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Jensen Twin Servo[®] 990 Mic Preamp

Transformer Enhanced Technology for Superior Sonic Performance. Bringing Science to Sound.



The ideal integration of advanced design software, hardware engineering know-how, and carefully controlled "golden ears" listening tests, the Jensen Twin Servo[®] 990 Microphone Preamplifier has earned high marks for sonic performance since its introduction in 1988. Technically elegant, this uncompromising design uses proven fundamental technology refined by Jensen's exclusive Comtran computer aided design tools and precision manufacturing processes. Jensen may be the only company to fully integrate the design of transformers and surrounding circuitry for total compatibility from the initial design phase. The Twin Servo® has enjoyed widespread use by hundreds of professionals who find its sonic clarity superior to both ordinary transformerless designs and preamps costing much more. The wide bandwidth and flat group delay of Jensen's transformers combined with Twin Servo® circuitry result in a smooth, transparent top end and a tight, clean bottom end. Recordings are free of coloration or high frequency harshness typical of many other preamps.

Superior common-mode performance reduces external noises (hum or buzz) better than any transformerless design. The circuit topology itself significantly reduces internal noise (hiss), particularly at medium and low gain settings. If you make wide dynamic range digital recordings, you'll truly appreciate this preamplifier!

The basic circuit was originally published as an application note by Jensen for their finest microphone input transformer, the JT-16-B. Each channel uses two precision 990C operational amplifier modules, developed and patented by Jensen, to achieve one tenth the distortion and twice the bandwidth of a single stage design. Preamp gain is adjusted by changing the feedback to both stages in tandem, which minimizes noise and maximizes headroom at any gain setting. The 990C modules use carefully selected and matched discrete components to far outperform any integrated circuit available. They also drive long output cables and low impedance loads with ease. Each channel has a two-color 20 LED level meter, switchable to Peak or VU ballistics, and a clip indicator.

DC servo feedback eliminates all coupling capacitors in the audio signal path. This reduces lowfrequency noise and eliminates the ugly distortions associated with electrolytic capacitors. They are especially degrading to low level microphone signals when used to block phantom power in transformerless designs. The extended low-frequency response of the transformers and the DC servo feedback produce a response extending to below 1 Hertz. This, combined with high-frequency response tailored to a Bessel function, produces extremely low deviation from linear phase, preserving the delicate time alignment between fundamentals and their harmonics. The transformer balanced input maintains its high common-mode rejection up to ± 300 volts. Although "electronically balanced" inputs may have impressive common-mode rejection numbers, they apply for noise only up to a few volts. In the presence of strong interference, such as that produced by SCR light dimmers or RF transmitters, their noise rejection completely disappears, resulting in the least protection against the worst noise. Both input and output transformers use specially processed nickel-iron-molybdenum alloy cores for extremely low distortion.

The power supply, often the weak point of an amplifier, is exceptionally robust. The toroidal power transformer has full electrostatic and magnetic shielding to minimize noise coupling from the power line and to make this unit a "good neighbor" to other audio gear in your rack. Symmetrical bipolar DC supplies use conservatively rated regulators which are short circuit protected and mounted to solid copper heat sinks. The compact 1.75" x 19" rack mount chassis is available with one, two, three or four channels. Units with less than four channels are expandable.

Backed by Jensen's 40+ year reputation for reliability and integrity, the Twin Servo[®] 990 Mic Preamp delivers high performance and exceptional value.

Details

There are four key elements to the signal path of the Jensen Twin Servo[®] 990 mic preamp:

- 1. Jensen JT-16-B mic-input transformer.
- 2. 990C op-amp (two).
- 3. Jensen JT-11-BMQ output transformer.

4. Input bias current compensation circuitry and DC servo circuitry.

Details:

Jensen JT-16-B Microphone Input Transformer: Jensen transformers are known worldwide as the best audio transformers, and the JT-16-B is their finest mic-input model. If you thought transformers were a compromise, you haven't heard the JT-16-B!

The large size, low impedance ratio $(150:600\Omega)$ and proprietary 80% nickel core material (nickel-iron-molybdenum) allow the JT-16-B to handle extremely high signal levels with lower distortion, wider bandwidth, flatter frequency response and more linear phase response than the more typical high-ratio transformers ($150:15k\Omega$).

