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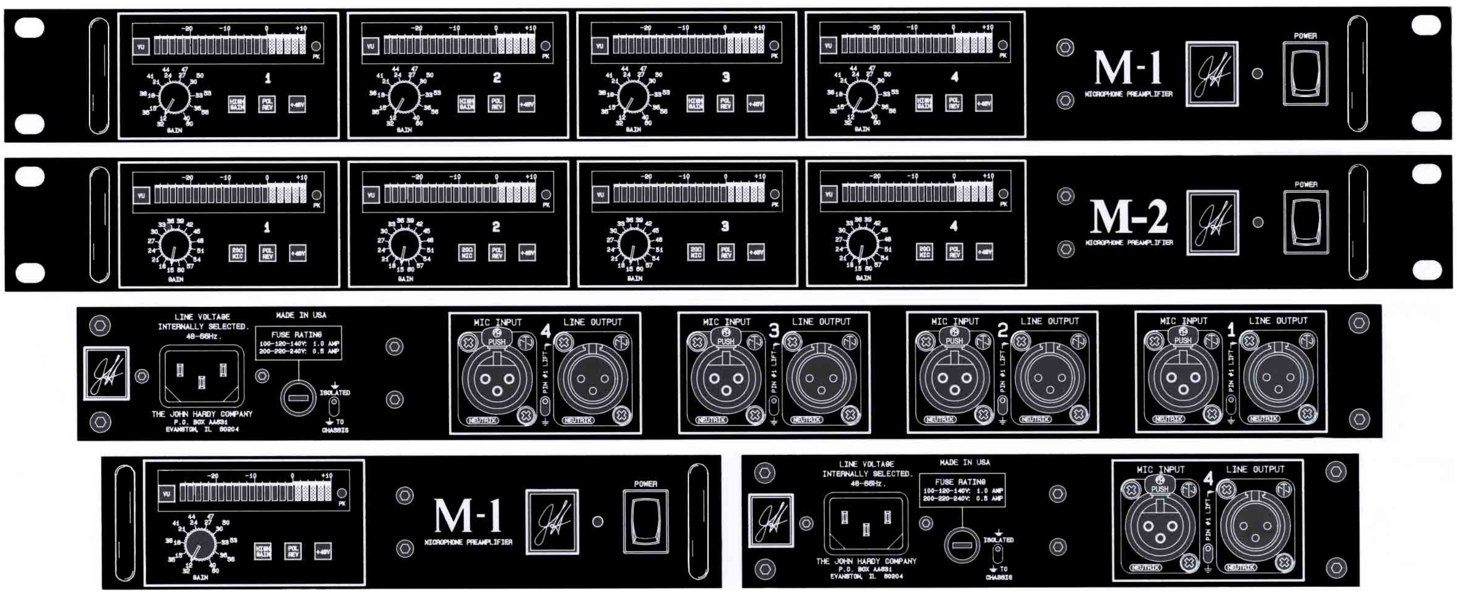
M-1 Mic Preamp
M-2 Mic Preamp
M-1 Personal Mic Preamp

June 1, 2011



The M-1, M-2 and M-1 Personal mic preamps are among the finest mic preamps in the world. They provide the accuracy and transparency that is missing in other mic preamps. No matter what your application, they will provide superior results. The world's best input transformer (Jensen JT-16-B), best op-amp (990C discrete class-A op-amp) and the elimination of all coupling capacitors from the signal path combine to provide the highest performance.

The M-1 and M-2 have a 19" wide rack-mount chassis (1.75"H x 19"W x 8"D) and can be ordered with one, two, three or four channels. The M-1 Personal mic preamp has an 8" wide chassis with a capacity of one channel. There are two meter options, and the best Jensen output transformer (JT-11-BMQ) is available as an option. These options and basic channels can be easily added later.

The M-1 was introduced in 1987. The M-2, introduced in 1996, is a variation of the M-1. The first difference is the gain controls: The M-1 has a two-section gain-pot providing continuously variable adjustment in two overlapping ranges of 12 to 40 dB and 32 to 60 dB (higher gain available on request). The "HIGH GAIN" switch changes ranges. The M-2 has a 16-position gain-switch with 1% metal-film resistors, providing accurate and repeatable gain-settings from 15 to 60 dB in steps of 3 dB.

Further differences involve the push-button switch to the right of the gain-pot or gain-switch. The M-1 has a "HIGH GAIN" switch as mentioned above. Since this switch is not required in the M-2, the p.c. board layout was modified to allow that switch to be used in the M-2 as either a "20Ω MIC" switch, or a "20dB PAD" switch, depending on how the board is assembled. The 20Ω MIC switch provides optimum matching of microphones with extremely low output impedances. The 20dB PAD switch attenuates the input signal by 20 dB prior to the JT-16-B input transformer, providing a maximum input level of +29 dBu.

