Dynamics Explorer Plasma Wave Instrument (PWI)

Instrumentation Summary Description

The University of Iowa

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Introduction

The Plasma Wave Instrument (PWI) flown on the Dynamics Explorer 1 spacecraft was designed and fabricated by the Plasma Wave Engineering Group based at the University of Iowa Department of Physics and Astronomy. The PWI instrument, designed to measure plasma waves and quasi-static electric fields in the Earth's magnetosphere, was operated from mid-1981 to early 1991.

A full description of the DE-1 PWI instrument and its capabilities is available in *Space Sciences Instrumentation* 5 (1981) 535-550.

This instrument summary includes a block diagram of the DE-1 PWI, descriptions of individual instrument subsystems, and some examples of PWI data products.

Instrumentation Summary

The DE PWI was implemented as a single main electronics unit, supported by several electric and magnetic antennas and associated preamplifiers.

The main electronics was comprised of a set of subsystems as follows:

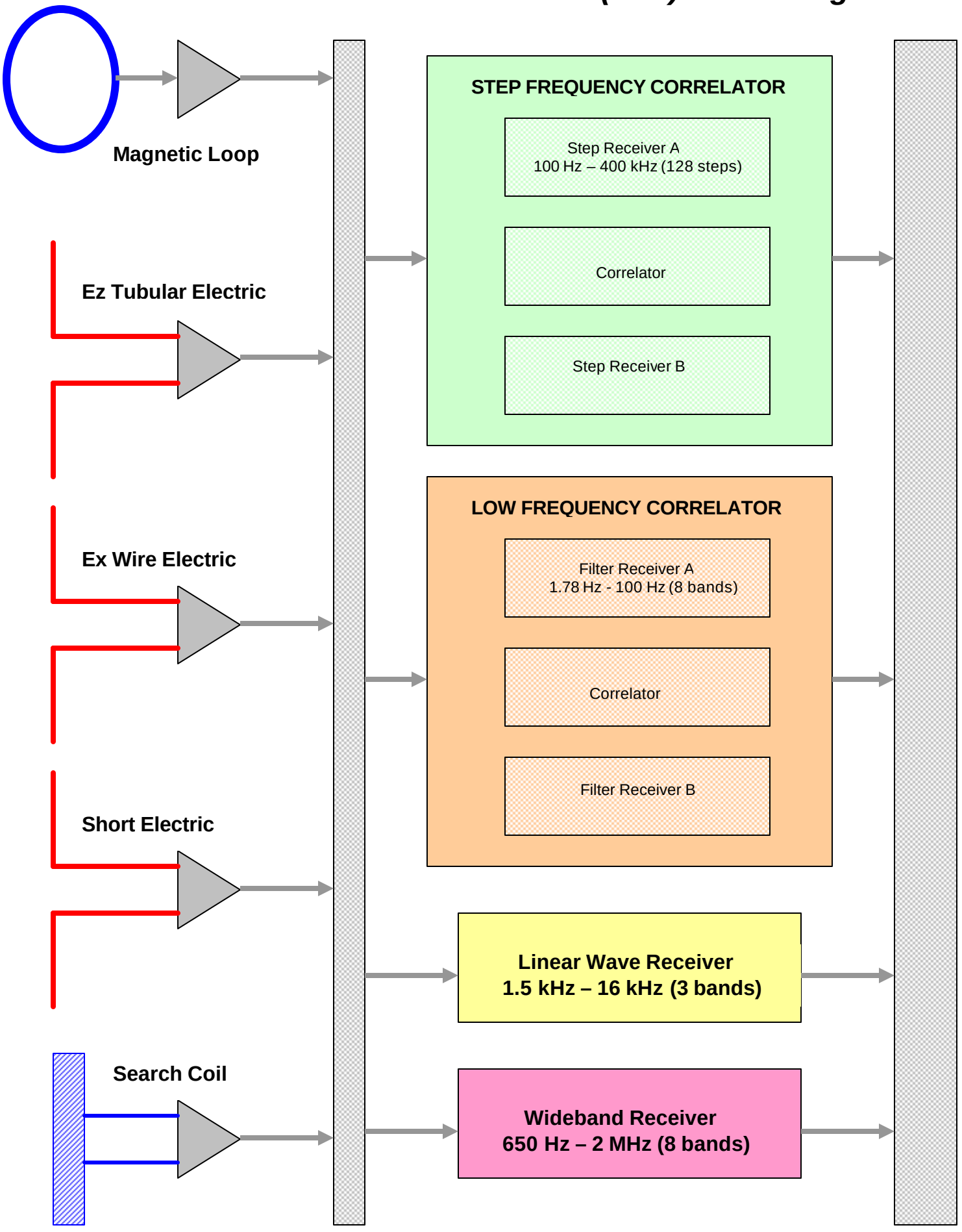
- Sweep Frequency Correlator (SFC)
- Low Frequency Correlator (LFC)
- Wideband Receiver (WBR)
- Linear Wave Receiver (LWR)

