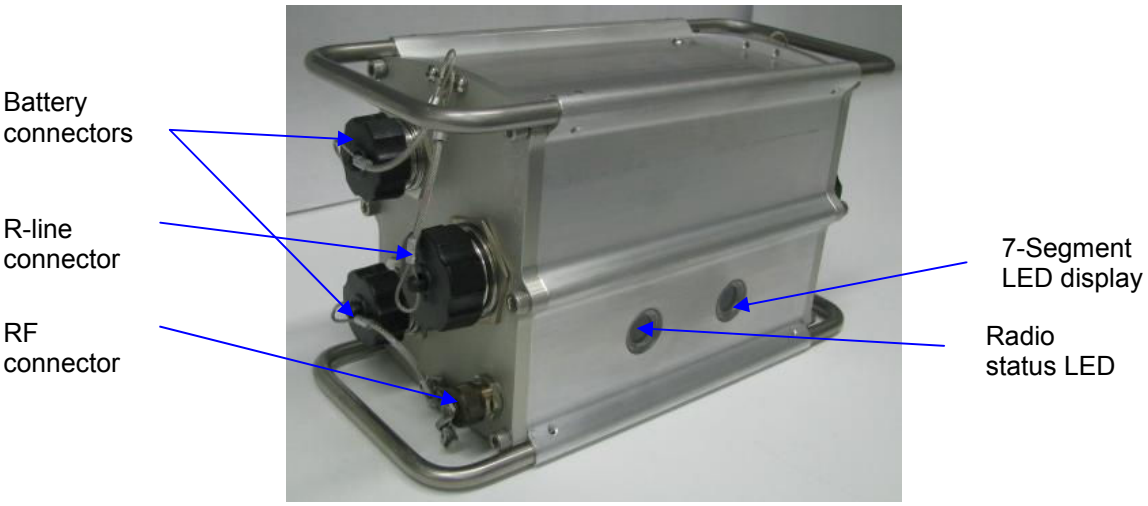
An LDR takes on one or two possible roles: Master or Slave. On any one operating frequency there is only one Master, and a configurable number of slaves. Masters are connected by the cabled ARAM network to the CRU (Central Record Unit) while Slaves are connected into the greater system through the LDR RF link and the Master.
The LDR will interface with ARAM’s “R-Lines” much like a RAM unit, unlike a RAM, however, the LDR will have a third (RF) port. The LDR system will operate in a master/slave relationship (as opposed to a peer to peer configuration). More than one slave is possible. Data flow is predominantly from the slave side to the master. From a manufacturability standpoint, however, the master and slave units are to be physically identical. The LDR system may be deployed in a “back-up-to-cable” role where the radio system does not operate unless cable(s) develop impairments.



3 LDR UNIT

3.1 CONNECTORS AND LED DISPLAYS





3.2 STATUS LED

Various combinations of these LED indicators will occur during operation. For example, during a shot, a LDR that is powered up and acquiring data properly will display a power LED, and a flashing green LED on the CRU side. If that LDR is not the last active LDR on the line, it will also display a green LED on the Line Side indicating another LDR is connected. Green LED'S on both sides will blink when data is moving.

CRU SIDE	LINE SIDE	DESCRIPTION
		⇒ No Power. ⇒ May indicate faulty or disconnected battery, no telemetry connection to the CRU, or CRU has powered down the line.
		⇒ Powered Up. ⇒ Pilot Voltage on any of the digital transmission pairs will turn the amber LED on. ⇒ Amber power LED indicates which side the CRU is on. ⇒ Normally indicates functioning battery and continuity of telemetry connection to the CRU.
BLINK 		⇒ Blinking amber power LED indicates that the RAM, LTU, or Repeater has been placed in repeater mode by the CRU and that the module is receiving interrogates from the CRU. In this case both transceivers are placed in repeater mode.
 **BLINK**		⇒ Blinking green LED on the CRU side indicates that the module is receiving interrogates from the CRU. It also indicates data on all digital pairs is being transmitted.
		⇒ A solid green LED on the Line Side indicates that the module can detect continuity on the telemetry connection to the next module. *This does not mean a battery is connected to that module.* ⇒ If the CRU is detected on both digital pairs, the Line Side must detect continuity on both digital pairs for the green LED to be on.
	 **BLINK**	⇒ A Blinking green LED on the Line Side indicates that the module is receiving recognizable data on both digital pairs from another module on the Line Side.
		⇒ A solid red LED on the Line Side indicates the CRU has configured the module and shut down the Pilot Voltage to the Line Side. ⇒ This prevents modules on the Line Side from receiving the power up signal. ⇒ This indicates the end of the network.

Note: Circle = LED off, Solid = LED on.

The above describes the operation of a *single* LED. *Combinations* of LED patterns will occur in regular operation. In **Blink** mode the LED is turning on and off at a steady, repetitious pattern about 4 times per second.

