OWNER'S MANUAL

THE DAYTON WRIGHT Model 999 PRE-PREAMPLIFIER

Mark 1

DAYTON WRIGHT GROUP LTD.

97 Newkirk Road North, Richmond Hill,
Ontario L4C 3G4, CANADA

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SECTION 1
GENERAL INFORMATION

Introduction:

1.1 This manual covers the installation, operation, and servicing of the Model Dw 999 Pre-preamplifier.

Description:

1.2 The DW-999 is a Infranoise (very low noise) Pre-preamplifier which is designed to amplify the low level low-impedance signals from a moving coil type of phono cartridge to the level where they are sufficient to drive the phono input of a conventional preamplifier. This unit permits the user to select among several cartridge load resistances, and if necessary, to install a special resistor to match the required load.

The circuit components are mounted on a double sided MIL-Grade-Epoxy Glass Circuit Board which is housed in a robust welded aluminum case. The Circuit Board is selectively coated with a solder resist on both sides in order to prevent solder bridging.

The Power Supply is built into a separate case and supplies 30 volts DC to each channel of the pre-preamplifier. Both sections of the supply are electrically isolated from each other.

The Left and Right Channels of the Pre-preamplifier are both electrically and physically isolated from each other on the circuit board in order to minimize any interaction. Both channels have individual and separate grounds.

As supplied, the unit operates off 95 to 130 volts, 50 to 60 Hz mains. The power supply cord supplied is suitable for use in Canada and the United States of America. Other operating voltages and cords can be supplied upon request.

Warranty:

1.3 The DW999 is warranted in the Continental United Statesof America and Canada under a LIMITED WARRANTY as follows:

This Dayton Wright Product is warranted against defects in both materials and workmanship for a period of Two Years from the date of manufacture, or from a period of

up to two years from the date of customer Purchase, the latter in no case to exceed three years from the date of manufacture and in no case to be valid unless the customer has his original Bill of Sale clearly showing the Date of Purchase and the Name and address of the dealer from whom this unit was purchased. This warranty is voided where this unit has been subject to misuse or abuse. Any usage of acid-core solder on this unit void the warranty as does any attempt to modify the circuit and/or the components used in its manufacture. Once return is authorized and the unit returned prepaid to the factory, we will repair or replace any parts which prove to be defective within normal usage and provided the warranty has not expired. The Dayton Wright Group Ltd.,'s decision as to whether a unit has been abused shall be final and binding. No other warranty is expressed or implied and The Dayton Wright Group Ltd. is not liable for consequential damages.

Exclusion for damage due to a lightening strike or power surge. Our warranty does not cover anything that is damaged by any incident like this. As transistors or other components may fail if subjected to a voltage spike, even after some months have passed, if we are called on to effect a repair, any such work will be excluded from any subsiquent warranty repair. It must be understood, in advance, that should we attempt a courtesy repair, tat it is NOT under any warranty whatsoever!

You may have additional warranty rights in certain States.

Outside the United States and Canada your warranty will be with the designated import agent for this product.

In the Continental United States and Canada, for Warranty return authorization contact:

This information is given only as it was supplied with the 555 Pre-preamplifier and may no longer be current!

The Dayton Wright Group Ltd.
Customer Services
3-97 Newkirk Road
Richmond Hill, Ontario,
L4C 3G4, Canada,
Old number:(416) 884-8586
New number: (905 508-7500

Identification:

1.4 This manual applaes to the DW999 Pre-Preamplifier only. The Unit may be identified by the 1999" on the top of the case, the model and serial number located on the back of the case, and the serial number on the circuit board itself. The date of manufacture is also on the circuit board. Any attempt to alter any of these numbers will void the warranty.

INQUIRIES:

This information is given only as it was supplied with the 555 Pre-preamplifier and may no longer be current!

1.5 Direct any inquiries to:

The Dayton Wright Group Ltd.,
Customer Service,

3-97 Newkirk Road ,
Richmond Hill, Ontario L4C 3G4
Canada.

Always identify the unit by the serial number and model number. Shipments to the above address will not be accepted unless prior arrangements have been made and a return authorization obtained. Out of country customers are advised that it is their responsibility to file the necessary export documents so that they will have proof of export and thus avoid payment of duties upon the basic value of the unit upon its re-entry to their country.

Section 2
INSTALLATION

Introduction:

2.1 This section contains the information needed to perform an initial inspection of the DW 999 Pre-preamplifier as well as the installation steps normal to its use in an audio system. Also covered are the procedures to be followed if initial inspection reveals damage to the unit, as well as repacking of the unit for storage or reshipment.

Initial inspection:

2.2 This pre-preamplifier was inspected both electrically and mechanically before it was shipped to the dealer. While we advise the dealers that all shipments should be inspected for damage immediately upon receipt so that shipping damage can be noted on the manifest and a claim made against the carrier, we have no way of verifying that this has been done.

It is wise therefore, to perform a careful physical inspection of the pre-preamplifier prior to its initial use. Inspect the packing material to see if there is any physical damage to the carton. If carton damage is present, make a note of it's location and extent. Also note any signs that the carton has been exposed to excessive moisture.

The pre-preamplifier case should be free of scratches or burnish marks. The interconnecting cable from the power supply should be free of cuts or blemishes. The connector screws should be in place on the connector or should be packedged separately. Four (4) sets of BNC Connectors are packed (In plastic Bags) with each pre-preamplifier.

The chassis mounted BNC Connectors should not be damaged or bent.

An inspection of the internal Circuit board may be done by removing the two screws on either end of the power connector at the rear of the case. This will allow the PC Board to be slid out. There should be no sign that any components have been broken, cracked or knocked free of the circuit board. Re-insert the board in the case and secure with the two screws that had been removed.

If the Pre-preamplifier is connected and operated outside the case remember that certain board traces if shorted together or if short-circuited to ground, can cause the transistors to be blown. Location of these damaged parts and their replacement is not covered under your warranty. If it is necessary to operate the unit uncased, be sure that it is resting on an insulated surface. As there is no power switch on this unit. up to 35 volts will be present in the power supply section of the board.

Claims:

2.3 The warranty is printed in paragraph 1.3 on pages 4 and 5. If shipping damage is present and you took delivery of the unit up at a dealers; it was his responsability to inspect the incoming material after shipment, any claim for damages must be setled between yourself and the dealer.

If the unit was shipped to you by the dealer, and you find shipping damage, it is your responsibility to make a claim against the carrier involved within a period of 14 days for hidden damage, or 7 days for visible damage. If you failed to inspect the material upon receipt and gave the carrier a 'clear' signature you might have difficulty in procuring a settlement.

Nevertheless it is your responsibility to notify the carrier in writing within the statutory period (which is best done by registered-return receipt requested mail) and to insure that he arranges an inspection of the goods as soon as possible. Your dealer should assist you by providing a certified true copy of the Bill of Lading and the Invoice so that you can then make a written claim. Upon receipt of your written claim the carrier generally has 120 days in which to negotiate a settlement.

The Dayton Wright Group Ltd. has packed your unit carefully in a manner sufficient to withstand the normal rigors of shipment. We therefore assume no responsibility for shipping damage.

Preparation for Use:

2.4 The unit should be unpacked and placed on a surface removed from any power transformers or other sources of magnetic AC interference. The power module cable may then be plugged into the rear of the pre-preamplifier and secured with the screws provided. We do not advise leaving these loose as inadvertent disconnection could cause a damaging transient to go through your audio system.

See section 3.21 on instructions for attaching BNC Connector's to your audio interconnect cables. We use these rather than the more common phono connectors as we have found that they not only are more reliable, and have lower distortion and noise but that as their ground connects first and disconnects last, there is far less possibility of an inadvertent disconnection damaging the other equipment.

Initially it is wise to place the unit in an easily accessible location as you may wish to alter the load resistor settings and the output level controls. Be sure that you know what load your cartridge requires. Remember that the "OUTPLIT LEVEL" controls are twenty turn (20) potentiometers.

