Adams Russell

COMMUNICATIONS PROGRAMS DIVISION

MODEL AR-12/96 FLEXIBLE DEMODULATOR/ DEMULTIPLEXER

FEATURES

- Real Time Demodulation
  OOK, FSK, PSK, QAM, Trellis
- Real-Time Demultiplexing
  R.101A, R.101B, and Strapping
- Real-Time Decoding
  Derandomization, BAUDOT, ASCII, EBCDIC

DESCRIPTION

Voice Grade Channel Demodulator

The AR-12/96 is a flexible demodulator which performs the functions of demodulation, channel equalization, bit synchronization, frame synchronization, derandomization, and demultiplexing of data signals transmitted over voice grade channels. Digital signal processing software combined with state-of-the-art digital hardware provides the capability to demodulate on-off keyed tones, voice frequency telegraphy (MTFSK), M-ARY phase shift keyed tones and quadrature amplitude modulated (QAM) tones in this single unit. The unit is easily configured for demodulation of standard international data signals by the operator using front panel keyboard inputs or through a remote control port. The AR-12/96 may be used as a stand-alone unit, or connected to an IBM PC/AT to perform powerful signal classification and demodulation functions. This unit replaces multiple signal-specific demodulators with a single unit which can be reconfigured in realtime by the operator. The software-based algorithms used in the AR-12/96 are adaptable to new signal types, modulation formats, randomizers, and frame synchronization formats by simple parameter changes, permitting the user to quickly adapt to changing signal environments. The AR-12/96 represents a significant advance in the state-of-the-art with the potential for greatly expanded capability at affordable prices. The hardware processor and software algorithms embodied in the AR-12/96 represent over ten years of research effort at Adams-Russell.

Performance Better Than Commercial Modems

The AR-12/96 Flexible Demodulator automatically acquires and locks to the 0-4 kHz analog input signal without use of a training sequence. This performance is achieved even when the signal is corrupted by maximum distortion (CCITT M.1020) and other tolerance extremes. The acquisition and data recovery have been proven to have better performance than commercial modems compatible with standard formats including:

TELEX/VFT —

CCITT R.31, R.35, R.36, R.37, R.38, R.39

DATA —

CCITT V.21, V.22, V.22 bis, V.23, V.26A/B, V.27, V.29, Bell 103, 113, 201, 202, 208, 209, 212

Codex 4800, 7200, 9600 (R.101A or R.101B formats, employing strapping)

Local/Remote Control

The AR-12/96 may be controlled manually via the simple control panel using operator prompts presented on the easily read LED alphanumeric display. Alternately, all operator functions may be performed via control interface providing fully automated control for system applications.

Multi-Channel Output

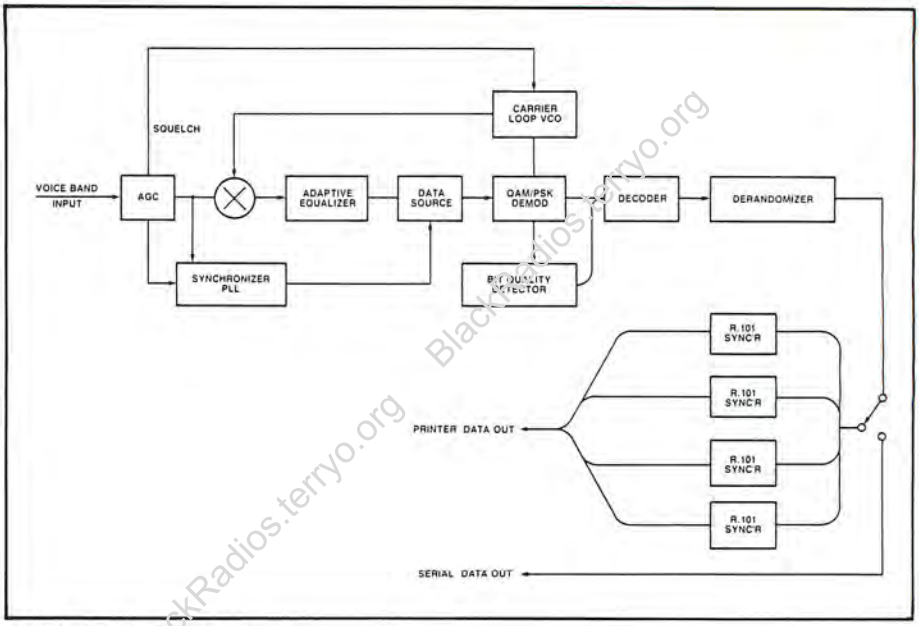
The AR-12/96 simultaneously demodulates, demultiplexes and code-converts all channels contained in the voice channel input. The channels are assembled and output with tags to facilitate further processing or printing. Individual channel polarity and coding selection, as well as R101A/R101B demultiplexing, provide adaptabilitiy to all standard signal configurations.

