1.) Mechanical installation

2.) Electrical connections

3.) Explanation of calibration

4.) Alignment

- 4.1. Adjusting of the Circuit Breaker Electronics
- 4.2. Calibration of the playback section (PU)
- 4.3. Calibration of the Cutterhead
- 4.4. Adjusting the cutting level

5.) Acceleration Limiter BSB 74

These calibrating instructions are valid when using the following: A VMS 66 or VMS 70 lathe with an SA 74 cutterhead suspension and a NEUMANN console SP

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1.) Mechanical Installation

The amplifier system VG 74 contains:

1.1. 1 19" Housing SG 74a

1.1.1. 1 Amplifier assembly VB 74 with

2 Power operational amplifiers consisting of one card each:	LOV 74
Power amplifier N	LOV 74 N
Power amplifier P	LOV 74 P
Power amplifier V	LOV 74 V
1 Signal processing	SAB74a L
1 Circuit breaker	SEL 74
1 Voltage regulator	SR 08

2 Power operational amplifiers consisting of one card each:	LOV 74
Power amplifier N	LOV 74 N
Power amplifier P	LOV 74 P
Power amplifier V	LOV 74 V
1 Signal processing	SAB 74a R
1 Circuit breaker	SEL 74
1 Voltage regulator	SR 08

1 Acceleration limiter	BSB 74 L
1 Acceleration limiter	BSB 74 R

April 1976
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V-172 III.70

	1 Monitor preamplifier	MVS
1.1.4.	1 Power supply assembly	NB 74
1.1.5.	1 Cable set, connects VG 74 with VMS 70	

The power supply assembly NB 74 is delivered separately and has to be inserted during set-up of the amplifier system VG 74. The electric connection of the above mentioned amplifier assemblies with the power supply assembly NB 74 is made by means of 2 plug connections which are marked correspondingly.

2.) Electric Connection

At the rear of the individual assemblies connectors for external connections can be found on a vertical connector panel. In addition at the rear of the limiter assembly a 5 pole DIN connector is provided for the connection of a pick-up.

VG 74	TO BE CONNECTED WITH
MOD. INPUT	MOD. from SP
MONITOR PREAMPLIFIER OUTPUT	MON. to SP or equivalent
PICK-UP	Pick-up connection on Lathe
CUTTER FEEDBACK	AM 53 CUTTER FEEDBACK on Lathe
CUTTER DRIVE	AM 51 CUTTER DRIVE on Lathe

Check to see that the voltage selector on the power supply assembly NB 74 is set to the line voltage proper for your location (see electric connection diagram 21669-200-A93.). Now connect the power supply cable to the AC line. In conformance to the electric connection schematic above connect as follows:

L & N	to AC power line
E	to AC protecting ground.

Also check to make sure that the fuses appropriate to the line voltage in use have been installed in the fuse holders.

3.) Explanation of Calibration

Since the amplifier system VG 74 is tested and calibrated at the factory using an SX 74 cutterhead, it is operable immediately after it is installed in a tape-to-disk transfer system. The factory calibrations hold true for the most part, due to the high degree of stability and narrow tolerances in both the mechanical and electric parts.

Before undertaking the operation of the VG 74, however, a few checks should be made. We especially recommend that you check the cables "Cutter Drive" and "Feedback" to see that they are correctly connected and not mechanically damaged. The settings of the controls on the SAB 74a should also be checked to see that they agree with the settings on the check-out report and have not been altered.

Should the cutterhead on the lathe be in the released up position over the lacquer this will be signaled to the VG 74 and indicated there as CUTTER OFF. The cutter drive coils are also disconnected from the power operational amplifiers by reed relays in the SEL 74. At the same time, an internal feedback circuit which branches off through an electronic switch in front of the power amplifiers becomes effective, so that the signal still reaches the feedback monitor section.

The necessary adjustments on the VG 74 are, therefore, limited to slight corrections. In a complete NEUMANN transfer system all of the necessary calibration means and connections are supplied. The newer NEUMANN consoles have a nominal line level of +4 dBm $\hat{=}$ 1.228 V for a reading of 0 VU. When one of the metering section push buttons MOD OUT, PREV OUT, or MON are engaged, the read out is dependent on the position of the relative disk level. If a NEUMANN console is not available, the nominal line level may be fed from an oscillator. Connect a voltmeter to the MON PREAMP OUTPUT to indicate the nominal level of +4 dBm.

During all check out and test procedures, the RIAA switch on the SAB 74a should be in the OUT position, in order to avoid too great an increase in the cutterhead current at high frequencies.

April 1976
Printed in Germany
2647 Gebr. Wichmann
V-172 III.70

The circuit breaker electronics do NOT protect the cutterhead from damage resulting from excessive amplitudes in the region of resonance frequency (approx. 1 kHz) as may be caused by missing or reversed polarity feedback even in the presence of minimal cutterhead currents.

