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## Digital Multichannel Receiver WJ-8699



The WJ-8699 Digital Multichannel Receiver contains six independent, general purpose digital receiver channels, each with a dedicated digital input port capable of accepting sampled data at rates up to 27.2 megasamples per second (MSPS). Incorporating the accuracy and repeatability of a total Digital Signal Processing (DSP) implementation, the WJ-8699 simultaneously achieves exceptional amplitude, group delay and demodulation characteristics. The various digital inputs to the WJ-8699 need not be synchronous, phase-locked or at the same nominal sample rate. Each receiver channel internally performs an asynchronous sample rate conversion to produce a digital voice-grade channel (VGC) output that is phase-locked to the unit's internal timebase reference or to an externally supplied site reference. Contact the factory for the availability of accepting higher input data rates.

The six receiver channels within the WJ-8699 are independently tunable over the entire Nyquist band in 1-Hz increments. Fourteen standard IF bandwidths spanning the range from 100 Hz to 30 kHz are selectable on a channel-by-channel basis, with all filtering performed using linear phase, finite impulse response (FIR) digital filters. User-selectable demodulation modes include AM, FM, CW, USB, LSB,

### Features

- Six independently tunable DSP-based receivers in a single unit
- Tuning in 1-Hz steps
- Digital filtering that provides 14 IF bandwidths up to 30 kHz
- Exclusive use of linear phase FIR filters to provide flat amplitude response and no differential group delay
- Independent tunable notch filter, standard
- AM, FM, CW, USB, LSB, DSB & ISB detection modes standard
- Scan, step & lockout to facilitate signal acquisition
- Drop-in option cards to permit customized VGC post-processing
- Built-in test capability
- Easy field 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	35 lbs (15.8 kg)

### \*Restricted International Distribution\*

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DSB and ISB. Other channel parameters that are independently controllable include:

- AGC/Manual gain mode
- Manual gain level
- Tunable notch filter
- Scan range and threshold
- Scan activation
- VGC routing to headphones
- VGC routing to installed post-processing options

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

Except for headphone volume control, all operator-selectable parameters are controllable remotely via either an Ethernet or an RS-232 control interface. The Ethernet interface is available as either a 10BASE-T or an AUI port as 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.

Four option slots within the WJ-8699 provide for additional post-processing of any VGC received, allowing the unit to be tailored to meet 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
- SCSI interface for digital recording & storage
- Data demodulation (Fax, Modem & VFT)

## Functional Description

A functional block diagram of the WJ-8699 Digital Multichannel Receiver is provided. The unit accepts up to six digitized input signals, each one connected to a dedicated DSP-based receiver channel. Each receiver channel within the WJ-8699 consists of a Digital Tuner and a DSP Demodulator. Based on commands from the external system controller, each Digital Tuner performs:

- 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 50 kSPS complex sample rate. This raw IF data is applied to a DSP Demodulator module that performs critical channel filtering, back-end gain control and demodulation.

