MOTOROLA

RECEIVER MODULE

403 to 470 MHz
MODEL CLN1213 (with Varactor Preselector)
MODEL CLN1214 (without Varactor Preselector)

1 DESCRIPTION

The CLN1213, CLN1214 Receiver Modules are described in this section. A general description, identification of inputs and outputs, a functional block diagram, and functional theory of operation are provided. The information provided is sufficient to give service personnel a functional understanding of the module, allowing maintenance and troubleshooting to the module level. (Refer also to the Maintenance and Troubleshooting section of this manual for detailed troubleshooting procedures for all modules in the station.)

General Description

The Receiver Module provides the receiver functions for the UHF station. The receiver module performs highly selective bandpass filtering and dual down conversion of the station receiver RF signal. A custom receiver IC then performs an analog-to-digital conversion of the received signal and outputs a differential data signal to the Station Control Module. The CLN1213 receiver module contains an on-board varactor-tuned preselector which covers the entire frequency range of 403 to 470MHz. The CLN1214 receiver module is identical to the CLN1213 module except that the varactor-tuned preselector is replaced by a low pass filter and an external metal preselector.

Overview of Circuitry

The Receiver Module contains the following circuitry:

- Frequency Synthesizer Circuitry – consisting of a phase-locked loop and VCO, generates the first LO injection signal
- Varactor-tuned Preselector Filter (CLN1213 only) – provides bandpass filtering of the station receiver RF input (not used if metal external preselector is specified).
- Receiver Front End Circuitry – performs filtering, amplification, and the first down conversion of the receiver RF signal
- Custom Receiver IC Circuitry – consists of a custom IC which performs the second down conversion, filtering, amplification, and analog-to-digital conversion of the receive signal
- A / D Converter Circuitry – converts analog receiver status signals to digital format for transfer, upon request, to Station Control Module
- Local Power Supply Regulation – accepts +8V, +10V and +15V inputs and outputs +5V, +10V, and +15V operating voltages.

2 INPUTS AND OUTPUT CONNECTIONS

Figure 1 shows the receiver module input and output external connections.

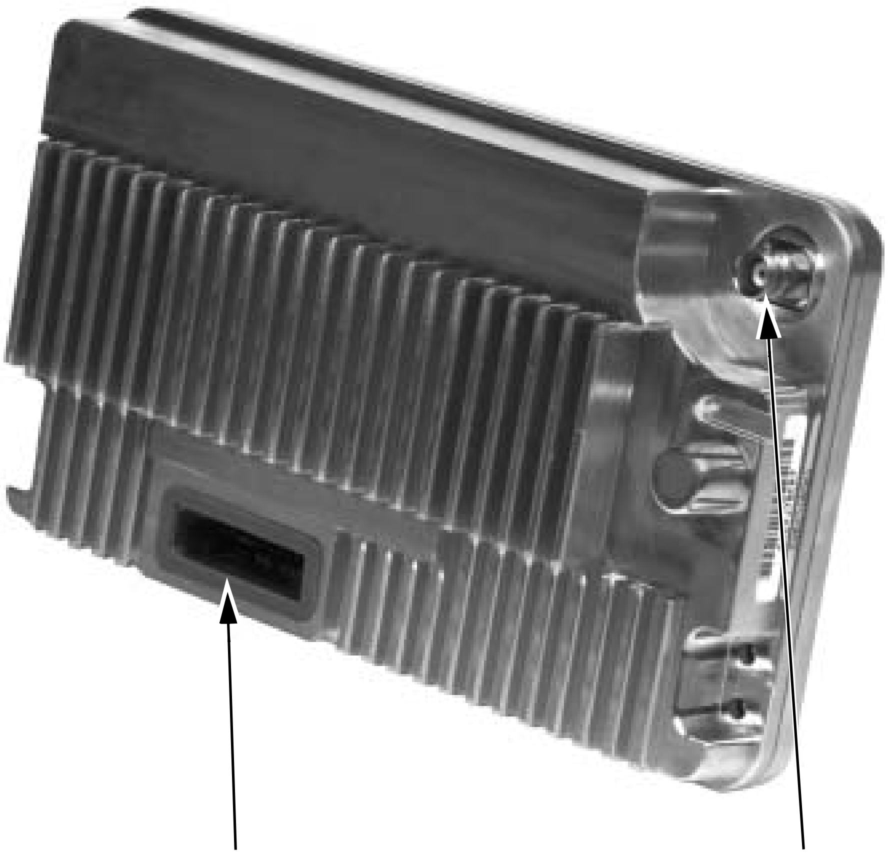


Figure 1. UHF Receiver Module Inputs/Outputs

3 FUNCTIONAL THEORY OF OPERATION

The following theory of operation describes the operation of the receiver circuitry at a functional level. The information is presented to give the service technician a basic understanding of the functions performed by the module in order to facilitate maintenance and troubleshooting to the module level. Refer to Figure 2 for a block diagram of the receiver module.

