LRU

Operational description

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Description of the LRU relay

The LRU relay operates within the frequency band from 215 MHz to 250 MHz. Within that band, it uses a minimum 200-kHz bandwidth, on one or two channels, each with a 800-kHz maximum bandwidth, depending on the selected data rate. The user is responsible for inquiring about local radio frequency regulations and using the frequency band accordingly.

The LRU unit operates from a 10.5 VDC to 15.0 VDC power supply voltage. The power supply should be capable of generating a minimum current of 15 A. A 12 VDC battery can be used as a power supply. The power supply used shall be compliant with the rules and regulations of the FCC, of Canada or with other local regulations.

The antenna impedance to be used is 50 Ohm. The maximum VSWR is 1.7:1 at the operating frequencies.

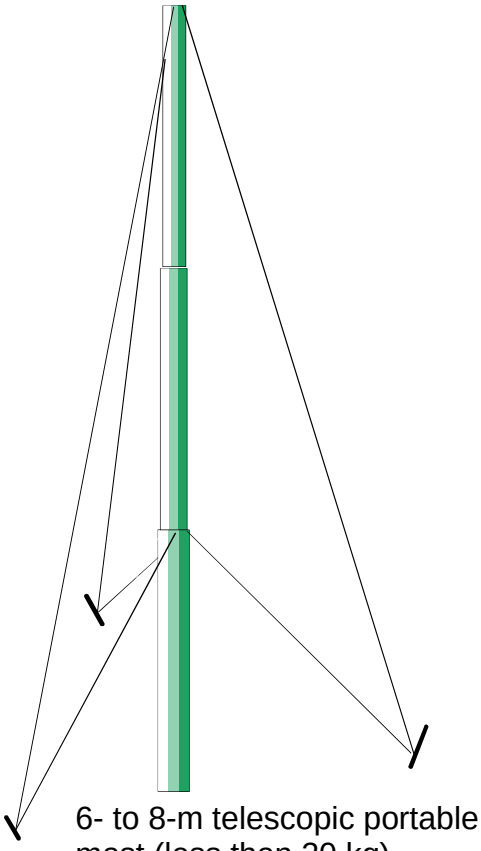
The allowable temperature range for both operating and storage is -40°C to +70°C.

The LRU unit comes with standard 408UL Transverse, Line, Power and XDEV connectors. The Type-N, radio connector is waterproof when connected. Attention should be paid to put the cap in place on the radio connector whenever the unit is not in use, in order to keep the connector clean and the unit waterproof.

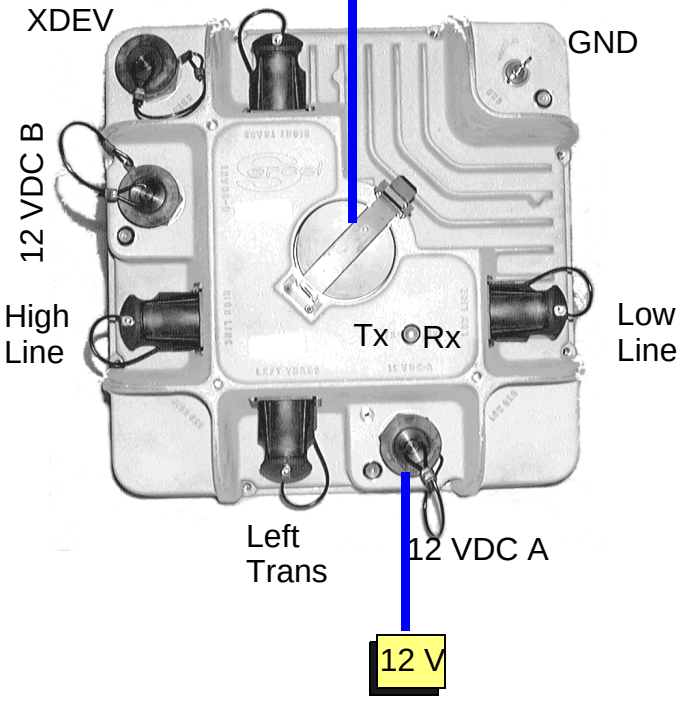
The LRU relay is a half-duplex transmission system. With "Field ON" activated in the Line main window on the HCI, the unit connected to the side towards the Central Unit continuously transmits a time tick signal (every 50 ms) that allows the other end to keep clock-synchronized.