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Repacking for Shipment or Storage:

2.5 ALWAYS SAVE THE ORIGINAL PACKING MATERIAL! Whenever you wish to store the unit or re-ship it the pre-preamplifier must be packed securely. The Factory will not accept responsibility for units that have been returned to them and damaged in shipment due to faulty packing techniques and/or materials. Make sure that the cable connector is positioned so that it will not mar the finish on the pre-preamplifier or the power supply module.

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Section 3
OPERATION

Introduction:

3.1 This section covers the general operation of the DW 999 Pre-Preamplifier including its controls and its

connections.

Controls & Connectors:

3.2 As noted, the DW 999 employs BNC Connectors for all Audio Signal Path Connections. As both these as well as phono connectors are used in video recording, BNC-to-Phono cables are usually available from dealers handling video accessories. We do not advise the employment of phono adaptors as these simply re-introduce the problems that we tried to avoid by using BNC units in the first place.

Use of BNC Connectors:

3.31 The BNC Type of connector is in use world-wide as a wide-bandwidth low-noise connector in applications ranging from avionics to test equipment. As such, it may be readily obtained from electronics parts houses. While lower cost units are nickel plated, the better quality units are plated with either silver or gold. Besides the aforementioned advantage of making the ground connection first (upon connection) and breaking it last (upon disconnection) the BNC unit has a bayonet type locking device to hold it in place.

In general, the cable-mounting portion of the connector system consists of a machined body upon which the positive bayonet-type-locking sleeve revolves. This body also has the slit sleeve ground connection which in turn surrounds a plastic insert which separates the outer grounded body and the inner live center pin. From the rear, a bushing screws into the main body and through of a tapered metal washer, a flat washer, and a rubber ring, connect the outer braid of the coaxial cable used to the connector body. This bushing is available in several different sizes and a size can usually be found that will fit whatever audio interconnect cable is being employed. Several manufacturers offer prefabricated cables with BNC connectors already attached at one or both ends.

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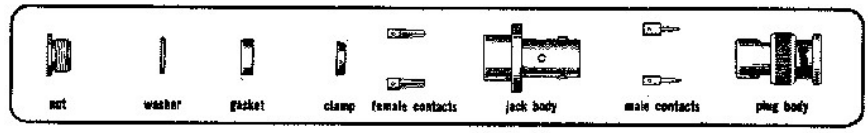
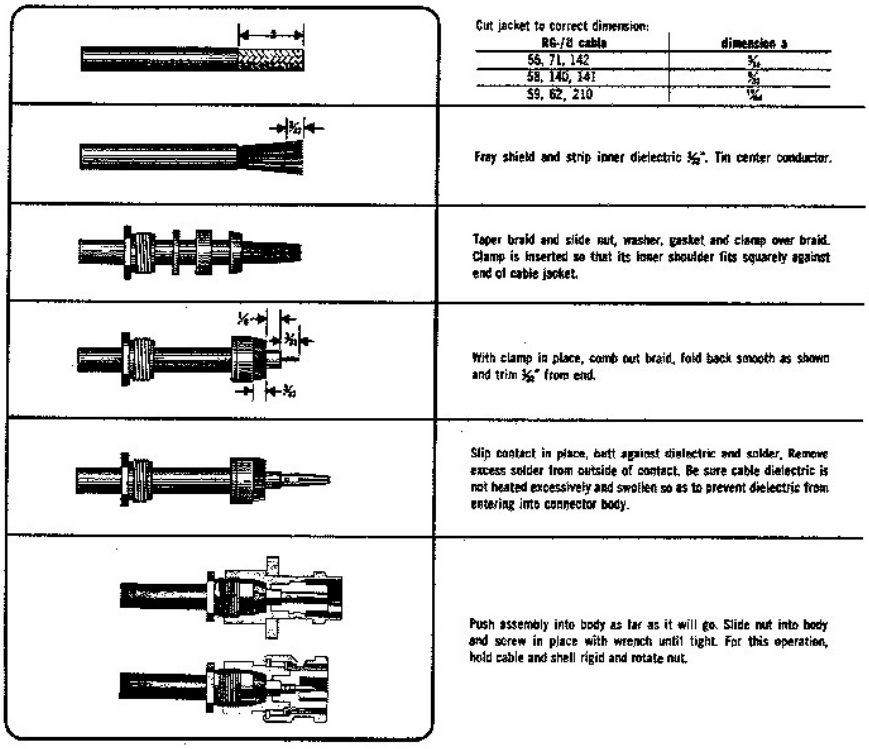
Making up Cables:

3.22 A bushing should be used that is a snug fit over the insulation of the coaxial cable being used.





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Adapters:

3.23 Because of the amount of Video equipment that uses BNC connectors, most retailers who sell video recording equipment have a selection of BNC to Phono cables and adapters. While these are generally satisfactory for the connection of the Pre-preamplifier to the preamplifier (providing the length of the cable is not too long) they exhibit the usual noise problems when used in the very low impedance input circuits encountered in moving coil cartridges. While an adapter may serve to get a system 'up-and-running', we would respectfully suggest that it be replaced as soon as possible.

Control Location:

3.24 The DW 999 has two user adjustments. (NOTE: THE REGULATED VOLTAGE AND THE TRIMMER CAPACITOR ADJUSTMENTS (if the latter is used) HAVE BEEN PRESET AT THE FACTORY AND MUST NOT BE TOUCHED!

These user adjustments are both accessible from the front panel. They are: The Cartridge Load Control Switch and the Output Level Control.

The Load is set by means of the small DIP-type switches set on either side of the input connectors. The output level control are screwdriver-adjustment units whose bushings are located adjacent to the output connectors. As would be .expected, the left channel is to the left of the case, while the right channel is to the

right of the case. The three binding posts in a line are, from left to right; the Left Channel Signal, Ground, the Case Ground (a green binding post) and the Right Channel Signal Ground. The Tone Arm Ground lead should be connected to whichever of the three ground terminals that results in the lowest noise figure being obtained.

Load Resistors:

3.25 Six Load resistors are located on the circuit board for each channel, and even more may be added using the spring clips provided. When all the DIP switches are OPEN or OFF - then the load will be 499 ohms. The first switch section is 83 ohms, the second is 65 ohms, the third is 28 ohms, the fourth is 14.5 ohms, and the fifth is 9.8 ohms. The sixth is for the resistor clips located internally. The switches may be used in combinations to achive other resistances:

RESISTOR	83	65	28	14.5	9.8	RESULTING LOAD
			NONE USED			499
	*					83
	*	*				29.2
	*	*	*			14.7
	*	*	*	*		7.4
	*	*	*	*	*	4.25
	*		*			41.25
	*		*	*		17.36
	*		*	*	*	6.34
	*		*		*	29.1
	*			*		28.29
	*				*	8.92
	*			*	*	5.59
		*				65
		*	*			26.59
		*	*	*		14.09
		*	*	*	*	5.84
		*		*		12.18
		*		*	*	5.49
		*			*	8.66
		*	*		*	7.26
			*			28.00
			*	*		9.7
			*	*	*	4.94
			*		*	7.36
				*		14.5
				*	*	5.91
					*	9.8

Opening the Case:

3.26 The Pre-preamplifier case may be opened by unscrewing the two screws on either side of the power connector. Slide the 'unit carefully out of the case. The Custom Load Clips are between the Load Selection switch and the Input Connectors. The lead on the resistor should be trimmed back so that it may be clipped in place-the clip is opened by depressing the projecting cap on the clip.

The case is closed-by sliding the board assembly back into the case and securing it in place with the screws that had been removed. Don't loose these screws as they have drilled and tapped heads to accept the screws on the connector cable's "D" Connector.