Highlights

The Jensen JT-16-B Input Transformer is Jensen's best mic-input model. Jensen is known worldwide for their superior audio transformers. If you thought transformers were a compromise, you haven't heard the JT-16-B!

The JT-16-B is a large, low impedance ratio (150:600Ω) transformer made with a proprietary 80% nickel (nickel-iron-molybdenum) core material. The large size allows it to handle extremely high signal levels of +12dBu at 30Hz and above, +9.7dBu at 20Hz. The low ratio provides less distortion, flatter frequency response and more linear phase response than more typical high-ratio transformers (150:15kΩ). The proprietary 80% nickel core material is far superior to, and much more expensive than the steel often found in other transformers.

The JT-16-B outperforms transformerless mic preamps because it eliminates the input coupling capacitors that are usually required with transformerless designs. Capacitors degrade the audio signal because they have a property known as dielectric absorption. Some of the signal passing through the capacitor is absorbed by the dielectric of the capacitor, then released a short time later. This smears the signal. Transformerless designs require these capacitors to keep the phantom supply voltage from reaching the circuitry of the preamp. Transformers inherently block DC voltages, eliminating the need for the capacitors.

The JT-16-B provides better common mode rejection than transformerless designs, important in electrically noisy environments. It handles common mode voltages as high as ±300V peak. Transformerless designs are usually limited to maximum voltages equal to their power supply voltages, typically ±15V to ±18V.

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 990C 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 990C operates from ±24V power supplies, allowing output levels of greater than +24dBu. It can drive long cables and loads as low as 75Ω, something monolithic op-amps cannot do. See the 990 data package for further information.

Elimination of All Coupling Capacitors from the Signal Path results in less degradation of the audio signal. Two superior techniques are used to accomplish this:

1. Input bias current compensation circuitry nulls out the small DC currents (thus voltages) that flow from the inputs of the 990C (or any op-amp), voltages that could cause noise when operating the gain controls. This circuitry also reduces the DC offset voltage at the output of the 990C. Most other mic preamps use coupling capacitors to block the input bias currents, resulting in signal degradation.

2. DC servo circuitry nulls out the DC offset voltage at the output of the 990C, eliminating the need for a traditional output coupling capacitor to block that voltage. The signal degradation caused by that capacitor is also eliminated. See the schematic on page 7 for details.

Standard Features

M-1: Dual Range Gain Control and "HIGH GAIN" Switch. The overall gain adjustment range is 12 to 60 dB, a span of 48 dB. Rather than cover the entire 48 dB in one revolution of the gain pot, there are two smaller, overlapping ranges selected by the "HIGH GAIN" switch. The low gain range provides adjustment of 12 to 40 dB, the high gain range 32 to 60 dB (higher gain can be provided on request). This provides 28 dB of adjustment per range, with 8 dB of overlap. The relatively small 28 dB of adjustment per range provides great feel and resolution, with sufficient overlap to keep you "in range" at all times.

There are two reasons for the great feel: First, with fewer dB of adjustment per revolution, it is easier to adjust the pot to the desired gain setting. The second reason is a more technical one, and very important. A single 10kΩ pot covering the entire 48 dB range in a single revolution could get a bit "touchy" as it approaches the maximum gain point (minimum resistance), due to contact resistance variation (CRV). The gain pot of the M-1 is actually a two section pot having a 10kΩ section and a 500Ω section. In high gain applications where CRV would be a problem with a 10kΩ pot, the 500Ω section of the pot is used. CRV is reduced by a factor of twenty, virtually eliminating any touchiness. See page 5 for details.

The unusually low minimum gain of 12 dB allows the M-1 to handle input levels as high as +12 dBu before the output is driven past its +24 dBu maximum output level. The JT-16-B input transformer can handle input levels of +12 dBu at 30 Hz and above, and +8 dBu at 20 Hz.

If you need infinite resolution so you can set the mic preamp to any gain, or be able to "ride gain" during a performance, the gain controls of the M-1 are ideal.

M-2: 16-Position Rotary Gain-Switch with 1% metal-film resistors provides accurate and resettable gain control from 15 to 60 dB in steps of 3 dB (higher gain can be provided on request). For situations where exact gain-matching of channels or exact resettability is required, the gain controls of the M-2 are ideal.

M-2: "20Ω MIC" Switch provides optimum matching with microphones that have a 20Ω output impedance. Note that the Jensen JT-16-B mic-input transformer does exceptionally well with just about any low-impedance microphone, including those with a 20Ω output impedance, but this switch provides further refinement. The switch takes the place of the "HIGH GAIN" switch of the M-1.

M-2: "20dB PAD" Switch provides a 20dB resistive pad before the input transformer. This increases the maximum input level to +29 dBu for situations where excessively high input levels are encountered. Most applications won't need a pad, but for those that do, this option provides it. This switch takes the place of the "HIGH GAIN" switch of the M-1.

