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Digital FDM Demultiplexer WJ-9549



The WJ-9549 Digital FDM Demultiplexer is a multichannel demodulator that accepts and processes up to four digitized baseband signals with independent sample rates up to 27.2 megasamples per second (MSPS). Incorporating the accuracy and repeatability of a total Digital Signal Processing (DSP) implementation, the WJ-9549 simultaneously achieves exceptional amplitude and group delay characteristics.

The WJ-9549 modularity allows 6-, 12-, 18-, or 24-channel unit configurations. Units with fewer than 24 channels are field-upgradeable by installing 6-channel cardsets into the appropriate Motherboard slots. Optional post-processing capabilities are also field-installable with similar ease.

The WJ-9549 accepts four digital baseband inputs, each with data rates up to 27.2 MSPS. The various digital inputs need not be synchronous, phase-locked, or at the same nominal sample rate. The demultiplexer internally performs asynchronous sample rate conversions to produce digital Voice-Grade Channel (VGC) outputs that are synchronous and phase-locked to the unit's internal timebase reference or to an externally supplied site reference. Connection between digital baseband inputs and the installed demodulators is fully flexible and nonblocking. Contact the factory to discuss the acceptance of higher input data rates.

Features

- Up to 24 independently tunable channel demodulators in a single unit
- Tuning in 1-Hz steps
- Exclusive use of linear phase FIR filters providing flat amplitude response & no differential group delay
- 4 digital baseband inputs with nonblocking connection to any channel demodulator
- Scanning capability & preprogrammed CCITT frequency plans
- Drop-in option cards to permit customized VGC post-processing
- Built-in test capability
- Easyfield maintenance
- Ethernet or RS-232 remote control

HEIGHT	3.5 in (8.89 cm)	DEPTH	22 in (55.88 cm)
WIDTH	19.0 in (48.26 cm)	WEIGHT	27 lbs (12.22 kg)

Restricted International Distribution

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All International sales of WJ equipment are subject to USA export license approval.

This material provides up-to-date general information on product performance and use. It is not contractual in nature, nor does it provide warranty of any kind.

The internal WJ-9549 demodulators are independently tunable over the input Nyquist band in 1-Hz steps. Four different tuning modes are standard.

Direct Frequency Tuning allows an operator to enter a nominal tuned frequency in MHz. Channel Tuning divides the input tuning range into contiguous 4-kHz increments, and allows the operator to enter the desired channel number. In addition to these increments, two common CCITT frequency plans (960 channel and 2700 channel) are preprogrammed into the WJ-9549. An operator tunes within these modes by specifying the appropriate CCITT hierarchies (SMG, MG, SG, G and CH). An operator can scan within each of the four tuning modes.

Operator control of individual demodulator parameters include:

- Digital input baseband selection
- Tuned frequency
- AGC/Manual gain control mode selection
- Manual gain level
- Upright/invert detection
- Scan threshold and scan activation
- VGC routing to headphones
- VGC routing to installed post-processing options

In addition, the unit provides a thorough built-in test operation, capable of detecting circuit faults to the module level.

An Ethernet or RS-232 interface remotely controls all operator-selectable parameters, except for headphone volume control. The Ethernet interface is available as either a 10BASE-T or an AUI port, specified at time of order. The 10BASE-T port provides network connection to twisted-pair cables via a modular RJ-45 connector. The AUI interfaces to an appropriate external Media Access Unit (MAU) via a 15-pin D-shell connector to provide network access to thick coaxial, thin coaxial, twisted-pair or fiber-optic cables.

The modular VGC option cards allow the user to tailor the WJ-9549 for specific system requirements. Each option card can access one or more operator-selected VGCs, and perform a specific operation on them. Possible operations include, but are not limited to:

- Analog reconstruction
- PCM formatting (T1 or CEPT)
- Signal characterization
- DTMF and Signaling recognition
- Data demodulation (Fax, Modem, and VFT)

Functional Description

The functional block diagram on page three shows how the WJ-9549 Digital FDM Demultiplexer accepts up to four digitized FDM basebands. These baseband signals are connected, under operator control, to any of the installed channel demodulators in a completely nonblocking fashion.

The demodulators within the WJ-9549 consist of a Digital Tuner, a Format Translator, and a DSP Demodulator. Each Digital Tuner is dedicated to a single-channel demodulator, while the Format Translators and the DSP Demodulators process six channels simultaneously.