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Custom Load:

3.27 A custom Load may be used by inserting a resistor in the spring clipd provided. Remember that there

is always a 499 ohm load in place, the formulae for summing of parallel resistors must be used:

$$\frac{1}{\text{DESIRED R}} = \frac{1}{R} + \frac{1}{499}$$

Thus to achive a load of l00 ohms, use a 125 ohm resistor in the clips and switch the last switch on.

DESIRED LOAD RESISTOR	RESISTOR USED IN CLIPS
100 Ohms	125 Ohms
50 Ohms	56 Ohms
40 Ohms	43.5 Ohms
30 Ohms	32 Ohms
20 Ohms	20.85 Ohms
10 Ohms	10.2 Ohms
5 Ohms	5.05 Ohms
2.5 Ohms	2.51 Ohms
1.0 Ohms	1.002 Ohms

Under 2.5 Ohms use the exact load resistor you wish to use on the cartridge ... the error will be negligible.

Output Level Adjustment:

3.28 The level adjustments are normally used to lower the output level so that the preamplifier is not overloaded by the output of the DW 999. As the DW 991 Pre-preamplifier has an maximum signal output in excess of 2 volts at anywhere from 20 Hz to 20 kHz it would require a preamplifier having a .2 volt overload at 1 kHz to accommodate its capabilities. As there is about-20 db of equalization from 20 kH z down to 1 kHz in the RIAA curve, 2 volts at 20 kHz -20dB (or divided by 10) = .2 volts at 1kHz (200 millivolts).

In practice the full 34 dB voltage gain of the DW 999 pre-preamplifier is rarely needed except with the very few ultra-low voltage moving coil units. Once the screwdriver-adjusted volume control is fully clockwise, the gain of the pre-preamplifier may be lowered 6 dB by rotating each of the two controls 10 turns counterclockwise.

While an oscillator, voltage divider (remember that most oscillators do not respond well to the 4 to 100 ohm load imposed by the pre-preamplifier), and RMS voltmeter CAN be used to both set and balance the output levels of the left and right channels of the pre-preamplifier a more humble and practical method involves borrowing a turntable with a conventional moving iron or moving magnet phono cartridge. Connect this up (hopefully to the second) to the phono input, and adjust the preamplifier's volume control to a comfortable level. Switch over to the moving coil unit/pre-preamplifier. Playing the same part of the same record, adjust both of the output levels on the DW 999 Pre-preamplifier to produce the equivalent playback level. The channels may be balanced by adjusting one of them up or down until equally good balance is produced on several different recordings.

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Power Supply Module:

3.3 The Power Supply Module contains a transformer having a double and isolated set of secondary windings. Each of these is connected to a bridge rectifier and thence to a large filter capacitor. The output DC is led to the pre-preamplifier via a power cord and 'DI connector. The proper fuse MUST be used to protect the power transformer.

The DW 999 Pre-preamplifier requires about 10 seconds after turn

on to function and another minute or two to stabilise. Attempts to use it before that period is over will result in higher than normal distortion and noise levels.

The pre-preamplifier MAY be left turned on all the time.

Hum and/or RF Problems:

3.4 It is often difficult to distinguish between AC Power line induced Hum and TV Inter-channel Sync-Interference. The former is usually lower in pitch and will change only when interconnect cables or equipment is moved away from power cables, power cords, or power transformers. RF hum changes with very small movements of cables and is more of a buzz than hum. It requires a real expert to deal with RF interference, as its elimination is more of an art than a science. Contact the factory for assistance.

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SECTION 4

PRINCIPLES OF OPERATION

Introduction:

4.1 This section provides a brief overview of the theory of operation of the DW 999 Pre-preamplifier.

General Theory:

4.2 The use of a Pre-preamplifier or 'Head amp' rather than a transformer dates from the early 170's when Dayton Wright Associates and Mark Levinson both introduced units designed to operate from very low source impedance's. While Audio dealers were skeptical about the potential market,, Audiophiles were very impressed with the improvement over transformers and sales were excellent. As a result the number of pre-preamplifiers proliferated.

However, because the input voltages were in the microvolt range and the gains of the units ranged from about 22 dB to 32 dB, most designers did not appreciate the need for low distortion at higher output levels. They forgot that as the pre-preamplifier is used before the RIAA equalized section of the preamplifier, the 20 kHz output level will be about 20 dB (ten times the voltage) than the 1 khz output. Many conventional cartridges have an output of 100 millivolts at 1 kHz on very loud passages, and if the equivalent output is needed from a pre-preamplifier; that is, 100 mV @ 1 khz, then it must be capable of a I Volt output at 20 kHz. Very few pre-preamplifiers had this capability.

The usual design used two PNP and two NPN transistors with their emitters tied together and used for the input. The bases were AC grounded -and the collectors capacitativly taken to the output. This yielded a low imput impedance due to the common base operating mode and a typical gain of about 22 to 26 dB. Typical distortion figures at 100 mV output would be about .04% Harmonic; rising to over 3% at 1 volt. More advanced designs employed several PNP transistors in parallel with an emitter follower output. Some had feedback as well. As the noise generating resistance in the transistor is the Base Spreading Resistance (and is from 50 to 200 ohms in PNP'S, or from 250 to 400 ohms in NPN'S) a reduction in the effective resistance can be obtained

by using Fowler's technique of operating several transistors in parallel. This lowers the amount of noise generated, both by reducing the aggregate base spreading resistance, and by allowing a better impedance match between the source and the transistors.

One danger is present. With very low base resistances, there is little local feedback to stabilize the transistor, and parasitic oscillation can take place if the cartridge has a very low resistance and appreciable inductance, when feedback is used. Thus it was not uncommon to find pre-preamplifiers that were unstable with certain moving coil cartridges.

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Other factors also intrude. Transistors operated at very low signal levels suffer f rom Early Effect distortion. This can be eliminated using a technique developed by us at Dayton Wright called the bootstrapped cascode. (This has been copied extensivly by other manufacturers such as Sony, etc., without crediting us as the source). Here, a portion of the emitter signal from the lower transistor of the cascode pair is applied to the base of the upper transistor. While this raises the input impedance of the emitter input of the upper transistor (now more voltage swing is present at the collector of the lower transistor and the slightly higher charging/discharging current of the collector capacitance does lower the bandwidth slightly) and much lower distortion results. we have employed this technique in all out pre-preamplifiers (and in some of our preamplifiers as well) since 1971.

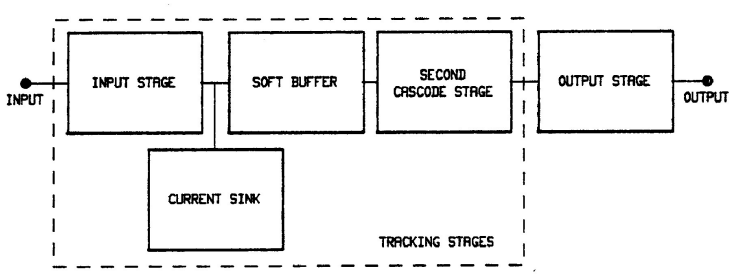
While an op-amp type of input using a 'long-tailed-pair' is less sensitive to cartridge loading induced changes in the effective feedback characteristics this configuration raises the noise level by a factor of 1.4 and is rarely used where noise is critical. Even feedback has limitations insofar as distortion reduction is concerned in pre-preamp2ifiers.

Dayton Wright Group has been developing the technique of 'tracking complimentary transfer functions ‘as a method of distortion reduction. Two stages, each with a known non-linearity are set up so that the non-linearity of the first stage is canceled out (or almost so) by the complimentary nonlinearity of the following stage or stages.

Obviously operating point tracking is required, and we employ a current sink set up with a 'soft" buffer to ensure that thermal tracking takes place between the stages. In addition, the very low impedance require correspondingly low value feedback components, and this in turn requires an output stage that can handle the current demands of this low-impedance feedback.