Supplied along with each LRU relay are two 7-elements antennas and two 6- to 8-m telescopic portable masts.

7-element
Yagi antenna



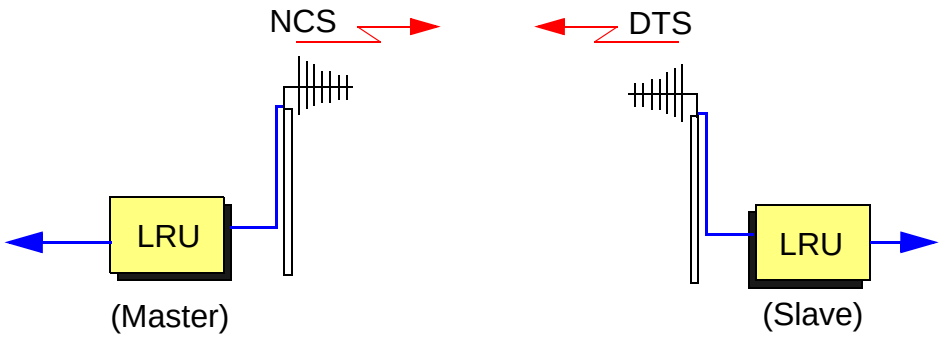
6- to 8-m telescopic portable
mast (less than 20 kg)



Theory of operation

The LRU relay uses a half-duplex transmission protocol.

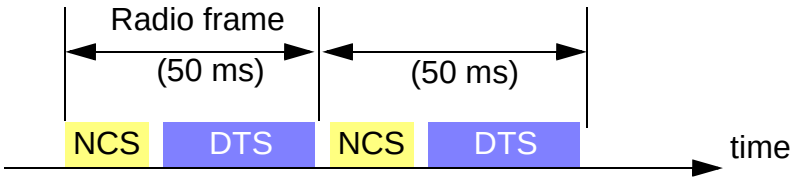
Half-duplex



In the LRU transmission protocol, time is shared between transmission of Master-to-Slave messages and transmission of Slave-to-Master messages.

Master-to-Slave messages are called Network Control Sequences (**NCS**), used for synchronization, zero-time transmission and control.

Slave-to-Master messages are called Data Transfer Sequences (**DTS**), used for data retrieval, seismonitor and collecting test results.



Typically, NCS messages are transmitted every 50 ms. In reply to an NCS message, the Slave LRU transmits a DTS message.

LRU frequency management

The RF transceiver in the LRU unit uses a single 2-MHz band for both transmission and reception. That band is selected between 216 MHz and 249 MHz using the "**Center Frequency**" parameter.

Within the 2-MHz bandwidth, you can choose which channel(s) to use for NCS and DTS messages, by specifying:

- a **Control Channel Frequency** for NCS messages,
- a **Data Channel Frequency** for DTS messages.

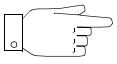
The necessary bandwidth for a Data Channel depends on the expected **Data Rate** (256, 512, 1024 or 2048 kbps). See the diagram on *page 7-5*.

The RF transmission is made using 200 kHz or 800 kHz wide digital phase modulation (respectively, FCC emission designators 200K0D1D or 800K0D1D).

NOTE: Because the LRU uses a half-duplex protocol, you can choose the same frequency for the **Control Channel** and the **Data Channel**.