The JT-16-B transformer provides superior common mode rejection and can handle much higher common mode voltages than transformerless mic preamps. It eliminates the need for input coupling capacitors that are required in transformerless preamps to keep the phantom supply voltage from getting into the active circuitry where it could cause damage. Those capacitors degrade the sound quality because of dielectric absorption, a condition where a portion of the signal passing through the capacitor is absorbed by the dielectric of the capacitor, then released a short time later. This causes a smearing of the sound.

The 990C Discrete Op-Amp is faster, quieter, more powerful and better sounding than the typical monolithic op-amps found in other equipment. Each individual (discrete) transistor, resistor, diode, capacitor and inductor of the 990 has been carefully chosen for its task. This provides a level of performance that is not possible in a monolithic op-amp where all components are fabricated on the same tiny chip of silicon.

The Twin Servo[®] uses two 990C op-amps per channel. The gain of the preamp is divided equally between the two op-amps, each op-amp providing half as much gain as the single op-amp of a single-stage design would otherwise have to provide. This provides lower distortion and wider bandwidth at higher gain settings. **JT-11-BMQ Output Transformer** is Jensen's best output transformer. It provides a balanced, isolated, floating output to eliminate ground loops. It has a 1:1 impedance ratio, bandwidth of 15 MHz and typical THD of .002% at 20 Hz and +4 dBu output level. Again, if you thought transformers were a compromise, you haven't heard the JT-11-BMQ!

Input Bias Current Compensation Circuitry and DC Servo Circuitry provide superior methods of controlling input bias currents and DC offset voltage. This allows the complete elimination of coupling capacitors from the signal path, eliminating the degradation to the signal that those capacitors could cause. Each of the two 990C op-amps has its own input bias current compensation and DC servo circuits.

Other Features:

Fully sealed Conductive Plastic gain control provides smooth, continuous gain adjustment from 16 to 60dB.

A special 2-channel version with 22-position rotary switches for the gain-controls is available with 1% metal film resistors for gain control (special Jensen Twin Servo[®]). This provides gain adjustment in precise steps of 2 dB. Call for details.

20Ω MIC switch <u>or</u> **20dB PAD** switch (specify which one when ordering):

The **200** MIC switch optimizes the input of the Twin Servo[®] for microphones with output impedances substantially below the traditional impedance of 150Ω .

The **20dB PAD** switch attenuates the input signal by 20dB before it reaches the input transformer. This can be helpful when extremely high input levels are encountered.

POLARITY REVERSE Switch reverses the signal polarity at a point immediately before the input transformer.

48V ON/OFF Switch for phantom power. The phantom supply has more than enough current to handle any microphone.

All front panel switches are LED illuminated. A custom clear plastic push button was developed. Each button's function is marked on the front surface and is illuminated dimly when off, brightly when on, each button with its own LED color. No guessing about these switches! **Ground Lift switch on each channel** allows disconnection of the shield (pin 1) on the output connector. This can be helpful in eliminating ground loops in certain situations. This mini-toggle switch is located on the rear panel.

VU-1 Meter Card is a very accurate and informative meter that directly monitors the output level of the mic preamp card. There is no need to monitor the input of the Jensen Twin Servo[®] because the JT-16-B input transformer can handle input signal levels of greater than +12 dBu (30Hz and above) without going into saturation. Input levels above +8 dBu would cause the output of the Twin Servo[®] to be driven past the maximum rated output level of +24 dBu with the gain controls adjusted to the minimum gain of 16dB. Therefore the output clips before the input saturates. Input levels of +6 dBu are beyond the capability of most preamps, but not the Twin Servo[®]!

The VU-1 provides a 20 segment LED bargraph display and separate "peak" LED (labeled "PK" on the front panel) to indicate extremely high signal levels. An LEDilluminated front panel switch gives a choice of "Peak" or "VU" meter ballistics. The "Peak" ballistic provides a fast attack time for the bargraph so that transients are fully indicated. The "VU" ballistic provides a slower attack time, similar to a standard mechanical VU meter. The meter scale accurately covers -28 to +10 VU in linear steps of 2 dB (15 yellow LEDs, 5 red LEDs). Easy calibration of the meter's OVU operating level is accomplished by moving an internal plug-in jumper to one of four positions: 0 dBu, +4 dBu, +8 dBu or Adjustable (the adjustable position covers -10 to +12 dBu via a 25-turn trim pot).