Note that you can get an M-2 channel built with the "20Ω MIC" option *or* the "20dB PAD" option, but not both. These options take advantage of the fact that the "HIGH GAIN" switch of the M-1 is not needed in the M-2, and the p.c. board was modified to allow that switch to be used in one of three ways.

M-1 and M-2 Common Features:

Polarity Reverse Switch ("POL REV") reverses the signal polarity immediately before the input transformer.

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

All Front Panel Switches are LED Illuminated. A custom clear plastic push button was developed for the M-1 and M-2. 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. The HIGH GAIN switch of the M-1 (20Ω MIC or 20dB PAD for the M-2) uses a red LED, the POL REV switch uses an amber LED and the +48V switch uses a green LED. No guessing about these switches!

Gold Plated XLRs for maximum reliability. Gold does not tarnish or oxidize.

Ground Lift Switch on Each Channel allows disconnection of the shield (pin 1) of the output XLR. This can be helpful in eliminating ground loops. This mini-toggle switch is on the rear panel.

Toroidal Power Transformer with additional silicon-iron shielding eliminates hum problems caused by stray magnetic fields. Some manufacturers use a separate power supply chassis and umbilical cord to keep the power transformer's stray magnetic fields from interfering with the audio circuitry. In the M-1 and M-2, the stray magnetic fields are controlled at the transformer. 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. Thanks to these extra details, the transformer can be built into the M-1 or M-2 chassis. No separate chassis and umbilical cord to deal with.

Toroidal power transformers inherently have lower stray magnetic fields than conventional EI-core transformers. They are also smaller and lighter. They are also 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 line filter included in the input connector. These features allow the preamps to be easily adapted for use anywhere in the world. The supply accommodates over/under voltage situations easily.

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

Built to Order, the way YOU want it. Start with only one basic channel if you wish. Additional channels, meters and output transformers can be easily field-installed. The mainframe is ready for all four channels, with blank panels provided for unused channels. Have it your way!

Options

VU-1 Meter Card is a very accurate and informative meter that directly monitors the output level of the MPC-1 mic preamp card. There is no need to monitor the input level of the MPC-1 because the output will clip before the input transformer saturates.

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 LED-illuminated front panel switch (green LED) 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 +10dB in linear steps of 2dB (15 yellow LEDs, 5 red LEDs). Easy calibration of the meter's 0VU operating level is accomplished by moving an internal plug-in jumper to one of four positions: 0dBu, +4dBu, +8dBu or ADJustable. The "ADJ" position covers a range of -10 to +12 dBu via a 25-turn trim pot. Standard setting is "+4" (0VU on the meter scale equals a +4 dBu output level).

The firing point of the separate peak (PK) LED is calibrated via a 25-turn trim pot for output levels of 0 to +22dBu. The standard setting of +22dBu provides at least 2dB of warning prior to clipping. 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 (better op-amps than you find in the signal path of many consoles!). 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.

PK-1 Meter Card provides a peak LED function only. It uses the same full-wave rectifier, peak detector, 25-turn trim pot for setting the firing point of the LED, on-card voltage regulation and isolated grounding for the 5 volt LED power supply that is used on the VU-1 card.

JT-11-BMQ Output Transformer is the best Jensen line-output transformer. It compliments the outstanding line driving capability of the 990C by providing a balanced, floating, isolated output. Ground loop problems are eliminated because the signal is coupled magnetically rather than directly, something that transformerless circuits cannot do. Your application may not require an output transformer, but if you need one, the JT-11-BMQ is the best.

PIN 2 or PIN 3 HIGH? There are two polarity standards in use today for XLR connectors. The official IEC, SMPTE and AES standards state that pin 2 is high (relative to pin 3), while the unofficial standard states that pin 3 is high (relative to pin 2). The M-1 and M-2 make it very easy to deal with this. A pair of plug-in jumpers is located next to each XLR, allowing you to quickly change from "PIN 2 HIGH" to "PIN 3 HIGH", or vice-versa.

It is very important to verify the polarity of the equipment that will be used with the mic preamp, and to maintain correct polarity when connecting the mic preamp. Possible problems range from an audible change due to an inadvertent reversal of polarity, to slight degradation of the signal if a transformer-coupled output is driving an unbalanced input of the opposite polarity, to possible damage to the 990C in a direct-output configuration driving an unbalanced input of the opposite polarity (driving a short-circuit!). Please specify PIN 2 HIGH or PIN 3 HIGH!

A few Important Details

Factory Selection of Critical Parts. R2 and R3, the 6.81kΩ resistors in the phantom supply network, are matched to 0.1% tolerance for the best performance.

1% 100ppm 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.

Polycarbonate Capacitors are used in critical timing circuits instead of cheaper mylar or polyester capacitors. They are much more stable, and have a more linear impedance.