3.3 RADIO STATUS LED

Three status LEDs are mounted on the left side of the radio assembly PCB. These LEDs are to convey the status of the radio assembly.

The LED'S are Amber (Link Status), Green (Receive Activity), and RED (Transmit Activity).

INDICATION	DESCRIPTION
	⇒ No Power or Sleep state. ⇒ May indicate faulty or disconnected battery, no telemetry connection to the CRU, or CRU has powered down the line.
	⇒ Active state. ⇒ Normally indicates functioning battery and continuity of wireless telemetry connection to the CRU.
BLINK 	⇒ Sniff state (blink characteristics are LED on for about 125ms per second).
 BLINK	⇒ Receiving data (blink characteristics are LED turns on and off about 4 times per second).
 BLINK	⇒ Transmitting data **(blink characteristics are LED turns on and off about 4 times per second).**

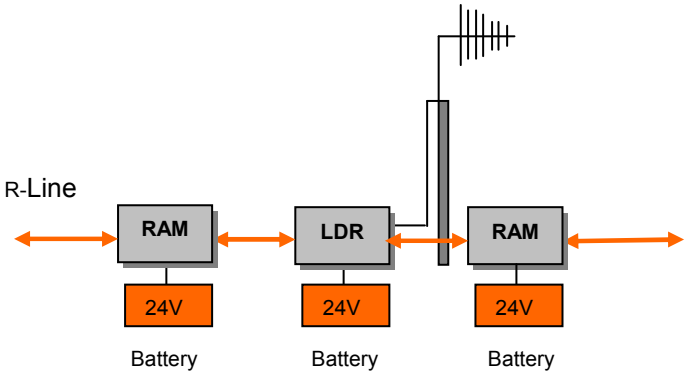
Note: Circle = LED off, Solid = LED on.

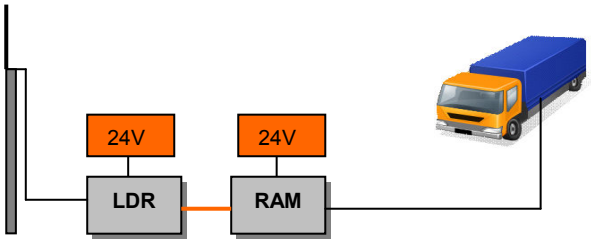
3.4 7-SEGMENT LED DISPLAY

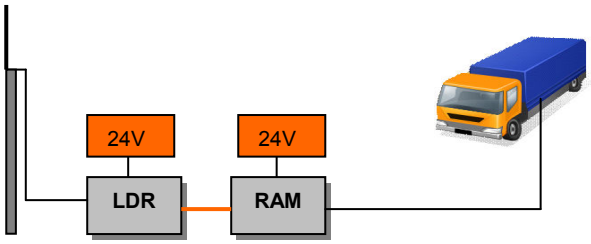
The 7-segment LED display indicates the received signal strength. The display indication has been calibrated as follows:

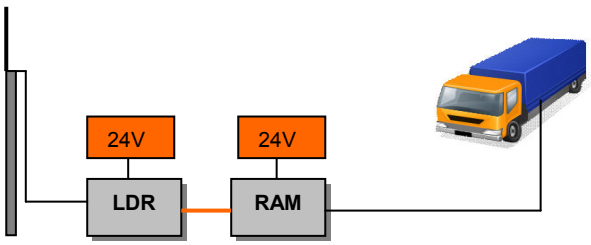
- 0-3 Marginal (20dB or less of margin to receiver sensitivity limit)
- 4-6 Good (20 – 40 dB of margin)
- 7-9 Strong (in excess of 40 dB margin; transmit power could be reduced)