Synthesizer and VCO Circuitry

Introduction

The synthesizer and VCO circuitry generates the first LO injection signal for the first mixer in the receiver front end circuitry. Functional operation of these circuits is as follows.

Phase-Locked Loop

The phase-locked loop (PLL) IC receives frequency selection data from the Station Control Module microprocessor. Once programmed, the PLL IC compares a 2.1MHz reference signal (from Station Control Module) with a divided-down feedback sample of the VCO output. Depending on whether the feedback signal is higher or lower in frequency than the 2.1MHz reference, correction pulses are generated. The width of these correction pulses is dependent on the amount of difference between the 2.1MHz reference and the VCO feedback.

The up / down pulses from the PLL IC are fed to a charge pump which outputs a dc voltage proportional to the pulse widths. This dc voltage is then low-pass filtered and fed to the VCO as the CONTROL VOLTAGE.

Note

If a frequency change is requested by the microprocessor, the low-pass loop filter is momentarily bypassed to accelerate the frequency change.

VCO

The dc control voltage from the synthesizer is fed to dual VCOs which generate the first LO injection signal. One VCO generates signals in the upper half of the band, while the other VCO generates signals in the lower half of the band. Only one VCO is active at a time. Selection of the active VCO is provided by a BANDSHIFT signal from the PLL IC.

The active VCO responds to the dc control voltage and generates the appropriate RF signal. This signal is fed through a buffer amplifier and impedance matching and output to the first LO injection amplifier in the receiver front end circuitry. A sample of the injection signal is returned to the PLL IC (via a feedback buffer) to serve as a VCO feedback signal.

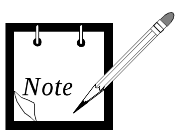
Receiver Front End Circuitry

The receiver RF input is fed from the antenna to the receiver module (or a 3-pole external preselector filter, if specified, which provides highly selective bandpass filtering). The signal is low-pass filtered, routed through a varactor-tuned preselector (if specified), amplified, image filtered, and fed to one input of the first mixer. The signal is mixed with the first LO injection signal (generated by the synthesizer / VCO circuitry) to produce a 73.35 MHz first i-f signal.

The first i-f signal is 2-pole bandpass filtered and fed to a FET amplifier. The amplifier gain is controlled by AGC properties inherent in the amplifier design. The amplified first i-f signal is then 4-pole bandpass filtered and fed to the RF input of the custom receiver IC.

Custom Receiver IC Circuitry

The custom receiver IC provides additional amplification, filtering, a second down conversion, and finally analog-to-digital conversion of the second i-f signal. The digital receive signal is then sent via differential drive circuitry to the Station Control Module. The data signal contains the necessary I and Q quadrature information, AGC information, and other data transfer information required by the Station Control Module to process the receive signal.



The recovered audio signal is in digital format throughout the station circuitry, resulting in a more noise-free, linear receiver. Analog audio is present only in the external speaker driver circuitry on the Station Control Module and on the Wireline Interface Board at the phone line connection to and from the station.

The remainder of the custom receiver IC circuitry consists of timing and tank circuits to support the internal oscillator, second LO synthesizer circuitry, and second i-f circuitry.

A serial bus allows data communications between the custom receiver IC and a Digital Signal Processor (DSP) located on the Station Control Module (via a DSP ASIC device). This bus allows the DSP to control various current and gain settings, establish the data bus clock rate, program the second LO, and perform other control functions.

A/D Circuitry

Analog signals from various strategic operating points throughout the receiver board are fed to an A / D converter, which converts them to a digital signal and, upon request by the Station Control Module, outputs the signal to the Station Control Module via the SPI bus.