Block Diagram

4.3 The DW 999 Pre-preamplifier block diagram:



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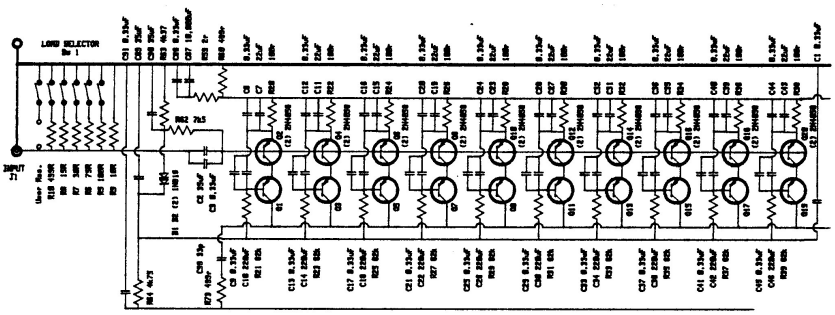
Specifics:

4.4 The following sections cover the operation of the stages in more detail.

Input Cascode Stage:

4.41 The input stage consists of ten bootstrapped cascode stages operating in parallel. Each stage has a loo ohm resistor as a current equalizing resistor in its emitter bypassed with a .33 uF polypropylene capacitor and a 220 uF Aluminum Electrolytic. The input signal is fed to all ten bases in parallel. The base of the upper transistor of the cascode pair is biased through a 82k resistor, and has the signal from the lower transistor's emitter fed to it through a .33 uF polypropylene and a 22 uF tantalytic in parallel. The collectors of the upper transistors are operated in parallel.

The biasing network consists of a 4k3 resistor from ground down (the ground rail is positive) to a pair of silicon diodes in series, followed by a 4.75 resistor to the 15.2 volt negative rail. The lower transistor bases are biased through a common 7k5 resistor from the junction of the 4k3 resistor and the start of the diode pair, while the upper transistor bases are biased by individual 82k resistors tied to the junction of the diode pair and the 4k7resistor. Both bias taps are bypassed up to ground with 35uF tantalytic capacitors, and the latter tap is also bypassed with a .33 uF Polypropylene as well. The stage uses 2N4058 PNP Devices selected for low shot-noise and low base spreading resistance.



INPUT STAGE

The 100 ohm emitter resistors are commoned and feedback from the output is applied at this point via a 100 ohm series resistor. The AC shunt is a 2 ohm resistor in series with a 10,000 uF capcaitor (bypassed with a .33 uF Polypropylene). In order to stabalize the DC operating point and to prevent latch up, a 499 ohm resistor is also used as a shunt element.

The input loading network consists of 5 switch selectable resistors, as well as a 499 ohm resistor. A .33 uF polypropylene in parallel with a35 uF tantalytic serve as the input coupling capacitor.

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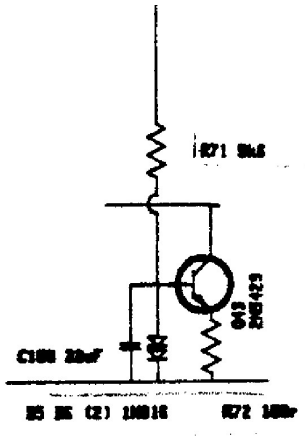
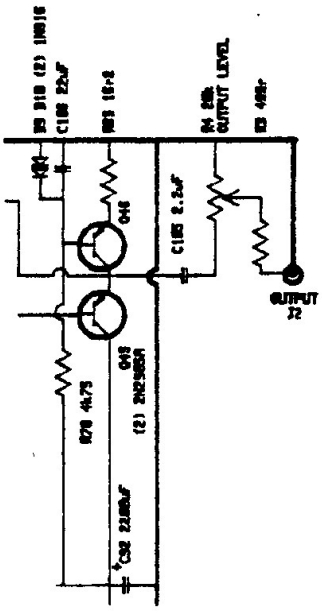
Current Sink:

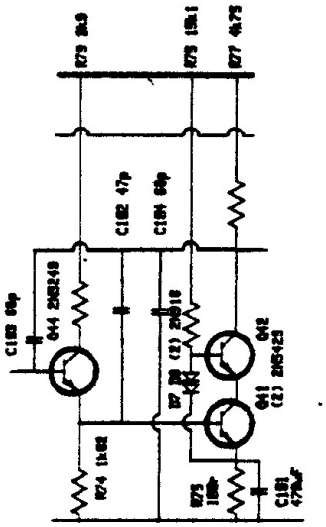
4.42 This is a single NPN transistor using a 100 ohm emitter resistor and a base biasing network of 2 IN916 diodes to the negative rail (bypassed with a 22 uF tantalytic to lower noise), pulled up by a 5k6 resistor up to the ground rail. The current sink is bypassed with a 33 pF in series with a 499 ohm resistor.



Buffer and Second Cascode Stage:

4.43 The current sink is followed by a 'Soft' buffer consisting of an emitter follower with a unbypassed 3k9 resistor in its collector circuit. The emitter load is 1k82 ohms, and the emitter signal is fed to the lower NPN transistor base (of a cascode). This cascode has a loo ohm emitter resistor bypassed with 470 uF, and the bias for the upper base is derived using a IN916 diode pair from the lower emitter to the upper base; this is pulled up towards ground with a 15k resistor. The collector load is a 4k75 ohm resistor. The dominant pole compensation is applied around these stages in a manner designed to hold the stage tracking at high frequencies.





Thus 68 pF runs to the buffer input, 47pF runs to the cascode input and a 68 pF trimmer runs to the negative rail. (this may be replaced with a 9 27pF caapacitor in some units). The trimmer is used to adjust the loading on the cascode stage at higher frequencies.

The Output Stage:

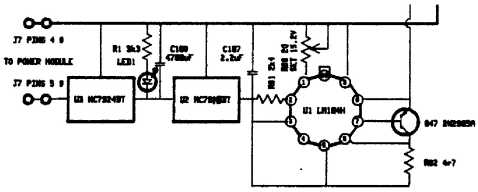
4.44 This stage is a PNP emitter-follower using a PNP current source and is quite conventional. It is necessary to ensure that there is adequate drive for the feedback loop as well as the output load.

The output is isolated by a 2.2 uF capacitor and a 20 k 20 turn trimpot is used to set the output level. A 499 ohm resistor defines the minimum output impedance.

The Regulators:

4.45 Three regulators are used in series in order to isolate the pre-preamps stages from: A) Line Voltage 'Bumps', B) Line voltage changes, C) A.C. component Hum, D) Regulator noise. The DC input is fed to a MC7924BT regulator which has an output of 24 volts and is loaded with a 4700 uF capacitor (slowing down the regulator). Then a MC791SBT regulator follows with a 2.2 uF capacitor across its output. A LM104H is used as the final regulator with a 2N2905A PNP as a current boost device. A trimmer pot allows the output voltage to be set at 15.2 volts, while a 4r7 ohm resistor defines the

maximum current that can be drawn before the regulator goes into current limiting protection. The use of a 2200uF electrolytic capacitor in parallel with a .33 uF polypropylene gets rid of the noise generated by the LM 104 H regulator.



The Power Supply Module:

4.46 This consists of a transformer with two secondary windings. Each winding is connected to a bridge rectifier with a large capacitor across its output. The two DC voltages are led to the preamplifier by a cable and 'DI connector. While no switch is provided, a fuse is in the primary of the transformer.

Power on indication is provided for each channel by a LED mounted back in the power supply section. A light pipe leads the light to the front panel. This avoids having power present near the sensitive input section.

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SECTION 5

PERFORMANCE CHECK

Introduction:

5.1 This section covers a simplified procedure useful for establishing the proper performance of the DW 999 Pre-preamplifier. While the factory uses computer controlled test equipment, this is probably beyond the financial means of many who wish to verify the proper performance of the pre-preamplifier.