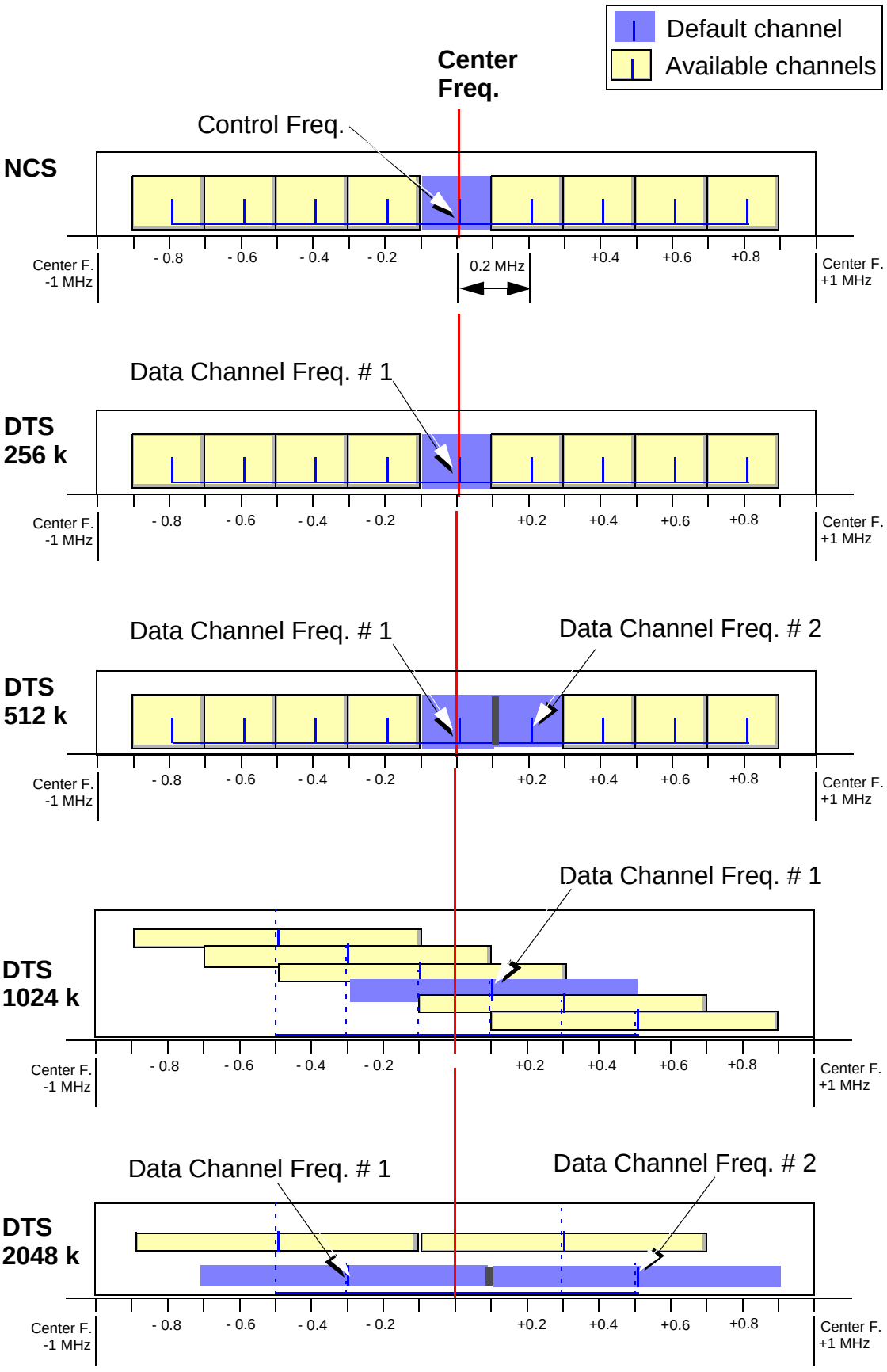
IMPORTANT

The two LRU units making up an LRU relay cell should have the same **frequency** and **data rate** settings.



NOTE: The available frequency band depends on the regional settings chosen by the user when installing software on the HCI workstation and on the FDPA408 terminal. For compliance with Canadian and US communications regulations, the frequency band is limited to respectively:

- Canada: 217 to 218 MHz and 219 to 220 MHz.
- USA: 216 to 218 MHz and 219 to 220 MHz.


Default channel
Available channels
Center Freq.
Control Freq.
NCS
Center F. -1 MHz
- 0.8
- 0.6
- 0.4
- 0.2
0.2 MHz
+0.4
+0.6
+0.8
Center F. +1 MHz
Data Channel Freq. # 1
DTS 256 k
+0.2
Data Channel Freq. # 2
DTS 512 k
DTS 1024 k
DTS 2048 k

Desensitization

Note that the maximum covered range may be shorter on desensitized channels (i. e. channels on which the strength of the received signal is normally decreased by the presence of spurious signals from the 8-MHz and 33-MHz master oscillators in the LRU). In the table below are the channels that may be affected by desentization, depending on the selected Data Rate.