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. They will also have better, more linear performance over a wider temperature range. Electrolytic capacitors are more failure prone than most other components (a good thing to remember when troubleshooting older equipment). Sometimes they allow small amounts of DC current to pass through (leakage current), causing pots and switches to be noisy when operated. (NOTE: in the M-1 and M-2 there are no capacitors in the signal path, so this problem cannot exist). Other capacitors will short-circuit, or 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 these mic preamps!

XLR Connectors are Soldered Directly to the P.C. Card, minimizing the 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 a "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.

Plastic knobs look like . . . well . . . plastic knobs! Plain round knobs don't give any tactile indication of which way they are pointing. Knobs with pointers or bars sticking out do tell by feel which way they point, but the protrusion is often 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 like spokes of a wheel. Which is the indicator line and which are the spokes?

This knob was developed to meet all requirements. It is machined out of solid aluminum, with a nonreflective black anodized finish. A laser-cut white ceramic 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!

An Extruded Aluminum Chassis was developed for the front, rear and sides of the M-1 and M-2 chassis. It solves a number of 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 are provided for easy installation and handling. Stainless steel threaded inserts are used for long life and the ability to withstand repeated assembly & disassembly.

Condensed Typical Specifications (0dBu = 0.775V)

E.I.N., 20-20kHz unweighted,	150Ω source:	-129	dBu
	0Ω source:	-132	dBu
Maximum input level, M-1	>30Hz:	+12	dBu
Maximum input level, M-2	>30Hz:	+9	dBu
Maximum input level, M-2 with pad	>30Hz:	+29	dBu
Maximum output level at 990 output	75Ω load:	+24	dBu
CMRR	60Hz:	117	dB
	10kHz:	80	dB
Deviation from linear phase	20Hz-20kHz:	+1.1/-0	deg
THD, JT-16-B, (below saturation)	20Hz	0.036	%
	30Hz:	0.022	%
	50Hz:	0.010	%
	1kHz:	0.003	%
THD, JT-16-B & 990:			
60dB gain, 10kΩ load, +24dBu output	10kHz:	0.005	%
	1kHz:	0.004	%
40dB gain, 600Ω load, +24dBu output	10kHz:	0.003	%
	1kHz:	0.003	%
40dB gain, 75Ω load, +24dBu output	10kHz:	0.030	%
	1kHz:	0.005	%
DC offset		<100	µV

Contact Resistance and Contact Resistance Variation

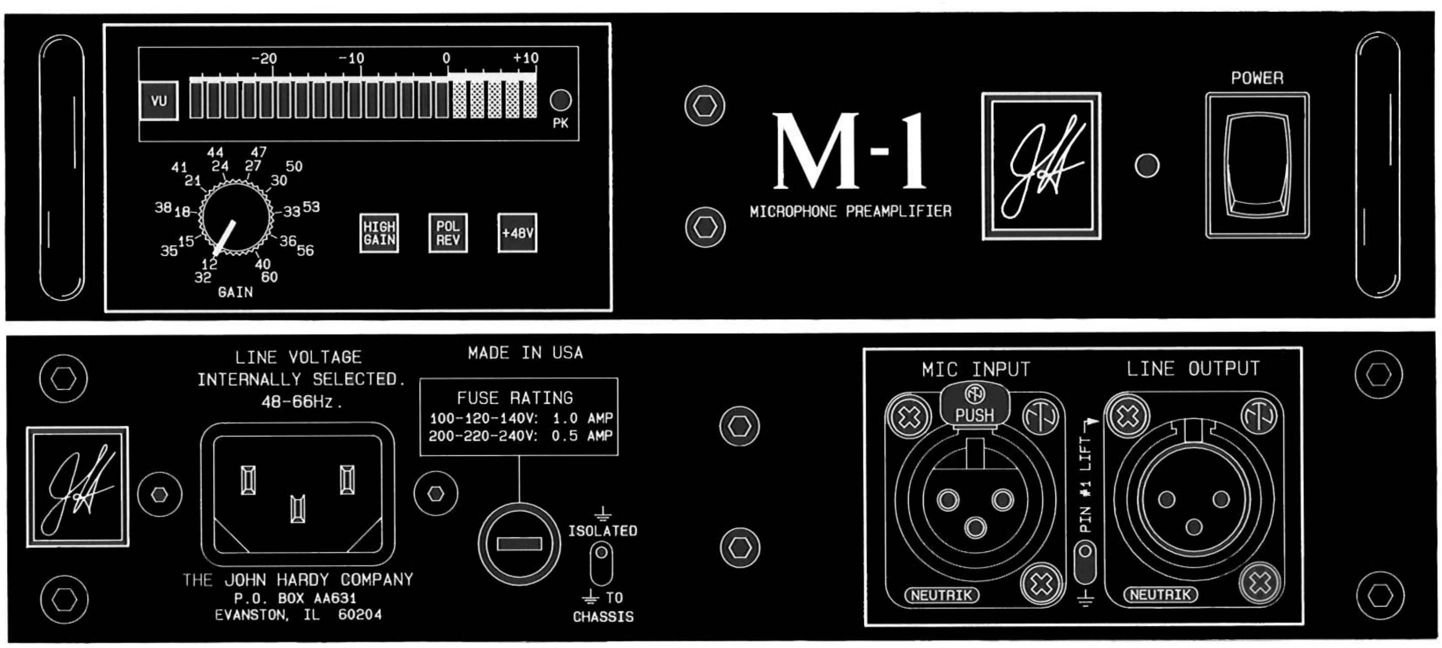
The most familiar specifications for potentiometers are: resistance value, tolerance and taper. Even these simple specs will vary with temperature, time, applied voltage, number of rotations, etc., but they are pretty straight forward. However, contact resistance (CR), and contact resistance variation (CRV), are specifications that are unfamiliar to many people.