One of the most difficult aspects of the Performance Check is the measurement of distortion in the pre-preamplifier as it is below the noise level of the measuring equipment. The technique that can be used is to use a harmonic distortion measuring set that has a output after the fundamental removing notch filter. This output is fed to a spectrum analyzer and that instrument used to separate the harmonics from the noise; the latter will be wide band.

Nevertheless, it must be remembered that this will yield the total distortion of the measuring system and the pre-preamplifier; so a second measurement must be made with the pre-preamplifier load on the oscillator, but of the oscillator itself. The difference between the two is the distortion of the pre-preamplifier.

The measurement is normally made with the pre-preamplifier output running about 3 dB below overload although 1.5 volts is satisfactory. otherwise the noise is too great f or even the spectrum analyzer to be able to resolve the harmonics. The distortion at 1.5 volta, at 1 kHz should run under 0.0006% using a 400 Hz LF Cutoff and a 30 kHz HF cutoff. This drops off rapidly as the output level is lowered.

The frequency response is such that excellent 100 khz square waves are passed, the rise time of the unit into a 47 kHz load being in the order of 350 nanoseconds.

Equipment Required:

5.2 The equipment required will be:

a) Distortion Test Set Sound Technology 1710A
Note: this must have an output after the fundamental has been filtered from the returned waveform.

b) Spectrum Analyzer Hewlett Packard 3580A

c) Dual Trace 25 mHz oscilliscope Advance Gould OS1000A

d) Function Generator Hewlet Packard 3314A

e) RMS Voltmeter Hewlet Packard 400GL

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Distortion measurement:

5.3 The distortion analyzer feeds the pre-preamplifier through a network consisting of a 499 ohm resistor in series with a 4.9 ohm resistor; the pre-preamplifier load switch being set for 9.8 ohms. The output signal monitor line from the test set feeds input A of the dual trace scope, and the scope is set to sync from this.

The output from the pre-preamplifier feeds back to the input of the Distortion Analyzer, and the monitor of this input after the fundamental has been filtered out is fed to channel B of the scope AND to the Spectrum Analyzer. (The output level on the pre-preamp should be fully up)

Let the DW 999 warm up for 15 minutes, then set the output for 1.5volts RMS as indicated on the Distortion Analyzer. The analyzer is setup so that the Hum filter (400 Hz) is on, the noise Filter is set at 30 kHz and on, and a frequency of 1 kHz has been selected. The distortion should read about 0.0014 percent on the meter of the Distortion Analyzer and will be very noisy.

Use the oscillator-direct button on the analyzer to read the oscillator's distortion, resetting the set-level-control as necessary. The distortion reading on the meter should be about the same. Use the spectrum analyzer set for a 1 kHz interval and a 30 Hz bandwith to display the harmonics of the oscillator/distortion analyzer and record the scale readings for each harmonic. Then switch in the pre-preamplifier and reset up the analyzer. Record the new harmonic levels. If the second harmonic drops instead of rising, then invert the phase of the input so that the pre-preamplifier is not canceling the even harmonic distortion.

Use the usual formulae to find the relative difference between the two readings on each harmonic.

The oscillator/function generator and RMS voltmeter can be used to inject a signal of known level into the Spectrum analyzer in order to calibrate its graticule.

The indicated difference in distortions should run from 0.0002 to 0.0006 per-cent with 75% of it being second, and 25% of it being third harmonic.

Frequency Response:

5.4 There is nothing special about the technique of frequency response measurement save to be sure that: a) Pre-preamplifier is not overloading, and b) the oscillator load is acceptable through using the 499 ohm/5 ohm voltage divider mentioned earlier.

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Section 6

REPLACEMENT PARTS

Introduction:

6.1 There are few if any exotic parts used in the production of the DW 999 pre-preamplifier and there should be little need for replacement parts. It should be possible to obtain anything needed (save PC Boards and/or Sheet Metal Work at a local Electronics Parts supply house.

If you cannot obtain the needed part locally, the Dayton Wright Group Ltd., does carry a complete supply of replacement parts. Customers should be forewarned that our prices are probably going to be higher by 50 to 90% that the use of a local source.

We have used the manufacturers name rather than his Federal Supply Code Number. Please note that several manufacturers manufacture metal Film precision resistors and substitutions can be made here although some slight increases in noise level could result.

Note that while the component value is screened on the circuit board along with its component type and number, from time to time,, The Dayton Group reserves the right to make changes without notifying the prospective or actual user. Engineering change notices are available that cover these.

When writing for parts, use the Model Number, the Revision number on the circuit board,, the part number AND description! We will advice if there has been any change in the design!

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6.2 Parts Listing

Quan.	DW-Stock No.	Value	Description	Mfg.	Mfg. No.	Part Designation
2	50-469-C330		33pF Ceramic Cap	Philips	63810339	C99,109
2	50-469-C470		47pF Ceramic Cap	Philips	63810479	C102, 112
2	50-469-C680		68pF Ceramic Cap	Philips	63810689	C103,113
2	50-456-T650		5.5-65PF Trimer Cap	Philips	010GA60E	C104,114
48	50-415-B337		0.33uF 63V Polyprp Cap	Acushnet	N1862Z.35	Cl,3,4,6, C8,9,12,13,16,17,20,21,24,25, C28,29,32,33,36,37,40,41,44,45, C48,49,52,53,56,57,60,61,64,65, C68,68,72,73r76,77,80,81,84,85, C88,91,94,97
4	50-413-225C		2.2uF 100V Polyest Cap	Philips	344CHA2M2	C105,107, C115,117
24	50-422-D336		22uF 16 V Tant Bd Cap	ITT	TAP22Ml6	C7,11,15,19, C23,27,31,35,39,43,47,51,55,59, C63,67,71,75,79,83,100,106,110, C116
6	CSR13D356K-L		35uF 15V Sld Ttl Cap	Mallory	CSR13D356KL	C2,5,89,90,

					C95,96
20	50-426-227A	220uF	10V Al.EL R Cap	Philips 426UP10220	C10,14,18,22, C26,30,34,38,42,46,50,54,58,62, C66,70,74,80,82
2	50-470-C471	470uF	10V Al.El.Cap	Philips 437EID470	C101,111
2	50-470-E222	2200uF	16V Al.El.Cap	Philips 437ETE221	C92,98
2	50-470-C103	10,000 uF	10V Al.El. Cap	Philips 437E7DIO3	C87,93
2	50-398-F472	4700 uF	25V Al.El.R Cap	Philips 2222 16472	C100,110

16	IN916	IN916	Sil Diode	Motorola IN916	DI,2,3,4,5, D6,7,8,9,10,11,12,13,14,15,16

4	45-350-1	Com-Female	BNC Jack	Amphenol 31-10	Jl,2,3,4
2	16-16-03	Bndg Post	Blk Bndg Post	Johnson 1110403001	J5,6
1	16-16-04	Bndg Post	Gm Bndg Post	Johnson 1110404001	J-
1	45-150-09P	9 P D Con	PCB Mtg 9P D	Winchester 47-1109P	J7
2	103-95-5	LED	LED - Yellow	National NSL5352A	LED1,2

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6.2 **Parts Listing Continued**

Quan.	DW-Stock No.	Value	Description	Mfg.	Mfg. No.	Part Designation
40	103-153-2	2N4058	S PNP Low Noise	T.I.	2N4058	Ql,2,3,4,5, Q6,7,8,9,10,11,12,13,14,15,16, Q17,18,18,20,21,22,23,24,25,26, Q27,28,29,30,31,32,33,34,35,36 Q37,38,39,40
8	103-150-3	2N5429	S NPN Low Noise	Motorola	2N5429	Q41,42,43 Q44,48,49,50,51
6	2N2905A	2N2905A	PMP Metal Can	National	2N2905A	Q45,46,46 Q52,53,54