Voltage Regulator Circuitry

The voltage regulator circuitry consists of two +5V regulators, and filtering circuitry. The +5V regulators accepts a +8V input (from a regulator on the backplane) to generate Custom Analog +5V and Custom Digital +5V operating voltages to supply the custom Receiver IC and Synthesizer IC.

In addition to the voltage regulator circuitry, +15V from the Station Control Module is filtered for the synthesizer charge pump. Also, +10V (from a regulator on the backplane) is filtered to supply a +10V operating voltage for the receiver board circuitry.

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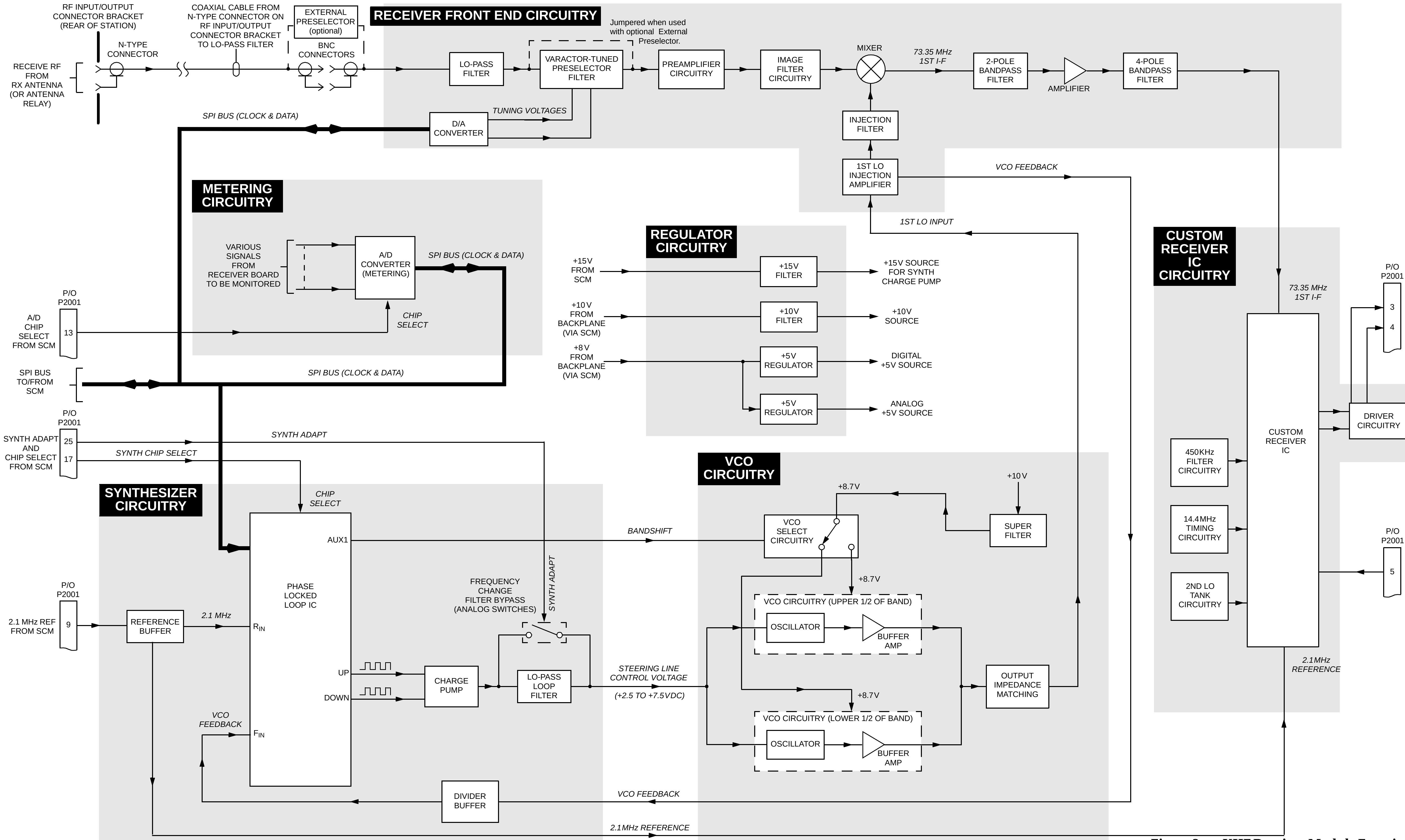

Figure 2. UHF Receiver Module Functional Block Diagram