The set of antennas supporting the PWI receiver subsystems were as follows:

- Long Wire Electric (Ex)
- Tubular Electric (Ez)
- Short Electric (Es)
- Magnetic Loop (B)
- Magnetic Search Coil (H)

A block diagram of the DE-1, and a more detailed summary of individual receiver subsystems, is given in the following section.

DE-1 Plasma Wave Instrument (PWI) Block Diagram



PWI Receiver Characteristics

Step Frequency Correlator (SFC)

Frequency Range	4 channels; 100-800 Hz, 0.8 – 6.4 kHz 6.4 -50 kHz simultaneously for 2 receivers
Time Resolution	128 frequency steps log-spaced 100 Hz - 400 kHz with 1% bandwidths
Amplitude Resolution	Normal mode: 100 dB with option for 30 dB attenuation
Sensors	Any pairs from Ex, Ez, Es and B
Correlator Resolution	+/-5% normalized correlation and +/-5% phase
Implementation	Two double-conversion, SSB, synchronous stepping receivers with common frequency synthesizer. Waveforms are correlated in 1-bit XOR to give in- and quad-phase products.

Low Frequency Correlator (LFC)

Frequency Range	2 receivers with filters at 1.8, 3.1, 5.6, 10, 18, 31, 56 and 100 Hz.
Frequency Resolution	8 filters; 1.8 – 100 Hz with +/- 15% bandwidth
Amplitude Resolution	100 dB
Sensors	Any pairs from Ex, Ez, Es and H
Correlator Resolution	+/-5% normalized correlation and +/-5% phase
Implementation	Filter receivers are routed to logarithmic compressors for 100 dB amplitude range.. Waveforms are correlated in 1-bit XOR to give in- and quad-phase products.

PWI Receiver Characteristics (continued)

Wideband Analog Receiver (WBR)

Frequency Range	Selection of 1, 10 or 40 kHz bandwidth with lower band edge at 0.65, 31.25, 62.5, 125, 250, 500, 1000 or 2000 kHz
Amplitude Range	100 dB
Sensors	Any one of Ex, Ez, Es, B or H
Implementation	Bandpass filter at 0-1 kHz into a log compressor amplifier; band pass filters at 0.65 – 10 kHz and 0.65 - 40 kHz for baseband or for single-sideband down conversion into AGC amplifier

