

**Rockwell MDM-3001  
used as an  
HF CHANNEL SIMULATOR  
by  
NNN0WWL**

A good correlation exists between the results obtained during laboratory tests conducted using an HF Channel Simulator and the test results obtained during on-air equipment trials<sup>[1]</sup>. The use of a channel simulator permits comparisons to be made under identical controlled circumstances, which can be varied to represent a wide range of anticipated real world operating conditions.

The Rockwell MDM-3001 MIL-STD Data Modem provides an HF Channel Simulator (HFCHANSIM) mode specifically for use in testing of another MDM-3001 modem in conjunction with a Protocol Analyzer to provide for Bit Error Rate tests of the modem under test.

The MDM-3001 can be configured and controlled for all modes of operation, both two-way modem modes and HFCHANSIM via its front panel 20x2 LCD display and 3 button Up/Dn/Select user interface or via computer remote control where a program written to the MDM-3001 binary remote control protocol is required..



For basic HFCHANSIM use the only interfacing required is GND, Audio In and Audio Out using the J1 AUDIO connector on the rear of the unit. The J2 DATA connector is only used for HFCHANSIM should remote control be required.

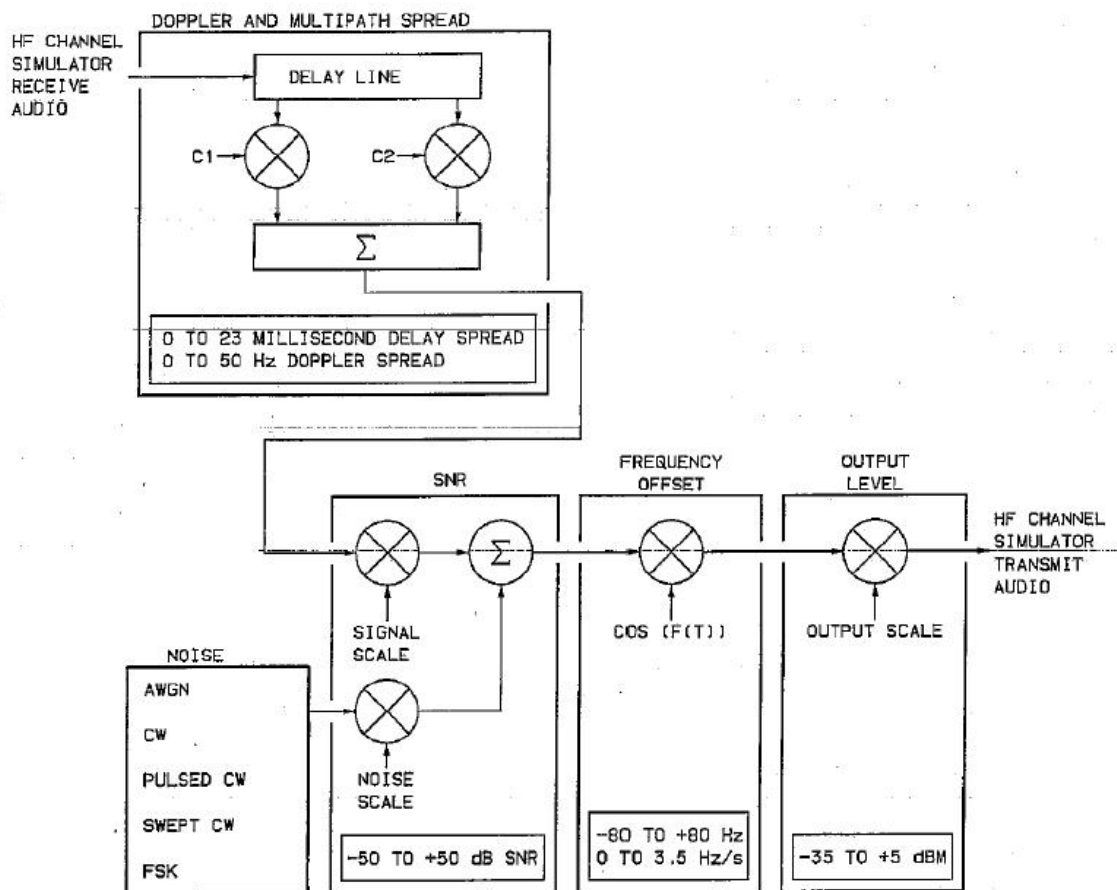


<sup>1</sup>ITU-R Recommendation 520-2: Use of High Frequency Ionospheric Channel Simulators, 1978/1982/1992.

The MDM-3001 is DSP based using an ADSP-21062 32-bit DSP processor that operates a high sampling rate of 40 million instructions per second (MIPS) and performs 32-bit fixed-point and either 32- or 48-bit floating point calculations. High Precision Analog-to-Digital (A/D) and Digital-to-Analog (D/A) converters provide the interface to the analog world. Low noise 600-ohm balanced audio input and output ports are provided. The output audio level can be adjusted over the range of  $-30$  to  $+5$ dBm.

The HFCHANSIM capability can be characterized as providing channel conditions which include Additive White Gaussian Noise (AWGN), Rayleigh and Ricean fading as well as interference. This units HFCHANSIM implements a stationary Gaussian Scatter Ionospheric propagation model as defined by CCIR-549<sup>[2]</sup>.

The MDM-3001 HFCHANSIM block diagram is depicted below.



The units HFCHANSIM supports one or two channels of Multipath. Doppler spreads up to 50Hz and Delay spreads up to 23 milliseconds are supported. The average Signal-to-Noise Ration (SNR) can be adjusted from  $-50$  to  $+50$ db as measured in a 3kHz bandwidth. A frequency offset can be added to the output signal from  $-80$  to  $+80$ Hz and be swept between the selected value to a rate (Slew Rate) of 3.5Hz per second and up to  $+50$  DB of Attenuation of the input signal. Various noise sources are selectable to allow for channel various conditions of channel interference to be simulated including that of

<sup>2</sup>CCIR Recommendation 549-3, HF Ionospheric Channel Simulators

AWGN, Continuous Wave (CW), Pulsed CW, Swept CW and Frequency-Shift Keying (FSK) waveforms generated within the HFCHANSIM. These additional signals can be adjusted within their specific characteristics, for example baud rate can be set of FSK. Additional types of interference signals can be mixed externally with the incoming test signal.

The HFCHANSIM SNR information display screens provide the current SNR and a long term average SNR as measured internally to the modem. The long term average is used to verify the SNR when fading is selected. The SNR screen is only displayed when there is an input audio level present else a NO INPUT SIGNAL message is displayed.

Although the HFCHANSIM provides an input attenuator and external one may be required. In addition an external attenuator may also be provided between the units output and the input of the unit under test where in the case of testing MS-DMT the level is maintained at about  $-55\text{db}$  ( $\pm 1\text{db}$ ).

The units HFCHANSIM unlike the newer Rockwell MDM-9604, does not provide DSP based STANAG 4203 filters for use when performing base band testing. Thus when I desire to roughly simulate S4203 filtering I make use of Idium Press SCAF-1 Active Filters (<http://www.idiompres.com/scaf-1.php>) that provides a factory tuning range of 450Hz to 3.5 kHz as seen below where above the cut off frequency the roll off is 96 dB per octave. The filter passband range is easily changed with simple RC component changes to slide low frequency response of the filter down to achieve the 300-3300hz passband of S4203. The passband amplification of signal through the SCAF-1 is adjustable internally from  $-10\text{ dB}$  to  $+5\text{ dB}$ .