First check to make sure that no polarity reversal is present in the feedback circuits. If the cutter feedback signal should reach the drive amplifier with wrong phase relationship it will lead to the oscillation of the cutterhead at its main resonance of about 1 kHz. At this point the cutterhead consumes practically no current but produces excessive amplitudes which may destroy the cutterhead.

Whenever the VMS 70 lathe and VG 74 amplifier system are delivered as a system, the proper interconnecting cables are supplied (cutter drive, cutter feedback). These cables are checked very thoroughly.

The cutterhead will also oscillate if the feedback, though of proper polarity, exceeds the maximum value indicated on the test report. The oscillation then is above the audible frequency range and will trip the circuit breaker before any damage is done. Nevertheless it is recommended that the feedback control not exceed the recommended value.

The ensuing cutterhead calibration is based on a calibrated monitor system. After the feedback has been set and the FB MONITOR LEVEL opened, 1000 Hz are fed at standard line level to one side of the VG 74 input at a time and the DRIVE LEVEL control is opened until reference level is attained on the test lacquer disk. This is readily checked using the pick-up arm on the lathe. When properly aligned, therefore, the following will be true:

MOD. INPUT LEVEL = FB MON. LEVEL = PU MON. LEVEL = REFERENCE VELOCITY

0 VU = 5 cm/s peak recorded velocity each channel
100 % light beam indication = 10 cm/s peak recorded velocity each channel

April 1976
Printed in Germany
2647 Gebr. Widmann
V-172 III.70

4.) ALIGNMENT

4.1. Adjusting of the Circuit Breaker Electronics SEL74

4.1.1. The Circuit Breaker has the following three functions:

a) The cutterhead is disconnected from the drive amplifiers when it is thermically overloaded. When this occurs the lamps CUTTER OVERLOAD and CUTTER OFF light. Reset by means of the OPER button, but only when there is no signal at the input. You may trip the breaker purposely by manually pushing the CUTTER OVERLOAD.

b) In the range below 700 Hz the SEL 74 also trips if the excursion amplitude exceeds 100 micron (4 mils).

c) In the released position, the cutter is disconnected from the power amplifiers. This is indicated by the CUTTER OFF lamp.

4.1.2. No input signal can be present during the following calibration. To control the tripping at the highest permissible temperature of 200° C, connect the Heat Calibration Resistance WW 74 (8.2 Ohm per channel) to the SA 74 Cutterhead Suspension. Lower the cutterhead lever. The "Circuit Breaker" potentiometer is at its right stop. Turn the "200° C Adjust" multiturn potentiometer completely to the left stop. Push the OPER button. The OVERLOAD lamp extinguishes. Slowly turn the multiturn potentiometer (200° C Adjust) to the right until the OPER light goes out and the OVERLOAD lights.

Shortly before cut off, the temperature meter on the SEL 74 will indicate 200° C. Remove the WW 74 and again connect the SX 74 cutterhead. With the cutter in its working down position and with the OPER button pushed, adjust the thermometer instrument to read 25° C by means of the potentiometer "25° C Adjust" which is found on the SAB 74a. The "Circuit Breaker" potentiometer may be used for lowering the cut off poin below 200° C.

April 1976
Printed in Germany
264 Gebr. Wichmann

4.2. Calibration of the Playback Section (PU)

Set the switch marked RIAA OUT/IN on the SAB 74α to the "IN" position. Set the "MONITOR SELECTOR" to the "PU" position.

To obtain reference line level compare the velocity to be cut with that of a standard alignment record. The "NAB Standard Test Record 12-5-98" is to be used. Play back the left alignment tone on the test record using the pick-up arm on the lathe (1000 Hz), and advance the PU LEVEL on the MVS until you obtain +4 dBm ≙ 1.228 V at the monitor output of the VG 74.

At the front panel of the module "Monitor Preamplifier (MVS)" measuring sockets for the left and right channels can be found. At these sockets the signal which is selected by means of the "MONITOR SELECTOR" switch on the same module, can be obtained. The sockets are provided for the connection of a transistor voltmeter or an oscilloscope.

4.3. Calibration of the Cutterhead SX 74

Setting feedback:

4.3.1. Switch the RIAA OUT/IN switch in the SAB 74α to the OUT position.

4.3.2. Set the MONITOR SELECTOR to the FB position.

4.3.3. Turn the stylus heat potentiometer on the lathe down to zero (to the left).

4.3.4. Lower the cutterhead to the right of the turntable by leaving the lead screw engaging lever in its vertical position and pushing START.

4.3.5. Turn the FEEDBACK potentiometer all the way to the left and push the OPER button on the SEL 74.

4.3.6. Feed 5 kHz with a level which indicates 0 VU = +4 dBm on the MON. PREAMPLIFIER OUTPUT. (The MON. button pushed on the SP).