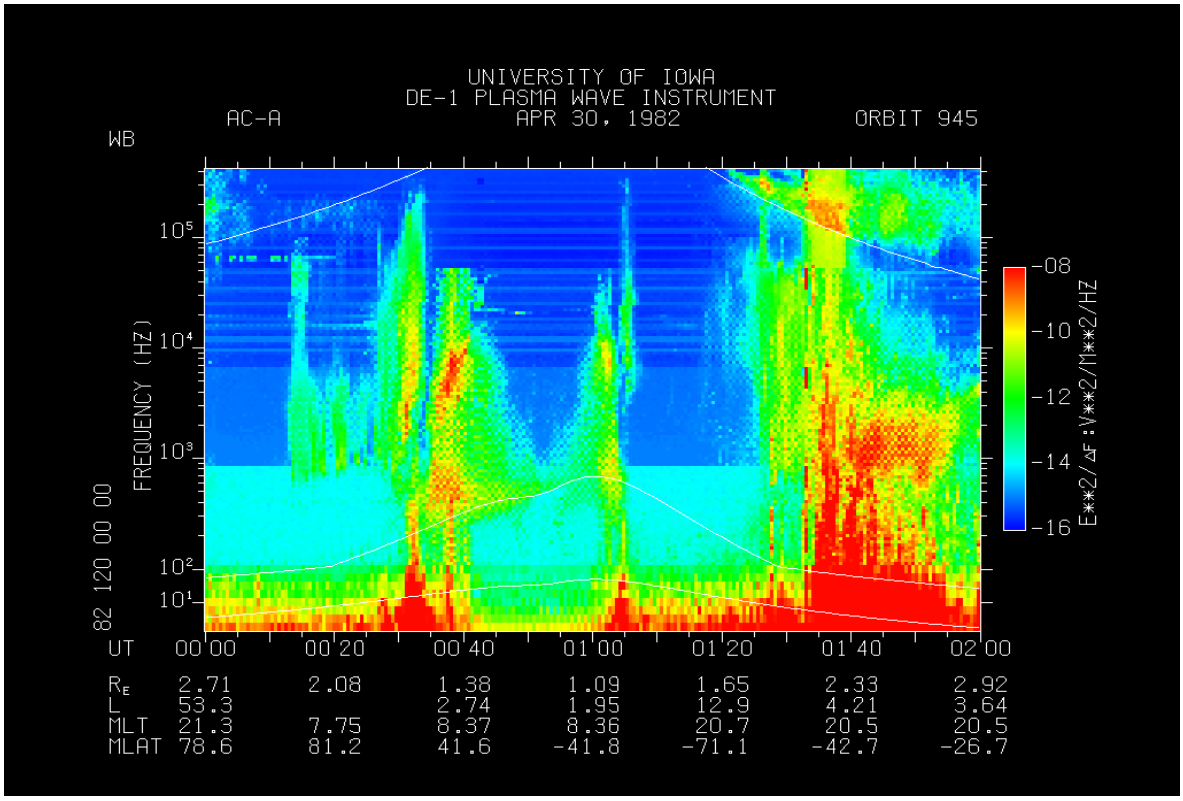
Linear Wave Receiver (LWR)

Frequency Range	4 channels: 1.5-3, 3-6, 10-16 kHz, and 3.11 kHz (15% BW)
Amplitude Range	70 dB in 10 dB steps with 30 dB linear detector range in each step
Sensors	Any one of Ex, Ez, B or H
Implementation	Bandpass filters into receiver with 10, 20 and 40 dB gain amplifiers; gain state selected to set noise level 30 dB below maximum input signal to transmitter