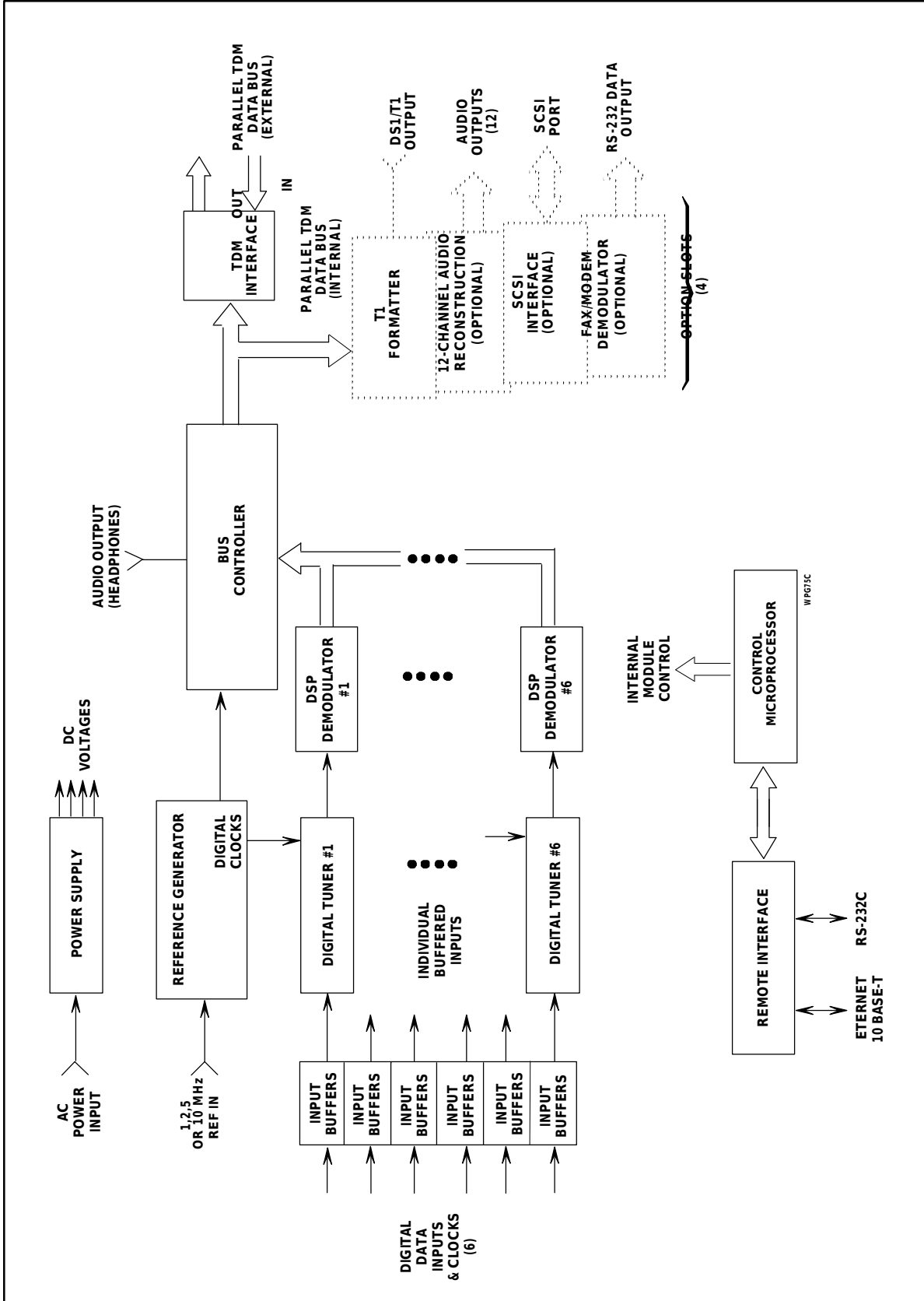
The Bus Controller generates address, clock and control signals necessary to the operation of the Digital Tuner and DSP Demodulator modules, as well as timing and control of the internal TDM data bus. In addition, the Bus Controller performs the audio reconstruction of two selected channels for the front-panel stereo headphone jack, and monitors slot occupancy and run-time error status of the Digital Tuner and 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 as many as 48 channels of digitized VGC data to up to four option cards for further processing. VGC data is placed on the bus, not only by resident receiver channels, but also by receivers installed in other WJ-8699s. This is accomplished by interconnecting multiple units together via their TDM interface ports, in a *stacked* configuration.

## System Applications

The WJ-8699 Digital Multichannel Receiver incorporates several features that facilitate its integration into a system. The WJ-8699's modular construction provides for easy maintenance with minimum downtime. A thorough built-in test capability quickly detects and isolates hardware faults to the board level. Many of the installed boards exist in multiple quantities, thus reducing the required inventory for spares. A key advantage of the modular construction is the ability to configure the WJ-8699 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-8699 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 more than one Digital Multichannel Receiver, a user can achieve as much as an eight-fold increase in the number of options boards available to each unit.