The firing point of the separate peak (PK) LED is calibrated via a 25-turn trim pot for output levels of 0 to +22 dBu. The standard setting of +22 dBu provides at least 2 dB of warning prior to the clipping point.

Jumpers are provided to choose BAR mode (cumulative LEDs) or DOT mode (one LED at a time) for the display.

Circuitry includes a full-wave rectifier, peak detector, Peak and VU ballistics, and a temperature compensated log/linear converter. The circuitry is DC coupled and uses high-speed, precision op-amps with extremely low DC offset voltage and drift. All of these features guarantee accurate performance over a wide temperature range, and for years to come. On-card voltage regulation for the op-amp power supplies, and isolated grounding for the 5 volt LED power supply assure that the VU-1 will not interfere with the mic preamp circuitry.

Toroidal Power Transformer with additional silicon-iron shielding eliminates hum problems caused by stray magnetic fields. Each transformer is carefully tested for stray magnetic fields under worst-case full-load conditions. The optimum rotational position is determined, then the silicon-iron shielding is added to assure hum-free performance, even with the power transformer sitting just inches away from sensitive audio circuitry! Some other mic preamps have their power supplies housed in a separate chassis. This is costly, space consuming, awkward, and can even degrade the audio performance.

Toroidal power transformers inherently have lower stray magnetic fields than conventional EI-core transformers. They are also smaller and lighter (and much more expensive!)

Universal Power Supply. An internal switch provides six primary voltage choices: 100, 120, 140, 200, 220 and 240 volts. The power cord is detachable with a standard IEC/NEMA connector. A line filter is included in the input connector. These features allow the Twin Servo® to be easily adapted for use anywhere in the world. The supply is designed to accommodate over/under voltage situations easily.

Chassis Ground Isolation Switch allows the chassis ground and signal ground to be isolated from each other, or tied together. This can be helpful in eliminating ground loops in certain situations. This mini-toggle switch is on the rear panel.

Gold Plated XLRs for long-term tarnish-free operation.

PIN 2 or PIN 3 HIGH? Although the official IEC, SMPTE and AES standards state that pin 2 is high (relative to pin 3), there is some equipment that follows the unofficial standard which states that pin 3 is high (relative to pin 2). Rather than be stuck in one standard, the Twin Servo® is designed so that it is very easy to internally re-configure the wiring of the XLR connectors. Two plug-in jumpers are located next to each XLR, allowing you to quickly change from "PIN 2 HIGH" to "PIN 3 HIGH", or viceversa.

It is very important to verify the polarity of the equipment that will be used with the Twin Servo[®], and to maintain correct polarity when connecting the Twin Servo[®]. Possible problems range from an audible

change due to an inadvertent reversal of Plastic knobs look like . . . well . . . plastic polarity, to slight degradation of the signal if a transformer-coupled Twin Servo® output is driving an unbalanced input of the opposite polarity. Please specify how you want your connectors configured!

The two $6.81k\Omega$ 1% resistors in the phantom supply network are matched to a 0.1%tolerance to provide the best performance.

1% 100ppm and 50ppm metal film resistors are used instead of the more common 5% 200ppm carbon film resistors. They provide greater initial accuracy, better long term stability, and higher stability at extremes of temperature.

Electrolytic capacitors with a 105°C temperature rating are used instead of the more common 85°C rated parts. This higher temperature capability means that they will last much longer than the lower rated parts. Electrolytic capacitors are more failure prone than most other components, a good thing to remember when troubleshooting older equipment! Sometimes they start allowing small amounts of DC current to pass through (leakage current), causing pots and switches to be noisy when operated. (NOTE: in the Twin Servo[®] there are no capacitors in the signal path, so this problem cannot exist). Other times capacitors will short-circuit, or perhaps lose most of their capacitance. Whatever the failure mode, you have a problem, even in equipment that never approaches an operating temperature of 85°C. But not with the Twin Servo[®]!

XLR connectors are soldered directly to the p.c. board. This assures the minimum number of interconnections for better reliability and better sound quality.

Fully sealed potentiometer and trim pots for long, trouble-free life.

Central point grounding and power distribution. Rather than use а "motherboard", wiring harnesses are used to deliver power supplies and grounds to each channel individually. This provides the least interaction between channels.

The Knob. A knob is a basic device that should provide three basic things:

- 1. Good VISUAL indication of setting. 2. Good TACTILE indication of setting.
- 3. Good TRACTION for your fingers.