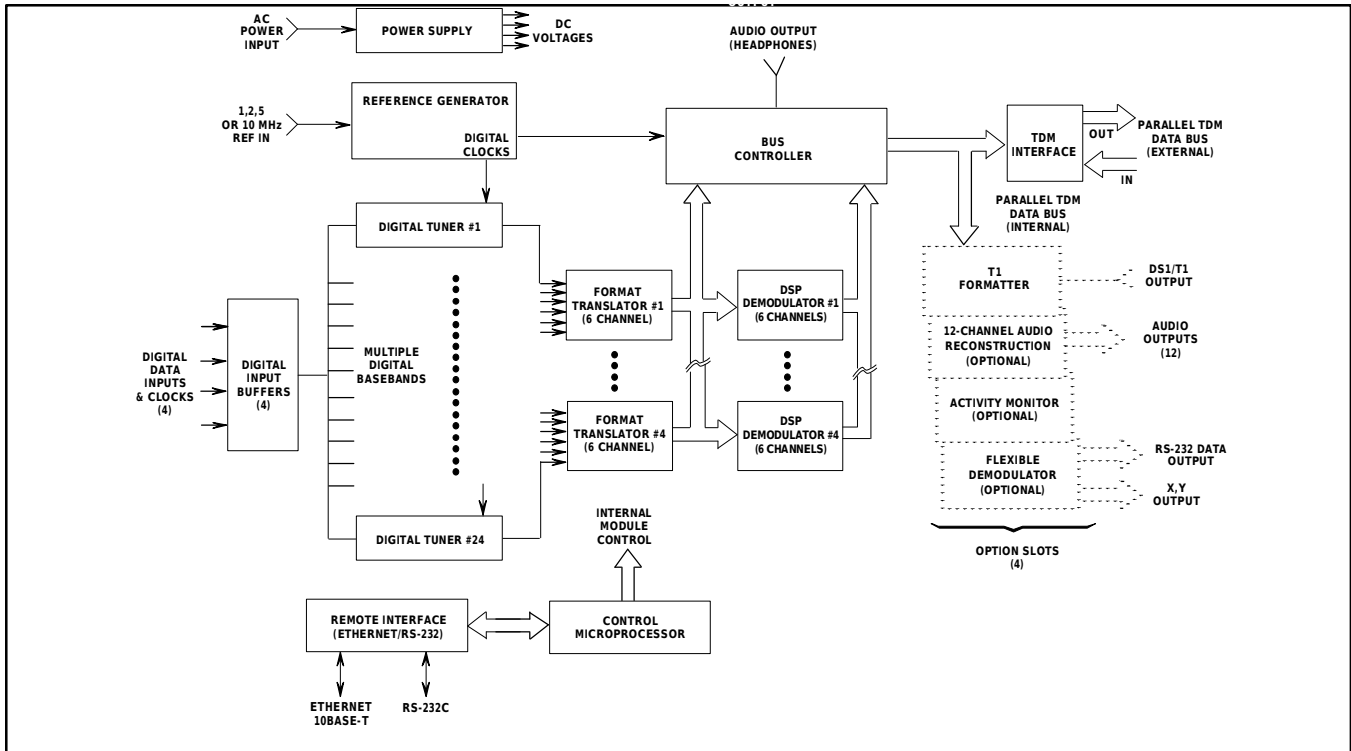
Based on commands received from the external system controller, each Digital Tuner performs:

- 1-of-4 input baseband signal selection
- Frequency tuning to 1-Hz resolution
- Linear-phase digital decimation filtering
- Front-end gain application
- Digital asynchronous sample rate conversion.

The output of the Digital Tuner module is a 16-bit I/Q data stream, operating at a 16-kcps complex sample rate. The data outputs of six Digital Tuners are applied to a single Format Translator module that simultaneously performs serial-to-parallel conversion, complex-to-real conversion and front-end gain control for all six signal paths. The Format Translator Card applies raw digital data to a DSP Demodulator module that performs SSB demodulation, critical channel filtering, and back-end gain control.

The Bus Controller module generates address, clock, and control signals required to operate the Digital Tuner, the Format Translator, and the DSP Demodulator modules, as well as the timing and control of the internal TDM data bus. In addition, the Bus Controller module performs the audio reconstruction of two selected channels for the front-panel stereo-headphone jack, and monitors slot occupancy and run-time error status of the Digital Tuner, the Format Translator, and the DSP Demodulator modules. The Bus Controller also plays a role in the built-in test sequence by performing signature analysis on the unit's digital data paths.