A pot has a moving contact, or “wiper”, and it is positioned along the surface of a resistance element. The key to understanding the problems of CR and CRV is to realize that the resistance element has a small but measurable thickness to it, and the current flow is not always occurring exactly at the surface of the element. This is because the current flow follows the path of least resistance created by the imperfect blend of conductive and non-conductive materials used to make the element. There is a measurable amount of distance, therefore resistance, between the contact and the nearest point of current flow. This contact resistance (CR) can be as much as 2% of the pot's resistance value, and will vary as the contact is moved from one position to the next (CRV). If the current is flowing near the surface of the element at the contact position, CR is low. If the current is flowing far below the surface at the contact position, CR is high. For example, if the pot measured exactly 10kΩ from end to end, and if you could find the exact electrical midpoint of the resistive element, it could measure 5200Ω from either end to the contact sitting at the midpoint. It takes 5000Ω to get to the midpoint of the resistive element, and an additional 200Ω to get to the surface of the element where the contact is, assuming a worst-case CR of 200Ω.

When a pot is used as a rheostat, as it is in the gain control of the MPC-1 mic preamp card, the CR must be added to the basic element resistance when making gain calculations. The gain pot of the MPC-1 card is configured so that a reduction of resistance causes an increase of gain.

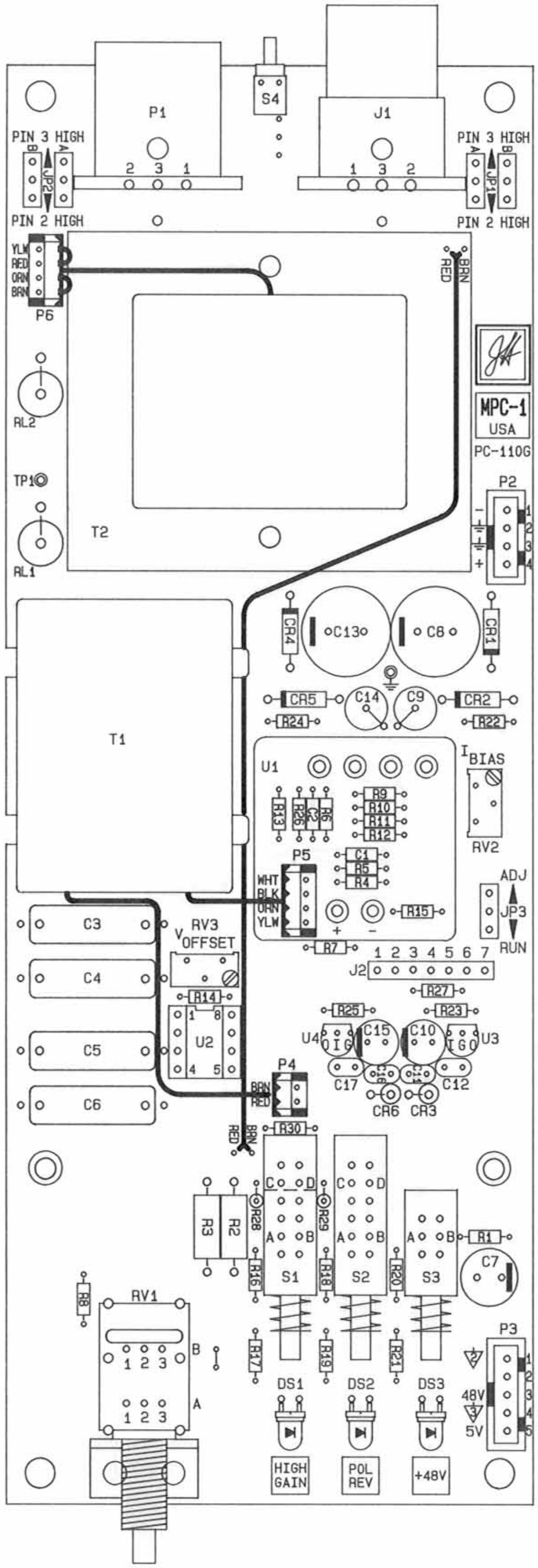
For the following example let's assume a single section 10kΩ pot is used, covering the entire 48dB adjustment range (12 to 60dB) in a single revolution. Due to the logarithmic nature of audio, it takes almost a 2kΩ reduction of resistance (10kΩ to 8kΩ) to provide a 1 dB increase of gain when going from 12 to 13 dB of gain, while it takes a mere 10Ω reduction of resistance (70 to 60Ω) to provide a 1 dB increase when going from 47 to 48 dB of gain. The worst-case CR of 200Ω (2% of a 10kΩ pot) would be insignificant in the first instance (resistance change from 10kΩ to 8kΩ for a gain change of 12 to 13 dB), since a CR of 200Ω is small compared to the 2kΩ change in gain pot resistance. But if you were increasing the gain from 47 to 48 dB by changing the gain pot setting from 70 to 60Ω, a CR of 200Ω could definitely be a problem, compared to the desired 10Ω change in gain pot resistance. Imagine a worst-case situation: at the theoretical 70Ω position, contact resistance might happen to add 10Ω, while at the theoretical 60Ω position, contact resistance might happen to add 200Ω. Instead of going from 70Ω to 60Ω, you would actually be going from 80Ω to 260Ω. The resistance goes up instead of down, and the gain is decreased by more than 8 dB instead of the 1dB increase you planned on! The next nudge of the control could have just the opposite effect. It is highly unlikely that CRV would be that bad, but it is unpredictable and undesirable.