Built-In Diagnostics

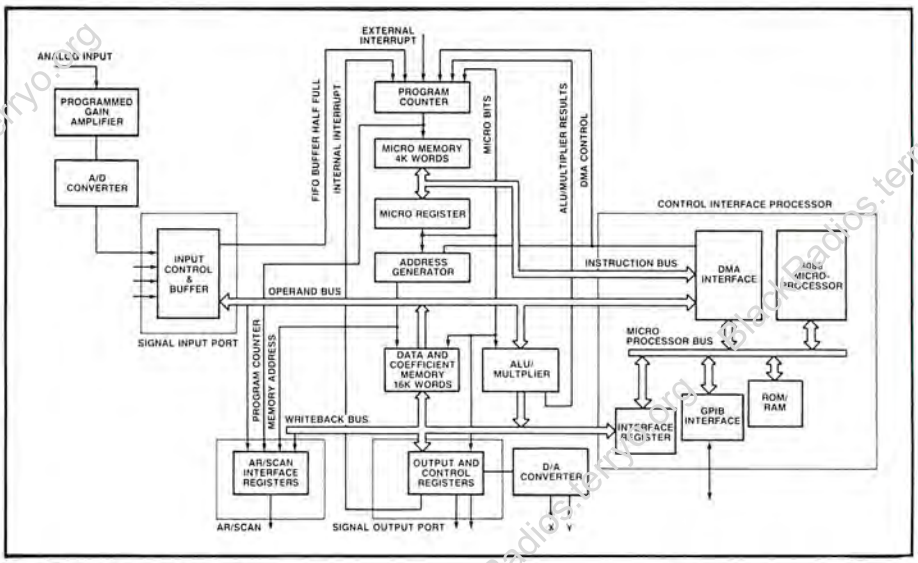
The AR-12/96 incorporates control programs specifically designed to exercise the unit thoroughly within a few seconds to confirm proper operation. Hardware test coverage in excess of 90% ensures rapid detection of failures and maximum confidence in demodulator performance.

Programmed Inplementations

Aside from input signal conditioning and analog/digital conversion, all demodulation signal processing is performed by programs controlling a high speed microcomputer within the AR-12/96. This provides drift-free operation without the need for periodic adjustments and near ideal implementation of the acquisition and demodulation function. Complex algorithms, including phase-locked loops, adaptive equalization, closed loop tracking, decoding and derandomization, are all performed by a common set of control programs controlled by a table of over 500 parameters



QAM/PSK Signal Flow



AR-40D Architecture

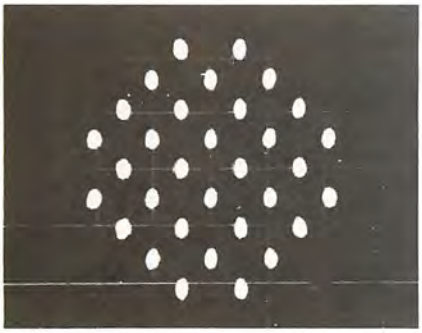
for each format. Each of these functions is based upon sound theory and implemented according to the results of years of experimentation and evaluation to assure optimum performance.

Adaptable To New Waveforms

The approach of using "table driven" software not only provides efficient use of processing resources, but also eases the adaptation to new waveforms. Through the use of the menu-driven controls, the operator may choose to set new parameters for controlling the demodulation function. For reasonable field operation, these are limited to polarity, synchronization, coding, new derandomizer polynomials, and demultiplexing formats. Totally new formats are easily developed at the factory.

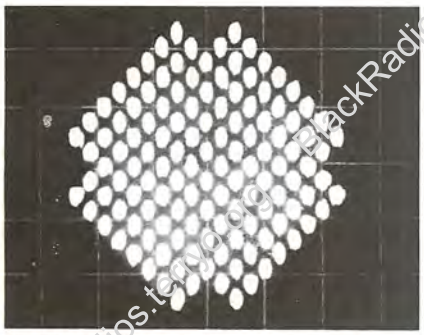
AR-40 Signal Processor

The AR-12/96 employs the latest version of Adams-Russell's proven signal processing computer. Recently revised to incorporate advanced, low-power CMOS technology and to upgrade its input/output processor to the IBM-PC compatible 8088, the AR-40D provides the input signal conditioning and digital processing to implement all AR-12/96 functions. The input signal level is controlled by a programmed gain amplifier and digitized to 12-bit resolution at 8,000 samples per second (Nyquist for 4 kHz channel). The 8088 input/output processor provides all program storage and control (via control panel or remote) functions. It also processes all output data and adapts to changes in output or control operation. The high speed processor operating programs loaded by the 8088



9600 bps

12.0 kbps



14.4 kbps - Trellis Option

processor perform all real-time acquisition, tracking and demodulation functions at a rate in excess of 18 million operations per second.