2	40-97-2ROOF	2 Ohm	1% Mtl Film Res	Philips MR30F2r	R9,65
2	40-97-4R75F	4r75	1% Mtl File Res	Philips MR30F 4r75	R82,95
2	40-97-IOROF	10 Ohm	1% Mtl Film Res	Philips MR30Flor	R9,17
2	40-97-15ROF	15 Ohm	1% Mtl Film Res	Philips MR30Fl5r	R8,16
2	40-97-16R2F	16r2	1% Mtl Film Res	Philips MR30Fl6r2	R83,96
2	40-97-30R0F	30 Ohm	1% Mtl Film Res	Philips MR30F30r	R7,15
2	40-97-75R0F	75 Ohm	1% Mtl Film Res	Philips MR3oF75ro	R6,14
28	40-97-1000F	100 Ohm	1% Mtl Film Res	Philips MR30Fl00r	R5,13,20,22, R24,26,28,30,32,34,36,38,40,42, R44,46,48,50,52,54,56,58,61,67, R72,76,85,89
8	40-97-4990F	499 Ohm	1% Mtl Film Res	Philips MR30F499r	R3,10,11, R18,60,66,76,89
2	40-97-1821F	1k82	1% Mtl Film Res	Philips MR30FlK82	R74,R87
2	40-97-2431F	2k43	1% Mtl Film Res	Philips MR30F2K43	R81,94
2	40-97-3321F	3k32	1% mtl Film Res	Philips MR30F3K32	Rl,2

2 40-97-3921F 3k92 1% Mtl Film Res Philips MR3oF3K92 R79,92
2 40-97-4371F 4k32 1% Mtl Film Res Philips MR3OF4K37 R63,69
6 40-97-4751F 4k75 1% Mtl Film Res Philips MR3OF4K75 R64,70,

R77,78,90,91

2 40-97-5621F 5k62 1% Mtl Film Res Philips MR3OF5K62 R71,84
2 40-97-7501F 7k5o 1% Mtl Film Res Philips MR3OF7K50 R63,68
2 40-97-1502F 15kO 1% Mtl Film Res Philips MR3oFl5KO R75,88

2 61-60-203P 20k Long Trimpot Bourns 3009P-1203 R4,12
2 61-107-W203 20k Square Trimpot Boums 3299W-1203 R80,93

20 40-97-8252 82k5 1% Mtl Film Res Philips MR3OF82K5 R19,21,
R23,26,27,29,31,33,35,37,39,
R41,43,45,47,49,51,53,55,57,59

2 117-79-40A Neg Volt Reg Adjustable National LM104H Ul,4
2 117-279-20 IS Volt Neg Volt Reg Motorola MC7918Cr U2,5
2 117-279-24 24 Volt Neg Volt Reg Motorola MC7924CT U3,6

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Model DW 999
6.2 Parts Listinq , Continued

Quan.	Stock No.	Value	Description	Mfg.	Mfg. No.	Designation
2	15-84-6A	6PST DIP	DIP Switch	Greyhill	76SBO6	SW1,2

mechanical Parts

4 23-201-1 .187 mtg Bushing Heyco B-187-125-062
2 18-2900-01 Plastic Rod rw 14-2900-01
1 14-1558-12A Circuit Board Unpopulated SPECIAL ORDER ONLY

1 M803-15-lB Circuit Board Populated SPECIAL ORDER ONLY
1 Y18-2055-02A Panel For Pre-preamp Case SPECIAL ORDER CNLY
2 Y18-2055-02B Cheek Inserts SPECIAL ORDER ONLY
1 Y18-2055-03A Pre-preamplifier Case SPECIAL ORDER CNLY
4 22-55-01 Feet, Adhesive
1 Y18-2057-02A Cover, Power Supply SPECIAL ORDER CNLY
1 Y18-2057-03A Case, Power Supply SPECIAL ORDER ONLY
1 M803-10-02 Power Supply 120 v SPECIAL ORDER CNLY
1 M803-10-05 Pgwer Supply 220 v G.B. SPECIAL ORDER ONLY
1 M803-09-01 Cable, Power Supply SPECIAL ORDER ONLY
1 14-1559-04 Power Supply Board Unpop. SPECIAL ORDER ONLY
1 MB03-12-02 Power Supply Board Pop. SPECIAL ORDER CNLY

4 22-28-3 Rubber Feet / Power Supply ont Rbr
2 23-112-10 Strain Relief Bushing PS Heyoo 5N-4

1 8X280202 Power Supply Transformer Hamond SPEC ORDER CNLY
2 103-151-18 400 PIV Rectifier DIP Vero VM18/VM48

2 50-399-9 Al.EL. Cap Philips SPEC ORDER CNLY
1 24-236-2 Line Cord 120 V North America SPEC ORDER ONLY
1 24-1236-2 Line Cord 220 V Great Britain SPEC ORDER CNLY
1 69-9-2 Fuse Holder Buss HKP

1 69-4-XX 1/2 Amp Fuse Buss AGC3 1/2

6 2-574-6 6-32 1/4 Screws B Hd A Spae Naur HX251
1 2-1200-19 Screw Set for Preamplifier Case Closure / D Connector

Ordering Information

6.3 Orders for replacement parts may be placed with The Dayton Wright Group although we would advise contacting the Order Dept first to obtain prices.

All orders should be accompanied with a certified check or money order for the amount quoted by the Parts Department. Note that Quotations are good for a maximum of 30 days but that we reserve the right to changes prices and parts designations without notice. DO NOT SEND CASH IN THE MAILI

Prices will be quoted FOB Richmond Hill, Ontario; shipping, insurance, and handling costs will be quoted separately.

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Model DW 999

Because of parts shortages in the industry, parts may be unavailable from time to time. The Dayton Wright Group Ltd. accepts no responsibility for delays caused by strikes, civil insurrections and the like.

Parts prices should be obtained by phoning:

(416) 884-8586 - ask for the Parts Department

NOTE: BE SURE TO INCLUDE THE MODEL AND THE SERIAL NUMBER OF 999 AS IT WILL BE ON OUR RECORDS.

Please be advised that records are kept of quotations, and orders; from time to time we are aware of people trying to buy the special parts necessary to build a piece of equipment themselves. We therefore reserve the right to refuse to accept any order.

Orders should be placed with:

Dayton Wright Ltd.
Parts Department
3-97 Newkirk Road North
Richmond Hill, Ontario L4C 3G4
CANADA
Phone: (905) 508-7500

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Model DW 999

Section 7

SCHEMATICS

Introduction

7.1 This section covers some of the information needed to locate faults and to repair them. The schematics for the left and right channels are supplied along with a drawing of the circuit board layout. Please note that the board is approximately (but not exactly) symmetrical and there is complete electrical isolation between the two channels irrespective of whether the power supply is plugged in or not. This section also covers troubles-hooting as well as DC voltages. By measuring certain voltages, the proper operation of individual stages can usually be verified.

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Model DW 999

Troubleshooting

7.4 The first thing to verify is that there is power reaching the board. Check the voltages across the large filter capacitors (Cl09, & C110) at the Left Rear and Right Rear of the Circuit board. Remember that the Left side of the board as you f ace the front panel is the Left Channel, while the Right side of the Board is the Right Channel. C109 is therefore, in the left channel's power supply, while Cll0 is in the right channel power supply. The voltages should be about 24 volts plus or minus 3/4 of a volt. If one of these voltages is near zero, then check the first two pins of the power supply connector on that side of the board. The voltage here should be above 30 volts; if not, the power supply module is faulty on that channel.

If the power supply is OK but the voltage across the capacitor is low, then the MC7925CT may be bad on the corresponding channel; or the filter capacitor may be shorted. If the MC7924CT (U3-Left or U6-Right) is hot to the touch, the filter capacitor (Cl00-Left or C110-Right) might be shorted.

If the voltages are OK on both channels move on to C107 (Left) or C117 (Right). The voltage across these should be about 20 volts. If not, check the IC's U2 (Left) and/or U5 (Right).