The internal TDM data bus supplies digitized VGC data to up to four option cards for further processing. Resident demodulators, as well as demodulators installed in other WJ-9549s, place VGC data on the bus. Interconnecting up to eight WJ-9549s in a *stacked* configuration, via the TDM interface, can make as many as 192 channels of voice grade data



WJ-9549 Digital FDM Demultiplexer Block Diagram

WPG75D

available to the option cards within each unit. Contact the factory for the availability of *stacked* operation.

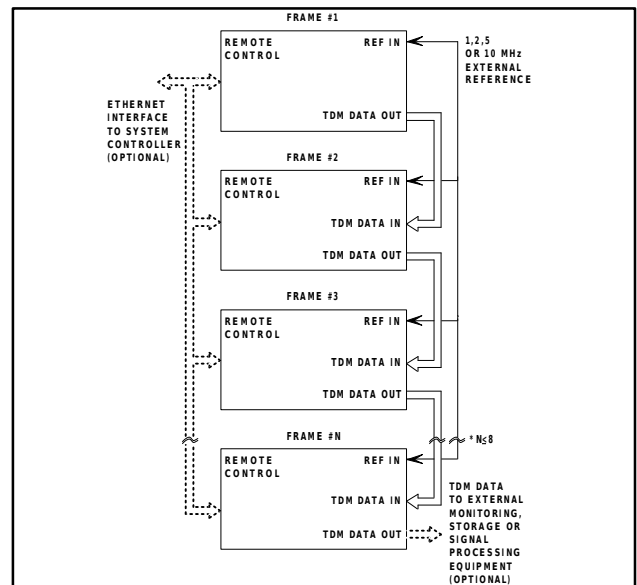
System Applications

The WJ-9549 design incorporates several features that facilitate the integration of the unit into a system. The flexibility of nonblocking baseband switching improves the utilization of demodulator resources relative to bridging schemes.

The WJ-9549’s modular construction provides easy maintenance with minimum down time. A thorough built-in test capability quickly detects and isolates hardware faults to the module level. Many installed modules exist in multiple quantities, thus reducing the required inventory for spares. A key advantage of the modular construction is its ability to configure the WJ-9549 for specific operational system requirements. A user can incorporate off-the-shelf or custom option cards, in many cases eliminating the need for additional demodulation or post-processing equipment. Alternate drop-in remote control interfaces can also be specified to accommodate a variety of system control schemes.

The WJ-9549 architecture allows the interconnection of up to eight units in a *stacked* configuration. In this

configuration, the VGC data from the units are timeshared on the TDM data bus and are, therefore, available to the option cards installed in each unit. In systems requiring multiple FDM demultiplexers, a user can achieve as much as an eight-fold increase in the number of option boards available to each demodulator.



Simplified Diagram for Connecting Multiple WJ-9549s in a **Stacked** Configuration

WPG75F

Specifications

Input Characteristics:

Number of Inputs	4 digital basebands
Connectivity to Demodulators	Fully nonblocking
Sample Rate (in MSPS*)	0.09765625, 0.1953125, 0.390625, 0.78125, 1.5625, 2.5, 3.125, 6.25, 10.0, 12.5, 25.0, 0.425, 0.85, 1.7, 3.4, 6.8, 10.88, 13.6, 27.2
Data Format	12-bit parallel, 2's complement
Sample Clock	50% \pm 10% duty cycle required
Logic Format	Differential 100K ECL, data & clock

Demodulator Characteristics:

(Measured at Optional Analog Output)

Frequency Response	175 to 3825 Hz (-3 dB)
Bandpass Ripple	\pm 0.35 dB, max (600 to 3400 Hz)
Adjacent Channel Rejection	60 dB, min (300 & 3700 Hz)
Total Harmonic Distortion	0.1%, max (820-Hz test tone at nominal output)
Noise Power Ratio (NPR)	50 dB, min (Gaussian noise load at -13 dBfs)
Differential Group Delay	No differential group delay distortion at the digital outputs All filters linear phase FIR

Digital Output (Standard):

Type	Parallel TDM data bus with word & framing clocks 192-VGC capacity
Data Format	16-bit Parallel, 2's Complement