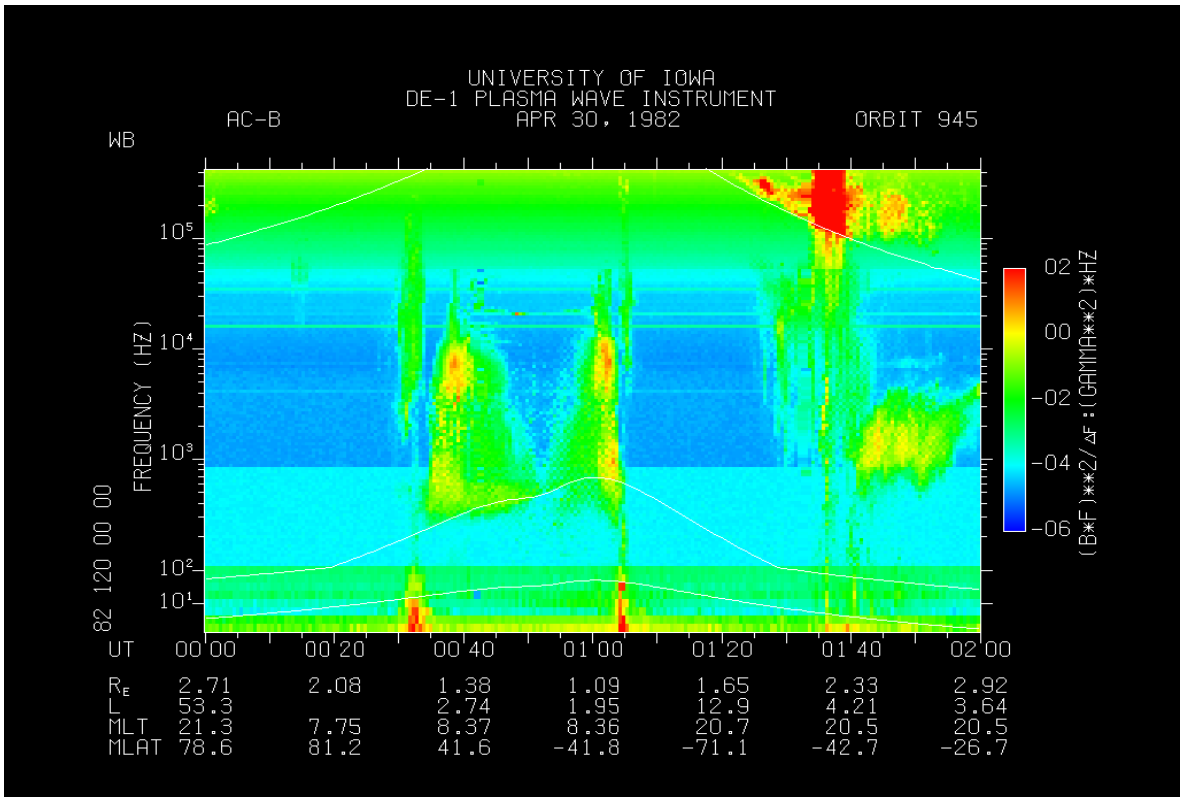
PWI Science Data Examples

The following are examples of standard data products produced using the DE-1 PWI in-flight science data.

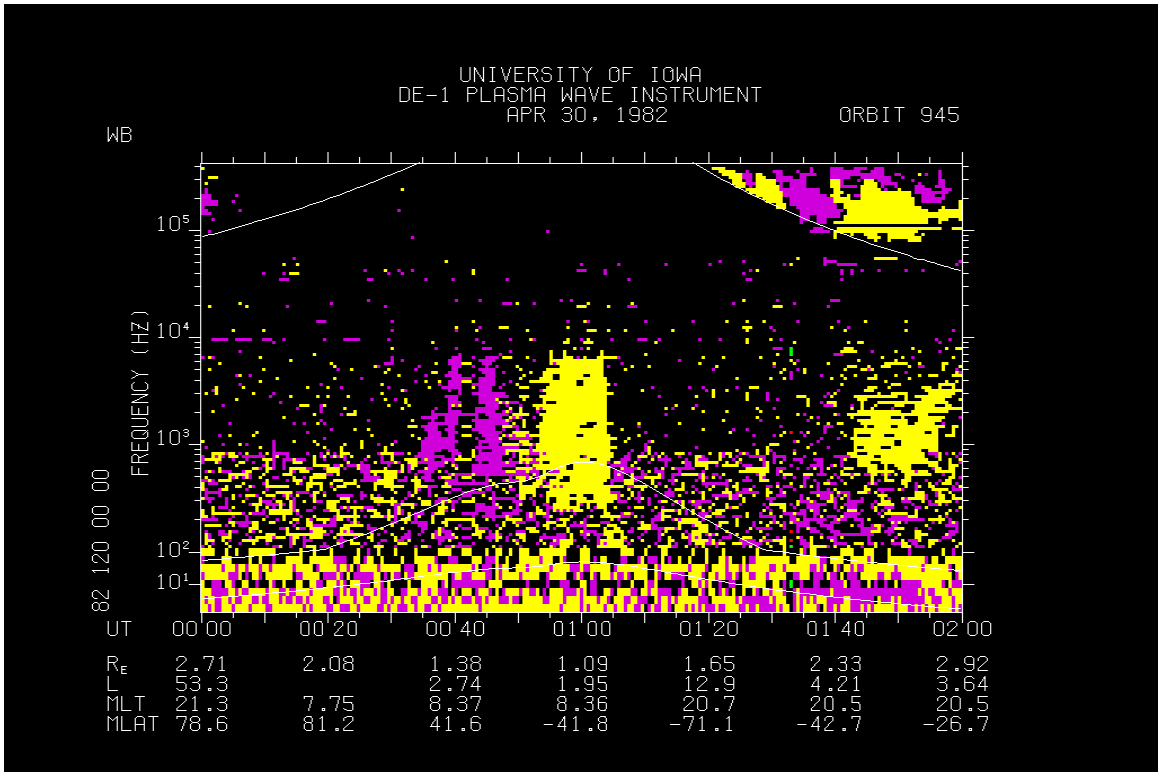
SFR-A Spectrogram (Ex antenna)