A complete suite of VAX and PC based software development tools eases development of new demodulation features and ensures long term support.

Signal Analysis (Option)

The AR-12/96 provides real-time x, y analog outputs to allow monitoring of the demodulation constellation on a standard oscilloscope during the acquisition and demodulation process to ensure proper selection of demodulator format and demodulator performance. The same outputs may be selected via the operator controls to display a variety of other formats to evaluate and identify the target signal prior to selection of demodulation parameters. They include:

- Spectral analysis
- Baud rate spectral analysis/ histogram
- Carrier frequency analysis
- Eye pattern/constellation plot
- Autocorrelation

Future Improvements

In addition to the standard features of the AR-12/96, several important enhancements are being developed for future availability. They include:

- Trellis code demodulation
- X.25 frame detection, bit unstuffing and address filtering
- DTMF decoding, filtering
- FAX

Custom Features

Recognizing other diverse requirements for flexible demodulators such as the AR-12/96, Adams-Russell is qualified and willing to offer custom versions of control programs, interfaces and/or mechanical packages to meet the peculiar requirements of any application.

The AR-12/96 equipment is also ideally suited for a wide variety of other signal processing applications such as spectrum analysis, pulse processing, real-time signal acquisition and many others.

Mechanical Package

The AR-12/96 is configured in an all aluminum housing with self-contained power supply, filters, low audible noise cooling fan, connector I/O and operator control panel. The housing design is inherently rugged and provides EMI/RFI shielding compatible with TEMPEST requirements. The configuration provides ready access for repair and optimum human factors. Simplicity and low cost is maintained through use of a single basic design for all models.

Rack Mount

The AR-12/96 is designed for mounting in standard EIA 19-inch relay racks. Side-to-rear cooling allows stacking multiple units with minimum clearance. All controls and x, y outputs are on the front panel. All other connections are on the rear panel. The rack mount model is ideally suited for integrated system applications.

SPECIFICATIONS

Signal Type	
VFTR (FSK)	— CCITT standard R.31, R.35, R.36, R.37, R.38, R.39 Mixed subcarrier spacing Up to 24 subchannels BAUDOT, ASCII, EBCDIC 1, 1.5 or 2 unit stop pulses
Data Modems	CCITT—standard V.21, V.22, V.22 bis, V.23, V.26A, V.26B, V.27, and V.29 Bell models 103, 113, 201, 202, 208, 209, 212 Codex models having 4800, 7200, or 9600 bps R.101A or R.101B formats
Acquisition (PSK)	Within 15 seconds without training sequence
Equalization (PSK)	Up to 6000 microseconds
Input Signal	
Termination	50 or 10K ohms (switchable) Balanced or single-ended
Level	-30 to +10 dBm with 50 ohm input 0.1 to 10 Vrms with 10K ohm input
Carrier Frequency Tolerance	±20 Hz
Keying Rate Tolerance	±0.5%
Distortion Tolerance	Per CCITT M.1020
BER/Acquisition Performance	Better than commercial equivalent modems
Data Output	Up to 24 subchannels (FSK) or 188 subchannels (PSK), simultaneously Text
Analog Digitization	8,000 12-bit samples per second - Standard Up to 500K samples per second - Optional
Control	Local, via menu-driven control panel, remote via Data/Control Interface
Data/Control Interface	RS-232, RS-422, IEEE-488 (user configuration package only)
Input Power	90-130 Vac, 47-64 Hz 190-260 Vac, 47-64 Hz with over voltage protection 120 watts maximum
EMI/RFI	Meets MIL-STD-461B
Reliability	Greater than 3000 hour MTBF per MIL-HDBK-217D
Operating Conditions	
Temperature	0-50°C
Humidity	0-95%
Altitude	0-15,000 feet
Storage Conditions	
Temperature	-40°C to +85°C
Altitude	0-50,000 feet
Cooling	Forced air — audible noise less than 30 dBa
Configuration	EIA rack mounting 3-1/2 x 19 x 22 inches
Weight	26 lbs.

Specifications are subject to change without notice

This equipment is warranted for one year, except for damage caused by accident or misuse, provided the equipment is returned for repair to the plant in Waltham, MA.

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