Analog Output (Optional):

Type	High-fidelity audio 16-bit D/A converter with 2X oversampling Available in 12-channel increments
Output Impedance	600 ohms, unbalanced
Nominal Output Level	1 Vrms into 600 ohms (AGC mode, no audio attenuation)
Audio Attenuation Range (All Outputs)	30 dB nominal
Output Connector	D-type, 25-pin female
T1PCM Output (Optional)	T1; 24-channel capacity, 1.544 Mbps
Line Length	0 to 655 ft (0 to 42.26 meters)
Output Impedance	100 ohms, balanced
Output Connector	D-type, 15-pin
Line Code	AMI or B8ZS (operator-selectable)
Encoding Characteristic	μ 255 or linear (operator-selectable)
Framing Formats	F4, F12 (D4/193S), F24 (ESF/193E) or F72 (SLC-96)
Transmit Clock	Internal or external (operator-selectable)
Internal	On-board phase-locked 1.544 MHz
External	Derived from T1 data input, or from 772-kHz square wave or sine wave signal source
Slip Control (External Clock)	Slips corrected on frame boundaries
CEPT PCM Output (Optional)	Primary level CEPT; 30-channel capacity, 2.048 Mbps
Output Impedance	75 ohms, unbalanced
Output Connector	BNC
Line Code	HDB3 per CCITT G.703
Encoding Characteristic	A-law or linear (operator-selectable)
Framing Format	CCITT G.704 or operator-defined
Pulse Shape	Compliant with CCITT G.703

*Contact factory for availability of 50.0 and 54.5 MSPS input sample rate capability.

Flexible Demodulator (Optional):

Demodulator Modes	See separate Flexible Demodulator data sheets for specific Modem, FAX & VFT modulations & protocols
Output	
Digital	RS-232 serial data at 9.6 or 19.2 kbps (transmit only)
Analog	I,Q baseband or symbol synchronization signals used for eye diagram & constellation display
Output Connector	D-type, 25-pin female
Headphone Audio (Standard)	Toll-quality stereo Independent channel selection & volume control for each side
Nominal Output Level	Adjustable up to 8 dBm into 600 ohms
Control:	
Local	Front-panel, 2-channel headphone selection & volume controls with numeric displays of headphone channel selections
Remote	Ethernet (10BASE-T or AUI) and RS-232; only 1 active at a time; consult factory for alternate interfaces
Gain Control Modes	Manual or automatic, applied to individual VGCs
Gain Range	42 dB, min
Tuning Modes	Direct frequency, channel, number, CCITT 960 & CCITT 2700 (operator-selectable for each VGC)
Tuning Range	0 to 13.6 MHz
Tuning Resolution	1 Hz
Tuning Accuracy	$\pm 2 \times 10^{-9}$ relative to the nominal input sample rate or ± 0.010 Hz, whichever is greater
Scans	Selectable (start, stop, step) or formatted (SMG, MG, SG, G)
Detection Modes	Based on CCITT 960 & 2700 frequency plans SSB upright or inverted spectrum (operator-selectable for each VGC); USB/LSB tuning convention selectable via internal switch
Frequency Reference:	
Internal Reference Stability	$\pm 5 \times 10^{-7}$, max
Internal Reference Aging	$\pm 3 \times 10^{-9}$ drift per day, max
External Reference	Accepts 1, 2, 5 or 10 MHz; ± 1 PPM, 200 mV peak-to-peak min into a high-impedance load. Automatically switches to external reference upon application of signal
Physical Environment:	
Temperature Range	
Operating	0 to 50°C
Meets All Specifications	10 to 40°C
Power Requirements	115 Vac $\pm 10\%$ (46 to 400 Hz) 230 Vac $\pm 10\%$ (46 to 65 Hz)
Power Consumption	150 W approx.; 24 channels No standard VGC post-processing options