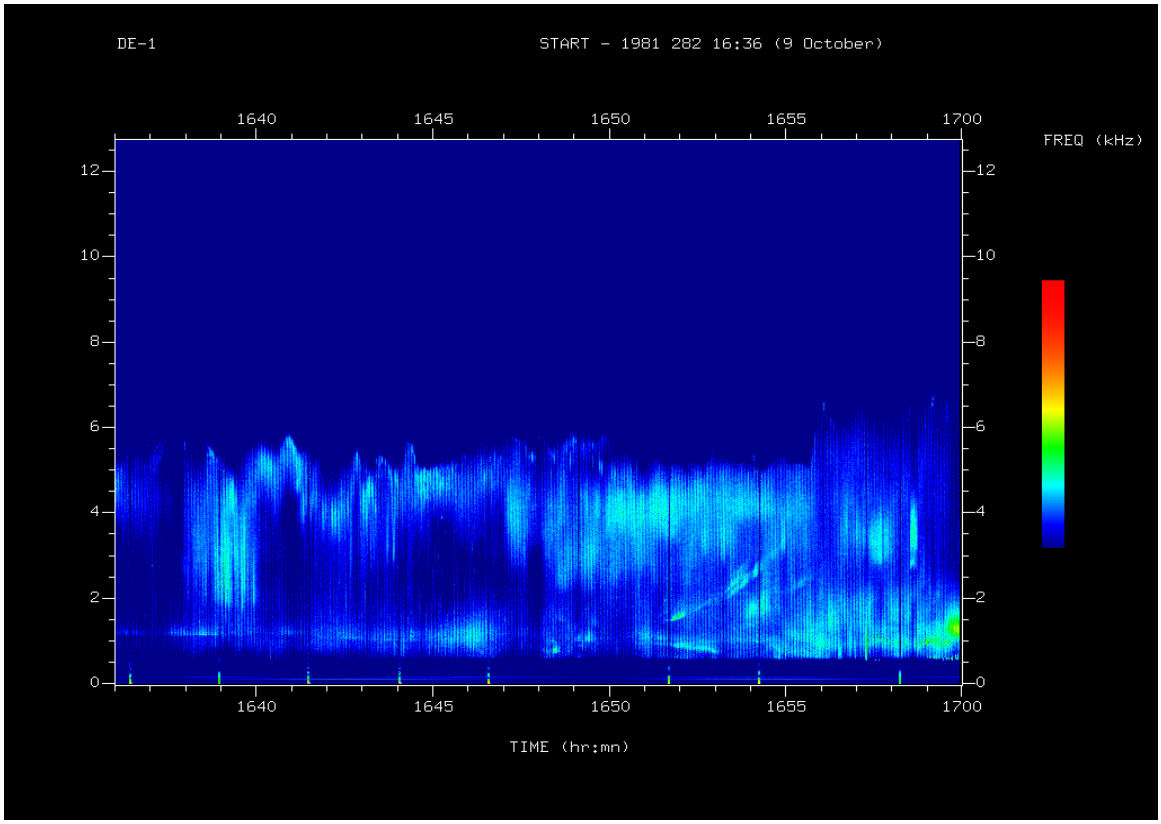
SFR- B Spectrogram (Loop antenna)



SFC Phase Spectrogram



Wideband Receiver Spectrogram (10 kHz)



Wideband Receiver Spectrogram (40 kHz)