Then check the voltages across C92 (Left) and C98 (Right). This should be about 15.2 volts. If it off slightly, reset to 15.2 volts using the corresponding trimmer R80 (Left) or R93 (Right).

If the voltage is below 8 volts and does not respond to the trimmer adjustment then the series pass transistor Q47 (Left) or Q54 (Right) may have been blown. These have heat sinks on them. Check these by measuring the Emitter to Base voltage which should be approximately 0.6 volts. Replace if below 0.4 volts. If the voltage is about 5 volts the LM104H might be damaged and these are U1 (Left) and U4 (Right). However if the output voltage is about 1 to 1.5 volts then the stage might be in current protection mode. Measure the voltage drop across the 4.7 Ohm resistors R87 (Left), R95 (Right). If this is over .65 suspect a short in the corresponding channel which is causing excessive current to be drawn from the power supply.

A quick check should be made of the voltage on the negative rail to collector of the current sink, these are transistors Q43 (Left), Q58 (Right). This voltage should be between 1.48 and 1.60 volts. If substantially higher, suspect the buffer stage transistor Q44 (Left) or Q 59 (Right) and check its emitter to base voltage which should be about .6 volts. If almost zero, replace the transistor. if still off substantially then check the lower transistor of the second cascode stage,, Q41 (Left) or Q48 (Right) for proper emitter to base voltage (around .58 to .62 volts). If this is very low, replace the transistor.

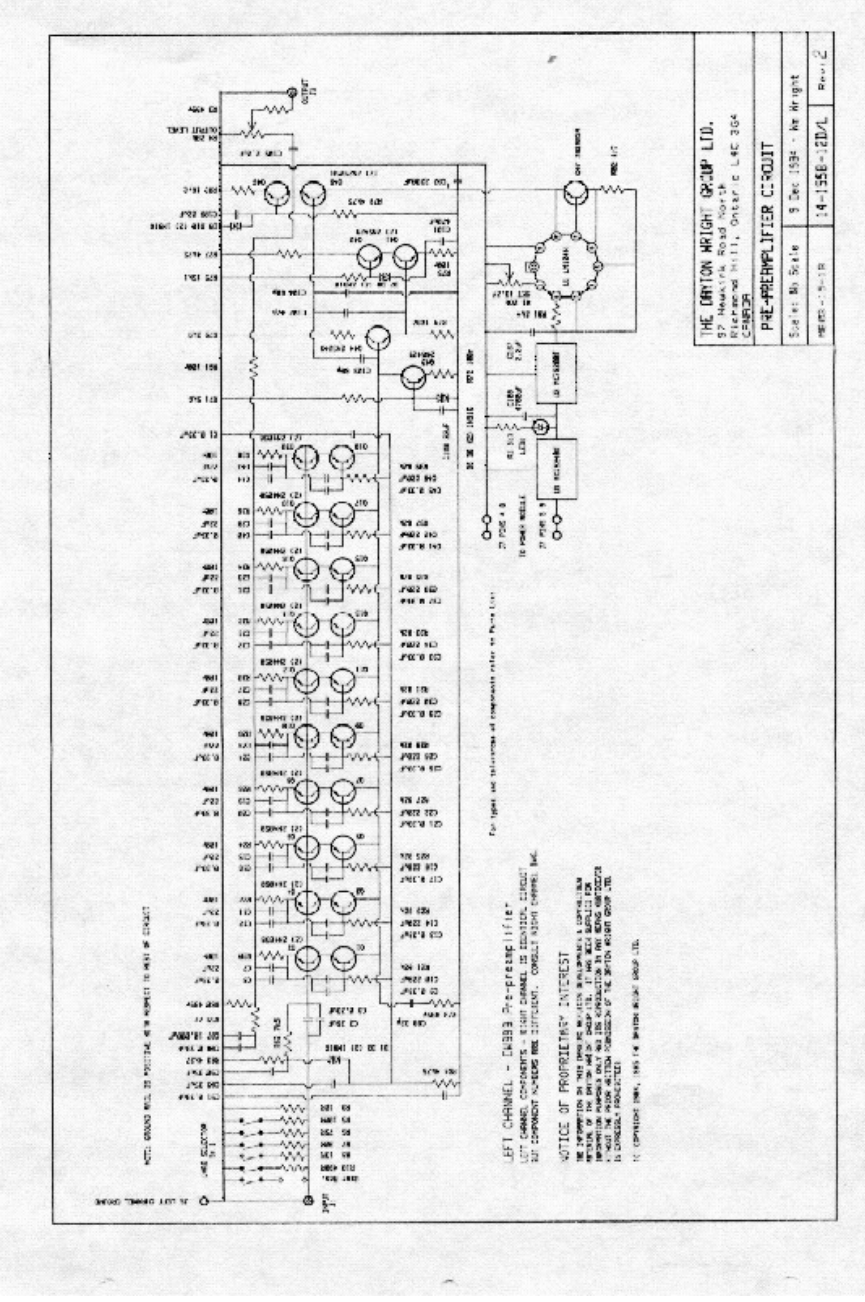
High noise levels will normally be caused by failure of the buffer stage transistors Q44 (Left) or Q59 (Right). This will also cause some distortion and lead to very strange (and high) voltages across the current sink transistors Q43 (Left) or Q58 (Right).

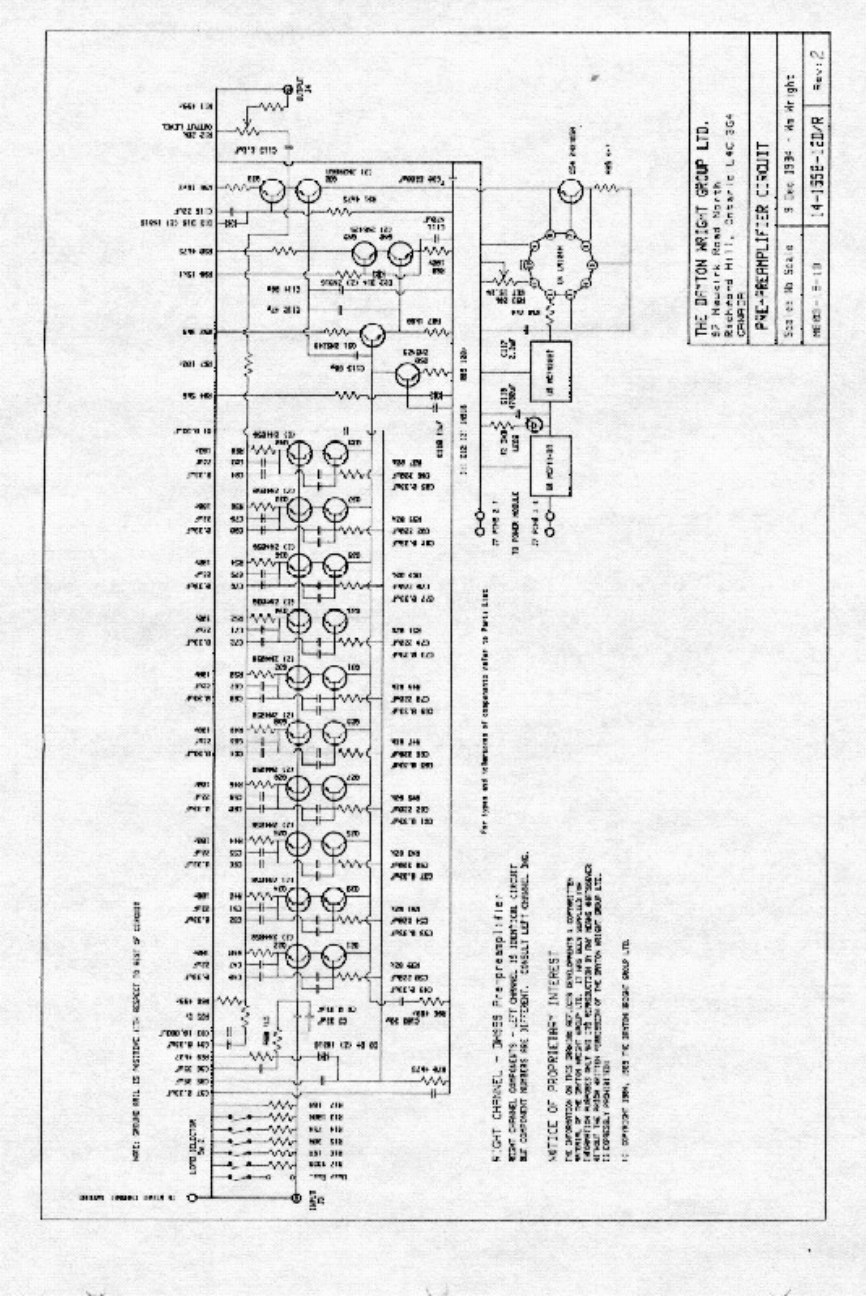
Excessive low frequency noise might be caused by a failure of one of the input capacitors, either the tantalytics C2 (Left) or C5 (Right) which might show excessive leakage, or the polypropylene capacitors C3 (Left) or C6 Cl0 (Right).