Options

Model #	Functions**	Physical Characteristics
WJ-9549/6CH 6-Channel Cardset	<ul style="list-style-type: none"> • Adds 6-channel demodulators • Allows easy field installation 	<ul style="list-style-type: none"> • Provides all necessary hardware • Uses none of the 4 option slots • Consists of: <ul style="list-style-type: none"> - 6 Digital Tuner PC Assemblies - Format Translator PC Assembly - DSP Demodulator PC Assembly • Requires no software updates to the Control Processor
WJ-9549/ACT1 Activity Monitor	<ul style="list-style-type: none"> • Provides simultaneous automatic signal classification for up to 12 selected VGCs • Categorizes signals as Voice, Data, Signalling Tones or Not Activity 	<ul style="list-style-type: none"> • Uses 1 of 4 option slots • Consists of: <ul style="list-style-type: none"> - Activity Monitor PC Assembly
WJ-9549/ACT2 Activity Monitor (Level 2)	<ul style="list-style-type: none"> • Provides signal classification as in the ACT1 Option, except classifies data signals as FSK signals (includes FSK modems & VFT signals) or PSK signals (includes BPSK, QPSK & QAM modems) 	<ul style="list-style-type: none"> • Uses 1 of 4 option slots • Consists of: <ul style="list-style-type: none"> - Activity Monitor PC Assembly
WJ-9549/AUD 12-Channel Audio Reconstruction	<ul style="list-style-type: none"> • Provides high-fidelity analog reconstruction of any 12 selected VGCs • Provides operator-adjustable nominal output levels of all 12 outputs over a 30-dB range (up to max of 1 Vrms into 600-ohm load) 	<ul style="list-style-type: none"> • Uses 1 of 4 option slots • Consists of: <ul style="list-style-type: none"> - Audio Reconstruction PC Assembly - Internal Cable Assembly - Set of rear-panel identification (ID) plates & decals - External Cable Assembly that makes each of the 12 audio-output signals available on an individual BNC connector
WJ-954X/T1 T1 Formatter	<ul style="list-style-type: none"> • Provides standard T1 PCM data stream containing up to 24 selected VGCs • Allows assignment of VGC outputs from various demodulators to arbitrary T1 channels, in a nonblocking fashion • Allows selection of linear & μ-law encoding on channel-by-channel basis • Allows the derivation of T1 timing from external clock source 	<ul style="list-style-type: none"> • Uses 1 of 4 option slots • Consists of: <ul style="list-style-type: none"> - T1 Formatter PC Assembly - Cable Assembly - Set of rear-panel ID plates & decals - Accessory cable assembly with ID plates & decals to allow for external T1 clock resources

Options

Model #	Functions (See specifications for details.)	Physical Characteristics
WJ-9549/CEPT CEPT Formatter	<ul style="list-style-type: none"> • Provides standard, primary level CEPT PCM data stream containing up to 30 selected VGCs • Allows assignment of VGC outputs from various demodulators within the WJ-9549 to arbitrary CEPT channels, in a nonblocking fashion • Allows selection of Linear & A-law encoding 	<ul style="list-style-type: none"> • Consists of: <ul style="list-style-type: none"> - CEPT Formatter PC Assembly - Cable Assembly - Set of rear-panel ID plates & decals
WJ-9549/FLX Flexible Demodulator	<ul style="list-style-type: none"> • Provides single-channel voice-frequency demodulator capable of demodulating & decoding variety of Modem, VFT & FAX signal formats • Performs: <ul style="list-style-type: none"> - Symbol timing recovery - Adaptive blind equalization - Carrier recovery - Data derandomizing - Data decoding - DTMF & signaling detection • Provides demodulated character data via RS-232 output port • Outputs eye diagrams & constellation patterns on 2 analog ports • See separate Flexible Demodulator data sheets for list of supported protocols • In VFT applications, all data channels or single-selected data channel, output through RS-232 port 	<ul style="list-style-type: none"> • Uses 1 of 4 option slots • Consists of: <ul style="list-style-type: none"> - Flexible Demodulator PC Assembly - 2 Cable Assemblies - Set of rear panel ID plates & decals - A floppy disk providing FAX reconstruction & data display/storage programs (MS-DOS compatible) - Up to 4 Flexible Demodulator Option Cards for installation & cabling to a single rear-panel multipin connector

The basic WJ-9549 contains no channel demodulators. To order factory installed demodulators, specify appropriate number of 6-channel Cardsets (WJ-9549/6CH) up to a maximum of four units. The WJ-9549 contains four option slots for installation of a variety of output formatters or special signal-processing options. Option cards installable in any combination, subject only to the 4-slot restriction and availability of rear-panel space for I/O connectors. Some options require an upgrade of control software and/or hardware. Contact factory to discuss unique requirements such as special VGC-processing options, or alternate remote-control interfaces.