WJ-8699 Digital Multichannel Receiver Functional Block Diagram

## Specifications

<b>Number of Receiver Channels</b> .....	Six, independently tunable
<b>Input Characteristics</b>	
<b>Number of Inputs</b> .....	Six digital IF/baseband signals
<b>Connectivity to Receiver Channels</b> .....	Dedicated input per channel
<b>Sample Rate (in MSPS)*</b> .....	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
<b>Data Format</b> .....	12-bit parallel, 2's complement
<b>Sample Clock</b> .....	50 ±10% duty cycle required
<b>Logic Format</b> .....	Differential 100K ECL, data & clock
<b>Tuner Characteristics</b>	
<b>Tuning Range</b> .....	0 to 13.6 MHz
<b>Tuning Resolution</b> .....	1 Hz
<b>Tuning Accuracy</b> .....	±2 x 10 <sup>-9</sup> relative to the Nominal Input Sample Rate or 0.010 Hz, whichever is greater
<b>Scans</b> .....	Selectable (start, stop, step) with Lockouts
<b>IF Shape Factor</b> .....	1.5:1 (3 to 60 dB), max
<b>Passband Ripple</b> .....	±0.35 dB, max (over 80% of selected bandwidth)
<b>Image Rejection</b> .....	60 dB, min
<b>Differential Group Delay</b> .....	No group delay distortion at digital outputs All filters linear phase FIR
<b>Gain Control</b> .....	Manual, Fast & Slow AGC
<b>Manual Gain Control Range</b> .....	70 dB
<b>Tunable Notch Filter</b> .....	5% of IF bandwidth 40% dB, min notch depth, absolute or relative tuning
<b>Demodulator Characteristics</b>	
<b>General-purpose Detection Modes</b> .....	AM, FM, CW, USB, LSB, DSB & ISB Consult factory for additional modes
<b>BFO Tuning</b> .....	+3000 Hz in 10-Hz steps
<b>Video Bandwidth</b> .....	3.2 kHz, min
<b>Digital Output (Standard)</b>	
<b>Type</b> .....	Parallel TDM data bus with word & framing clocks; 48-VGC capacity
<b>Data Format</b> .....	16-bit parallel, 2's complement
<b>Logic Format</b> .....	Single-ended, +5V CMOS, data & timing
<b>Analog Output (Optional)</b>	
<b>Type</b> .....	High-fidelity audio; 16-bit D/A converter with 2X oversampling; available in 12-channel increments
<b>Output Impedance</b> .....	600 ohms, unbalanced
<b>Nominal Output Level</b> .....	1 Vrms into 600 ohms (AGC mode, no audio attenuation)
<b>Audio Attenuation Range (All Outputs)</b> .....	30 dB nominal
<b>Output Connector</b> .....	D-type, 25-pin female

\*Contact factory for availability of 50.0 and 54.4 MSPS input sample rate capability.

<b>T1 PCM Output (Optional)</b> .....	<b>T1; 24-channel capacity, 1.544 Mbps</b>
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 .....	255 or linear (operator-selectable)
Framing Format .....	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) .....	All slips corrected on frame boundaries
<b>CEPT PCM Output (Optional)</b> .....	<b>Primary level CEPT; 30-channel capacity, 2.048 Mbps</b>
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
<b>FAX/Modem Demodulator (Optional)</b>	
Demodulator Modes .....	See separate Flexible Demodulator data sheets for specific Modem, FAX, & VFT modulation & protocols supported
<b>Output</b>	
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
Connector .....	D-type, 25-pin female
<b>Headphone Audio (Standard)</b> .....	<b>Toll-quality stereo; independent channel selection &amp; volume control for each side</b>
Nominal Output Level .....	Adjustable up to 8 dBm into 600 ohms
<b>Control</b>	
Local .....	Front-panel 2-channel headphone selection & volume controls with numeric displays of headphone channel selections
Remote .....	Ethernet (10BASE-T or AUI) & RS-232 Only 1 active at a time Consult factory for alternate interfaces
<b>Frequency Reference</b>	
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
<b>Physical Environment</b>	
<b>Temperature Range</b>	
Operating .....	0 to 50°C
Meets All Specifications .....	10 to 40°C
<b>Power Requirements</b> .....	<b>115 Vac <math>\pm 10\%</math> (46 to 400 Hz) 230 Vac <math>\pm 10\%</math> (46 to 65 Hz)</b>
<b>Power Consumption</b> .....	<b>110 W approximate, no output options installed</b>