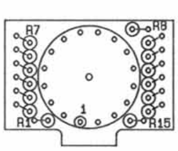
The gain pot of the MPC-1 mic preamp card is actually a two section pot (RV1A and RV1B on the schematic on page 7), with a 10kΩ section and a 500Ω section. In the low-gain mode (12 to 40 dB), the HIGH GAIN switch shorts across the 500Ω section of the pot, leaving just the 10kΩ section active. The CR of a 10kΩ pot is not a problem at lower gains, as mentioned earlier. In the high-gain mode (32 to 60 dB), the HIGH GAIN switch shorts across the 10kΩ section, leaving just the 500Ω section active. Contact resistance would be a problem at these higher gains if you were still using the 10kΩ pot, but the worst-case CR is just 10Ω with the 500Ω pot, compared to 200Ω with the 10kΩ pot. This reduces the CRV problem by a factor of twenty. The result is a much smoother, more consistent and higher resolution gain control.



PC-110G

MPC-1 MIC PREAMP CARD





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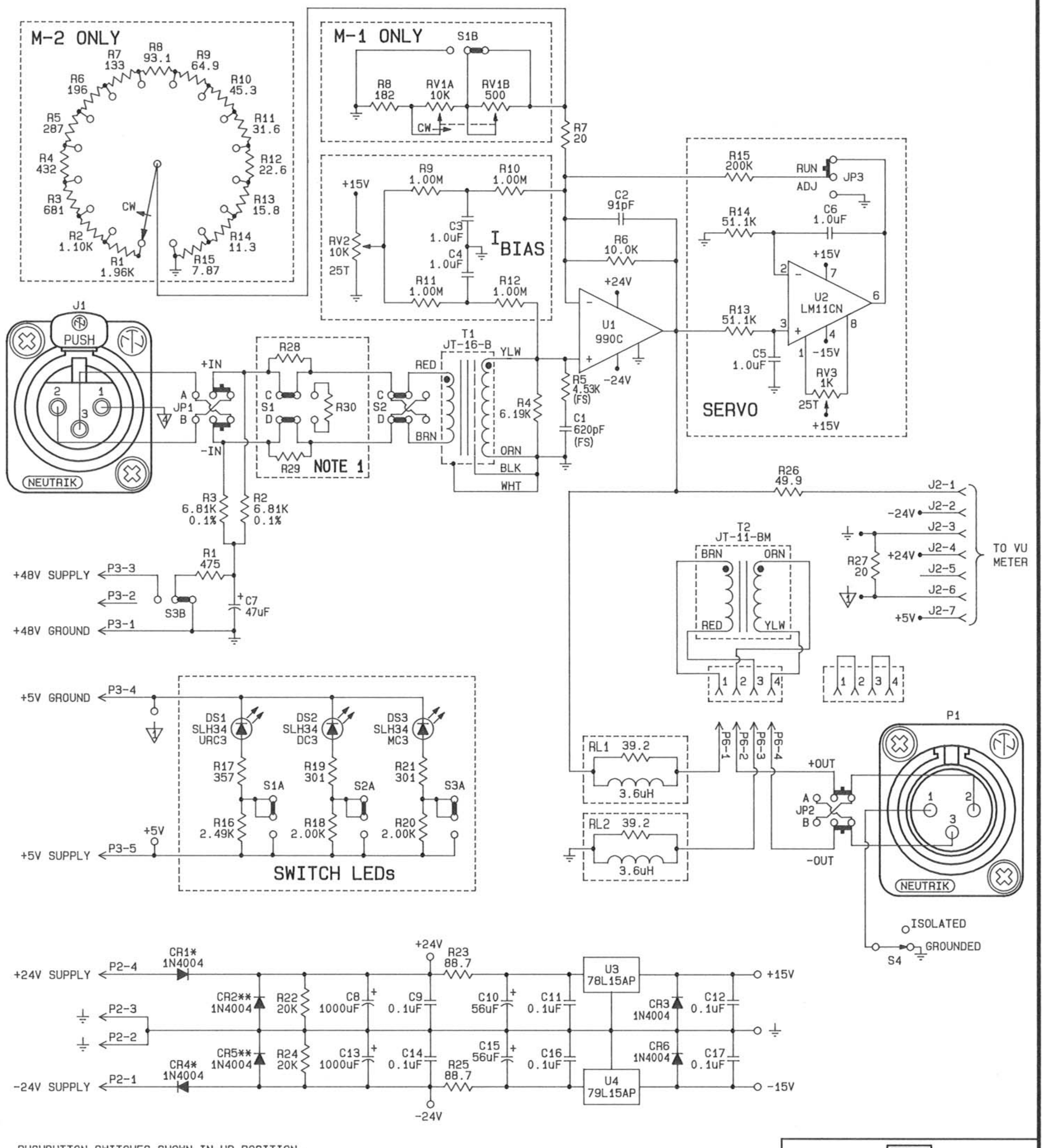
DRAWING #96102401A