4.3.7. Turn the FEEDBACK control to the right until the VU-meter level on the MON. PREAMPLIFIER OUTPUT drops by approx. 9 dB (see check-out report SX 74).

In order to increase the exactness of the read out on the SP, we recommend that after this you raise the RV potentiometer to +9 dB and then accurately set the VU-meter to 0 by means of the FEEDBACK potentiometer.

4.3.8. Repeat the steps outlined under 4.3.5. through 4.3.7. for the right channel.

4.3.9. Check the frequency response. Do not exceed 500 mA of cutterhead current! Frequency response may be compensated using the 20 Hz and 17 kHz controls in the SAB 74a unit.

Hint: For technical reasons with regard to cutting in the frequency range above 10 kHz an increased level is produced on the lacquer. This does not correspond with the level of the cutting signal and the signal at the feedback monitor output (approx. +2,5 dB at 16 kHz). For compensation of this effect a corresponding network is contained in the cutting signal path of the SAB 74a. The feedback monitor amplifier contains a second complementary network which is for the reequalization of the monitor signal.

4.4. Setting the Cutting Level

4.4.1. Set the RIAA switch to the IN position.

4.4.2. Set the switch on the "MONITOR SELECTOR" to the PU position.

4.4.3. Cut a test lacquer and allow the tonearm to follow in the groove last cut.

4.4.4. Feed a 1 kHz nominal line level into the left channel.

4.4.5. Bring the PU level to 0 VU by means of the DRIVE LEVEL potentiometer.

4.4.6. In the PB position, set the "FB MONITOR LEVEL" to 0 VU using the potentiometer provided for this purpose.

4.4.7. Set the right channel by following steps 4.4.4. through 4.4.6.

The system is now calibrated at a velocity of 5 cm/s single channel for a 0 VU reading when the setting of the "Relative Disk Level" potentiometer (SP) is set at 0 dB. Only on this potentiometer can desired changes in level be adjusted.

April 1976
Printed in Germany

2647 Gebr. Wichmann
V-172 III.70

5.) BSB 74 Acceleration Limiter

Although the VG 74 is capable of producing 8 Amp in the moving coils of the SX 74, thus permitting high input levels even at the highest frequencies, there are limitation in disk recording which are determined by the geometry of the cutting and playback operation.

An 8 Amp current produces an acceleration of 47,500 m/s^2. This acceleration brings with it a groove curvature which is dependent on the linear groove velocity:

$$\rho = \frac{v^2}{b}$$

An example may serve to illustrate this better: recording at a groove diameter of 20 cm (8 in.) and at 33 1/3 rpm, the following occurs:

$$v = \frac{20 \cdot \pi \cdot 33.33}{60} \approx 35\,cm/s$$

The groove curvature derived from this is:

$$\rho = \frac{35 \cdot 35}{4.75 \cdot 10^6} \approx 2.6\,\mu$$

If, as in this case, the groove curvature is smaller than that of the stylus, the playback distortion increases steeply. If the curvature is not to be smaller than that of a stylus of, for example, 15 µ (0.6 mils) radius, the boundary acceleration resulting would be:

$$b = \frac{v^2}{\rho} = \frac{35 \cdot 35}{1.5 \cdot 10^{-3}} \approx 8150\,m/s^2$$

Since, for a constant current, a cutter produces a constant acceleration independent of the frequency, the current would, in this case, be limited to approximately 1.4 A.

Since the BSB 74 is located at the input of the cutting system and its limiting action is forward regulating, it is necessary to reproduce a reference signal internally which is proportional to the cutter current. The modulation signal is divided into two frequency bands: the lower one is not affected, but the upper band is limited to a predeterminable level. The crossover frequency is 4 kHz. The regulation is accomplished by means of a four-quadrant multiplier, which functions as a "gain controlled amplifier. The two bands are re-assembled in proper phase relationship by means of an adder amplifier.

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There are four types of operation selectable by means of a switch which is only located in the right channel unit but which also controls the left channel.

In the BY PASS position, the modulation signal is simply switched through impedance converted.

There are three LIMITING MODE positions:

In the "OFF" position, there is no limiting. The signal, however, passes through all stages of the limiter.

In the "ON" position, the cutter current is limited, dependent on the REDUCTION potentiometer position. The attack time is $\leq$ 10 ms. The recovery time is approx. 150 ms.

In the "PCO" (program controlled operation) position, the recovery time is program controlled and can be up to 20 seconds during this kind of operation. The amount of loss is indicated on a meter calibrated in dB.

In the "ON" and "PCO" position, the cutter current is limited within 5 µs to 7 Amp independent of the position of the REDUCTION potentiometer, thus preventing an overloading of the power amplifier.

In order to prevent displacements of sound sources between the speakers during the process of stereo cutting both limiter modules, BSB 74 L and BSB 74 R, are controlled to the same value.

April 1976
Printed in Germany

2647 Gebr. Wichmann
V-172 III.70