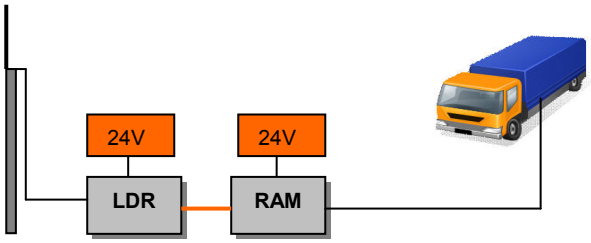
4 TYPICAL SETUPS







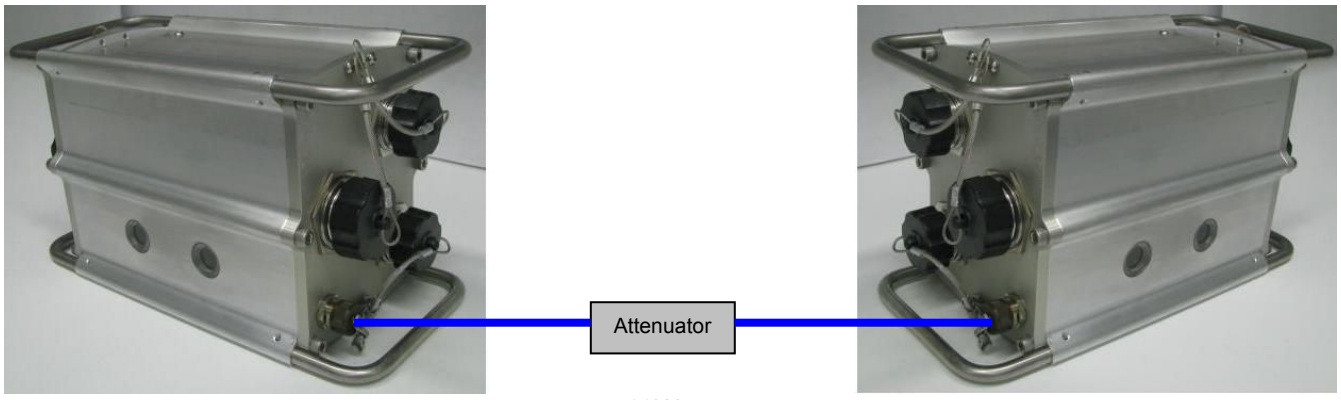




- Maximum range may be achievable only under ideal rural conditions (i.e. flat open treeless terrain / minimum noise and interference at receiver site) using (a) a directional/gain antenna and (b) a mast up to 15m in height at the master location.
- The slave antenna(s) shall be limited to non-directional / non-gain types mounted 3m above the ground.

CAUTION

If you want to test LDR by connecting two units through coaxial cables, a 10W, 60dB (Minimum) attenuator is needed.



5 ANTENNAS

Candidates:

- **Omni-directional**
  1. Antenex http://www.antenex.com/index051206.htm

Model	Frequency	Center Freq	Gain	Overall Length	Whip Style	MSRP
B2003	200 - 225 MHz	Tunable	3 dB	35	33” Straight	$36.66

  2. GAM http://www.gamelectronicsinc.com/mini.html
     SS-220 220Mhz 25” whip, optional Magnetic mount

  3. TG series
     http://www.gamelectronicsinc.com/tg.html

- **Yagi antennas**
  1. Antenex YS2165 http://www.antenex.com/index051206.htm

SILVER SERIES VHF MODELS

Model	Finish	Frequency	Center Freq	Elements	Gain	FB Ratio	MSRP
YS2165	Silver	216 - 225 MHz	Tunable	5	9.2 dBd	20 dB	$163.80

2. SINCLAIR SY206EB http://www.sinctech.com/catalog/resources/pdf/SY206EB-dm.pdf
   Yagi directional antenna, 9.5 dBd gain, 138-225 MHz

6 FCC/INDUSTRY CANADA NOTICE

6.1 STATEMENT ACCORDING TO FCC PART 15.19

FCC compliance is not valid if customer modifies product.

6.2 STATEMENT ACCORDING TO FCC PART 15.21

Modifications not expressly approved by ARAM could void the user's authority to operate the equipment.

7 LDR SPECIFICATIONS

Functions:
The purpose of this radio system is to provide a rugged VHF data link between various components of the ARAM seismic data acquisition system. Emphasis is placed on the “Vibroseis” market, where mobile excitation source equipment needs to be connected with the greater data acquisition network and the Central Recording Unit (CRU).

Frequency Range:

In US and CANADA: 217 - 218 MHz, and 219 - 220 MHz.
Other countries: compliance with local regulations

Operating Frequencies:
The default operating frequencies are:
Preset-1 (217.171592 MHz)
Preset-2 (217.522678 MHz)
Preset-3 (217.873763 MHz)
Preset-4 (219.127641 MHz)
Preset-5 (219.478727 MHz)
Preset-6 (219.829812 MHz)
Other channels can be supported subject to a frequency step size of 50.16 kHz and minimum offset from upper and lower band edges of 170 kHz.

Channel Plan:
For any given application all radios operate on the same channel using Time Division Duplex.

Operating Bandwidth:
325KHz

Modulation Scheme:
BPSK for packet setup, OQPSK for payload
BPSK at 276.48 kbps
OQPSK at 552.96 kbps

RF Output Power
The RF amplifier will be capable of running from 10dBm (10mW) to 37dBm (5W) in approximately 1dB steps.
A maximum power level can be configured to ensure that the transmitter does not exceed the limits specified in a particular license.

RF Output Impedance: 50 Ω.

Power Supply
Operating power voltage: 21VDC to 28VDC, 4 battery connectors
Use 24V (nominal) SLA battery pack.

Physical specifications
- Material: Aluminium.
- Size: 305x137x169 mm
- Weight: 4.8 kg

Environmental specifications
- Operating Temperature: -40° to +70°C.
- Storage Temperature: -45° to +85°C.
- Humidity: 0 – 100%

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