Centre Freq. (MHz)	Data Rate (kb/s)	Desensitization	
		affects	on channels
221.184	256 & 512	NCS & DTS	221.2
	1024 & 2048	DTS	221.0 221.1 221.2 221.3 221.4
229.376	256 & 512	NCS & DTS	229.4
	1024 & 2048	DTS	229.2 229.3 229.4 229.5 229.6
233.309	256 & 512	NCS & DTS	233.3
	1024 & 2048	DTS	233.1 233.2 233.3 233.4 233.5
237.568	256 & 512	NCS & DTS	237.6
	1024 & 2048	DTS	237.4 237.5 237.6 237.7 237.8
245.760	256 & 512	NCS & DTS	245.7 245.8
	1024 & 2048	DTS	245.6 245.7 245.8 245.9 246.0

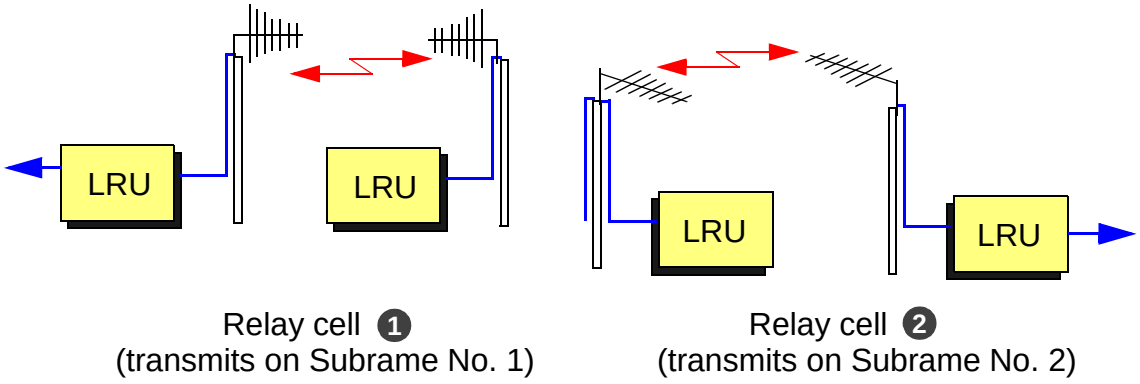
TDM (Time Division Multiplex)

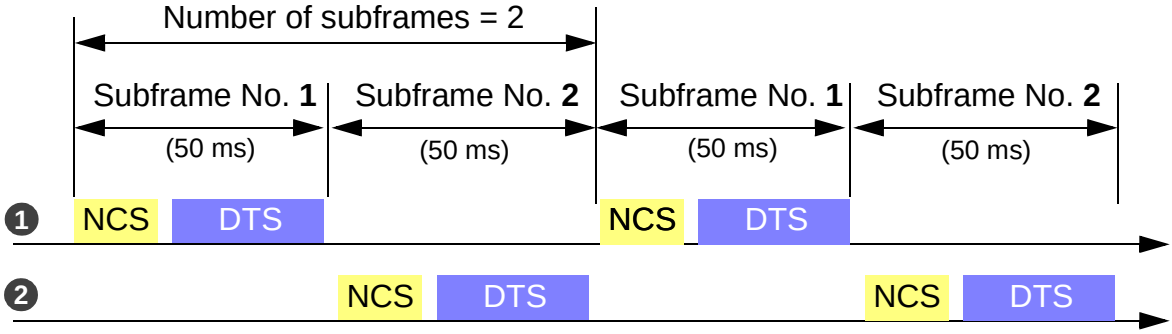
The Time Division Multiplex technique allows several LRU relay cells to use the same bandwidth without any conflict, by assigning distinct "**Subframes**" (i. e. time slots) to adjacent cells transmitting in that bandwidth.

The TDM technique is especially helpful in situations where neighbouring relay cells are likely to impinge on one another, as is the case:

- where two series-connected relay cells use the same antenna mast (see LRU User Manual),
- where too few frequency channels are available.

Where the TDM technique is implemented, each relay cell uses a dedicated "**Subframe**" (i. e. one radio frame out of two or four) instead of using every radio frame.





As a result the "**Data rate**" is divided by the "**Number of subframes**".