MPC-1



PUSHBUTTON SWITCHES SHOWN IN UP POSITION.

VALUES FOR R5 AND C1 ARE TYPICAL. FINAL VALUES ARE FACTORY SELECTED (FS).

*THESE DIODES USED ONLY FOR CUSTOM APPLICATIONS.
REPLACE WITH JUMPERS FOR M-1 USE.

**THESE DIODES USED ONLY FOR CUSTOM APPLICATIONS. DELETE FOR M-1 USE.

NOTE 1: FOR M-2 USE ONLY:
20 OHM MIC: R28=68.1 R29=68.1 R30=OPEN.
20dB PAD: R28=619 R29=619 R30=169.
M-1: R28=JUMPER R29=JUMPER R30=OPEN.
M-1: POLES "C" AND "D" OF S1 ARE NOT INSTALLED.

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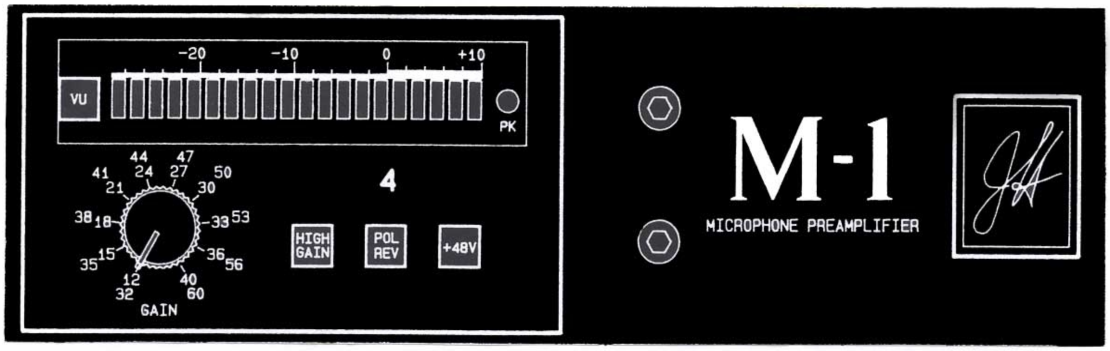
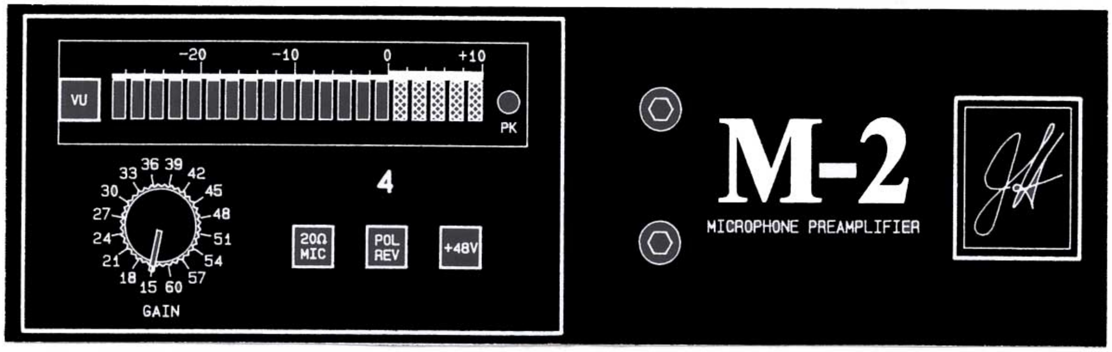
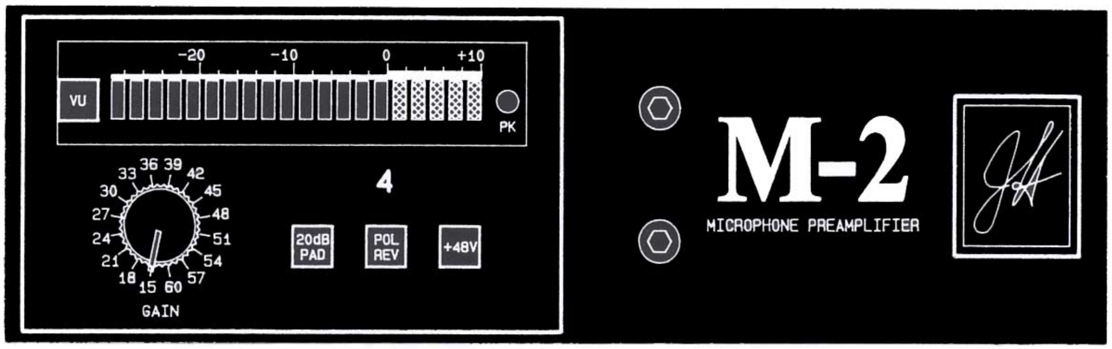