## Options

Model #	Functions*	Physical Characteristics
<b>WJ-8699/AUD</b> 12-Channel Audio Reconstruction	<ul style="list-style-type: none"> <li>• Provides high-fidelity analog reconstruction of any 12 selected VGCs</li> <li>• Provides operator-adjustable nominal output levels of all 12 outputs over a 30-dB range (max of 1 V<sub>rms</sub> into a 600-ohm load)</li> </ul>	<ul style="list-style-type: none"> <li>• Uses 1 of 4 option slots</li> <li>• Consists of: <ul style="list-style-type: none"> <li>- Audio Reconstruction PC Assembly</li> <li>- Internal Cable Assembly</li> <li>- Set of rear-panel identification (ID) plates &amp; decals</li> <li>- External Cable Assembly that makes each of 12 audio output signals available on 1 individual BNC connector</li> </ul> </li> </ul>
<b>WJ-8699/T1</b>	<ul style="list-style-type: none"> <li>• Provides standard T1 PCM data stream containing up to 24 selected VGCs</li> <li>• Allows assignment of VGC outputs, from various demodulators, to arbitrary T1 channels in a nonblocking fashion</li> <li>• Allows selection of Linear &amp; m-law encoding on channel-by-channel basis</li> <li>• Allows derivation of T1 timing from an external clock source</li> </ul>	<ul style="list-style-type: none"> <li>• Uses 1 of 4 option slots</li> <li>• Consists of: <ul style="list-style-type: none"> <li>- T1 Formatter PC Assembly</li> <li>- Cable Assembly</li> <li>- Set of rear-panel ID plates &amp; decals</li> </ul> </li> </ul>
<b>WJ-8699/CEPT</b> CEPT Formatter	<ul style="list-style-type: none"> <li>• Provides standard, primary level CEPT PCM data stream containing up to 30 selected VGCs</li> <li>• Allows assignment of VGC outputs from various demodulators within the WJ-869X to arbitrary CEPT channels in a nonblocking fashion</li> <li>• Allows selection of Linear &amp; A-law encoding</li> </ul>	<ul style="list-style-type: none"> <li>• Consists of: <ul style="list-style-type: none"> <li>- CEPT Formatter PC Assembly</li> <li>- Cable Assembly</li> <li>- Set of rear-panel ID plates &amp; decals</li> </ul> </li> </ul>
<b>WJ-8699/FMD</b> FAX/Modem Demodulator	<ul style="list-style-type: none"> <li>• Provides single-channel voice frequency demodulator capable of demodulating &amp; decoding variety of Modem, VFT &amp; FAX signal formats</li> <li>• Performs <ul style="list-style-type: none"> <li>- Symbol timing recovery</li> <li>- Adaptive blind equalization</li> <li>- Carrier recovery</li> <li>- Data derandomizing</li> <li>- Data decoding</li> </ul> </li> <li>• Provides demodulated character data via an RS-232 output port</li> <li>• Outputs eye diagrams &amp; constellation patterns on 2 analog ports</li> <li>• See separate Flexible Demodulator data sheets for list of protocols supported</li> <li>• In VFT applications, all data cannals (or a single-selected data cannal) output through the RS-232 port</li> </ul>	<ul style="list-style-type: none"> <li>• Uses 1 of 4 options slots</li> <li>• Consists of: <ul style="list-style-type: none"> <li>- Flexible Demodulator PC Assembly</li> <li>- 2 Cable Assemblies</li> <li>- Set of rear-panel ID plates &amp; decals</li> <li>- A floppy disk providing FAX reconstruction &amp; data display/storage programs (MS-DOS compatible)</li> <li>- Up to 4 Flexible Demodulator Option Cards installed &amp; cabled to a single rear-panel multipin connector</li> </ul> </li> </ul>

\*See specifications for details