Most knobs don't meet all three of the requirements. Some don't meet any of the requirements! In addition to these basic requirements, a knob should look good and feel good.

knobs! Plain round knobs don't give any tactile indication of which way they are pointing. Knobs with pointers sticking out do tell by feel which way they point, but the protrusion is usually so big that it gets in the way. Some knobs have an indicator line on top, but the typical decorative metal finish causes light reflections from the top surface of the knob like spokes of a wheel. Which is the indicator line and which are the spokes?

The knob of the Twin Servo[®] was developed to meet all requirements. It is machined out of solid aluminum, with a non-reflective black anodized finish. A white ceramic laser-cut insert is added to create visual and tactile indication of the knob's setting. The insert appears as an indicator line on the top of the knob, and protrudes just enough (.025") beyond the side of the knob so that you can feel it, yet it doesn't get in the way. Traction is provided by a fine diamond knurl, with sharp, fully formed teeth. The diamond knurl provides traction for rotary motion, and for vertical motion to keep your fingers from slipping "up" and off of the knob. Straight knurls can only provide rotary traction. Also, there is a certain amount of tradition in a diamond knurl. The knob looks great, feels great, and works great!

Custom Aluminum Extrusion Α was developed for the front, rear and sides of the Twin Servo[®] chassis. It solves several packaging problems, providing a neater, stronger and more efficient package. The brushed and black anodized finish looks great, and provides optimum thermal emission properties. Rack-handles provide easy handling. Stainless steel threaded inserts provide long life, even after repeated assembly and disassembly.

Satisfaction Guarantee: All Jensen Twin Servo[®] 990 Mic Preamps can be returned for full credit or refund, less shipping & insurance charges, within 15 days of delivery, if it is unsatisfactory.

Warranty: The Twin Servo® is warranted against defects in materials and workmanship for a period of one year from date of shipment. The John Hardy Company will repair or replace product under this warranty if factory inspection reveals evidence of such defects. The Twin Servo® must be returned to the factory in the original box and foam liner for inspection, shipped prepaid.



Specifications, typical (0dBu = 0.775V)			
Voltage Gain Range E.I.N., 20kHz bandwidth, unweighted RMS, 600Ω load Frequency Response, ref: 1kHz	±1 dB: 150Ω source: 20Hz: 20kHz: 0.4Hz: and 140kHz:	16 to 60 -128.7 -0.05 typ, -0.1 max -0.04 typ, -0.1 max -3	dB dBu typ dB dB dB typ
Time Domain Response Deviation from Linear Phase (maximum) Group Delay Squarewave Risetime Squarewave Tilt	20 to 20kHz: 2kHz to 120kHz: 20Hz:	±2 2.16 ±0.05 2.2 5.8	deg μs μs typ % typ
Total Harmonic Distortion (note 1) Output Level +4 dBu, any gain setting	100Hz to 20kHz:	0.001 typ, 0.003 max	%
Input Level +8 dBu (note 2)	20Hz: 100Hz to 20kHz: 20Hz:	0.036 typ, 0.100 max 0.001 typ, 0.003 max 0.120 typ, 0.300 max	% %
Common Mode Rejection Ratio	60Hz: 1kHz: 10kHz:	125 100 80	dB min dB min dB min
Common Mode Input Voltage		±300	V-pk max
Optimum Microphone Impedance (switch selectable)		150/20	
Input Impedance	20 to 20kHz:	1.27	k $\Omega \pm 15\%$ max
Phantom Power, Voltage Phantom Power, current		+52 9.5	VDC max mA max
Maximum output level	75 Ω load:	+24	dBu min
Output Load Impedance Range Output Source Impedance	minimum/nominal: 20Hz to 20kHz:	150/600 70±5	Ω Ω
Power Requirements, 4 channels:		100, 120, 140, 200, 220, 240 48-66 25	VAC Hz watts
Dimensions (note 3)		1.75"H x 19"W x 9"D	
Unless otherwise specified: 25°C ambient, 150 Ω source, 600 Ω load. (1) Low frequency response distortion is almost entirely 3rd harmonic. (2) Worst case of maximum possible input at minimum gain with unclipped output.			

(3) Handles extend 1" beyond front panel. Dimensions include handles. "Twin Servo" is a registered trademark of Jensen Transformers, Inc.