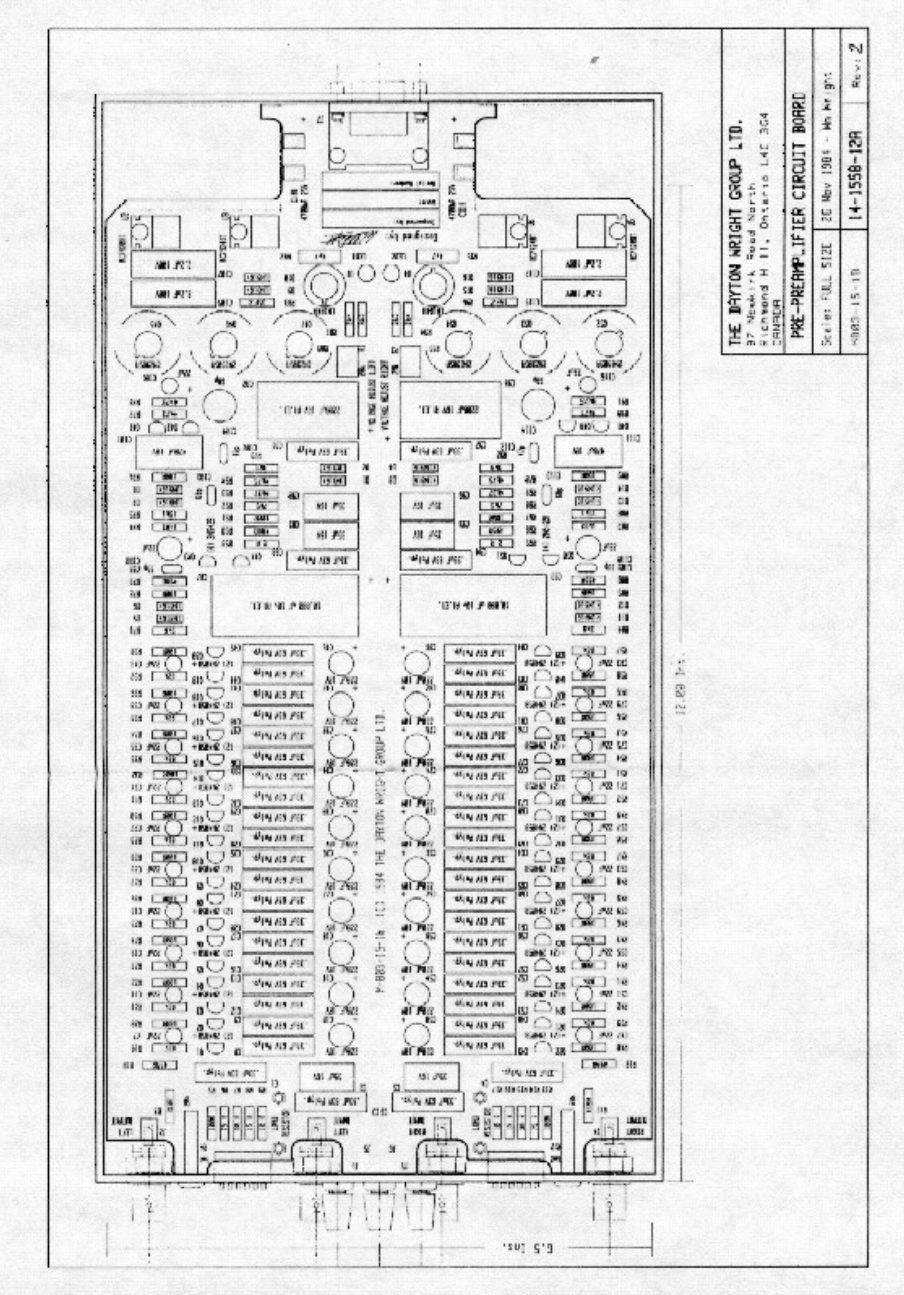
A general malaise could be caused by a failure of one of the transistors in the paralleled-cascode input stage, that is either the input or upper transistor of the pair might fail. Remember that these PNP devices have a different pinout than the NPN'S. The Emitter is towards the center of the board, the Base is towards the edge. The collector is the center lead if the transistor. The enmitter to base voltages should be the same for all of the transistors in both of the stages, if not,, check the capacitors for that section. The base currents drawn by the upper transistors of the casodes can be checked by taking a voltage drop reading across the 82k resistors.

The plastic cased NPN transistors used for the current sink, the buffer and the second cascode stage have a conventional pin out. That is, the emitters are nearest the edge of the board,, the base connections are in the center, and the collector connections towards the center. However the metal cased PNP transistors are arranged so that their collectors are nearest the circuit board edges, the bases in the middle, and the emitters towards the center of the circuit board. The collectors are also connected to the metal cases so beware of shorting heat sinks together

If the collector loading capacitor C104 (Left) or C114 (Right) is not set properly (or is off in value, about 27 pF is fitted when a variable capacitor is not used), the distortion will be excessive. Proper adjustment of the variable trimmer capacitor will cause a dramatic 'null' in the distortion under the circumstances.




THE DAYTON WRIGHT GROUP LTD.
PRE-PREAMPLIFIER CIRCUIT
RIGHT CHANNEL - DW999 Pre-preamplifier
NOTICE OF PROPRIETARY INTEREST



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DC Voltages:

7.4 These have been covered in the troubleshooting notes.

Dissassembly and Reassembly:

7.5 The pre-preamplifier is disassembled by removing the screws on either side of the nine pin "DI connector on the rear of the case. This allows the circuit board to be slid out of the case!

**Do not let the circuit board rest on a conductive surface,
and make sure that clipped component leads do not fall
on a live circuit to cause a short circuit.
This is the way that transistors get blown!**

Reassembly consists of sliding the board back into the case and using the aforementioned screws to secure the case to the connector.

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Switch Maintenance:

7.6 Because of the very low signal levels present in the loading switch we commend the use of Stabilant 22 (TM) or Tweek (TM) on the switch contacts. A co tube of the former is packed with each DW 999 pre-preamplifier, and a drip of same should be used on the ground and central pin of all the BNCIS, the cable pins where the interconnect plugs into the phono arm, and on the cartridge corrections themselves. It can also be used on the interconnect cable connectors between the pre-preamplifier and preamplifier, and between the pre-amplifier and power amplifier as well.

The switches (SwlSw2) should be treated once a year as well. Either
Stabilant 22 or the original (concentrated) Tweek may be diluted with isopropanol or ethyl alcohol so as to thin it out so that it can be introduced into the switch housing via the rocker openings.
Alternatley, use Stabilant 22A which is already diluted.

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