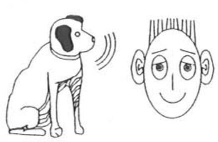
-20 -10 0 +10
VU
PK
41 44 24 47 27 50 21 30 38 18 33 53 35 15 36 56 12 32 40 60
GAIN
4
HIGH GAIN
POL REV
+48V
M-1
MICROPHONE PREAMPLIFIER

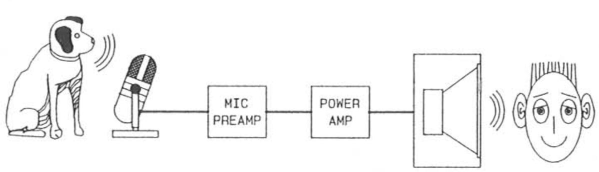


-20 -10 0 +10
VU
PK
33 36 39 42 30 45 27 48 24 51 21 54 18 57 15 60
GAIN
4
20Ω MIC
POL REV
+48V
M-2
MICROPHONE PREAMPLIFIER

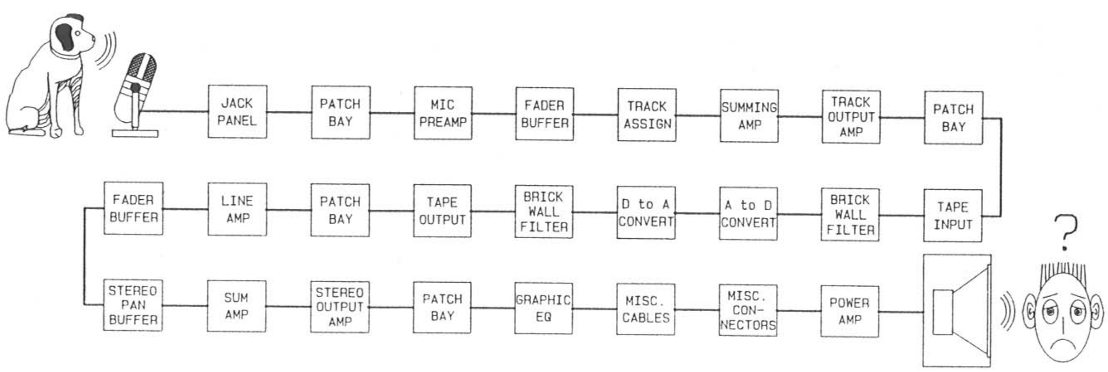


-20 -10 0 +10
VU
PK
33 36 39 42 30 45 27 48 24 51 21 54 18 57 15 60
GAIN
4
20dB PAD
POL REV
+48V
M-2
MICROPHONE PREAMPLIFIER





MIC PREAMP
POWER AMP



JACK PANEL
PATCH BAY
MIC PREAMP
FADER BUFFER
TRACK ASSIGN
SUMMING AMP
TRACK OUTPUT AMP
PATCH BAY
TAPE INPUT
BRICK WALL FILTER
A to D CONVERT
D to A CONVERT
BRICK WALL FILTER
TAPE OUTPUT
PATCH BAY
LINE AMP
FADER BUFFER
STEREO PAN BUFFER
SUM AMP
STEREO OUTPUT AMP
PATCH BAY
GRAPHIC EQ
MISC. CABLES
MISC. CON-NECTORS
POWER AMP
?