7.1. Basic pitch and basic depth

Stereo LPs normally have a quiescent depth of 2o to 30 µm (0.8 to 2 mil). Due to the 90° included cutting angle of the stylus, this corresponds to a groove width of 40 to 60 µm (1.6 to 2.4 mil). The distance between two adjacent grooves is 5 to 10 µm (0.2 to 0.4 mil).

7.2. Varigroove control

Audio-frequency modulation causes a groove deviation of up to 150 µm (6 mil) with both vertical and horizontal components, in the 45/45^{o} stereo groove system. To prevent touching of adjacent grooves caused by the lateral component the land must be increased accordingly.

Since the left stereo channel is related to the inner flank of the groove and the right channel to the outer flank, the timing conditions for the control of both channels are different.

Fig. 7.2.1. schematically shows a series of grooves. Groove 1 is unmodulated. In groove 2 a right channel signal appears. You can see that space has to be provided even before the start of modulation. After the start of modulation, the pitch may again run more slowly. Groove 3 is unmodulated. For this case the basic fine line pitch may continue right to the start of modulation, whereupon increased pitch is called for, to prevent overcutting of the groove. The following unmodulated groove 6 shows, by its spacing from groove 5, the operation of the control system. If a vertical modulation component occurs, then the basic depth has to be increased first to prevent the stylus from cutting too small a groove when withdrawing. Since there is a defined connection between groove depth and width an increase in groove depth makes necessary an increase of pitch as well.

7.3. Preview signal processor

By contrast to older Neumann groove computers, the VMS 80 derives all necessary signals from the preview head only. The head is located on the playback tape deck with a preview time of exactly half a revolution of the turntable (see chapt.4.2.). Both preview signals, preview L and preview R, are fed to the preview level controls through a phase reversing switch. An RIAA cutting characteristic network is next. After antiphase summing, one obtains the vertical component of the control signal PCD VERT at pin A 18 of the VSA 80 PC-board.

To create the lateral control signal one has to delay the left channel signal for the time of one turntable rotation (see chapt. 7.2.). This is done in a digital dynamic memory on the VSA 80 PC-board. Its sampling frequency is 4 kHz, so that according to the Nyquist theory signals up to 2 kHz are processed with respect to phase and amplitude. The minor amplitudes above 2 kHz are processed according to their peak envelope, i.e. without regard to phase relationships.

After addition of the delayed PREV L and PREV R signals this resulting lateral control signal (PCD LAT) is fed to pin A 6 on the VSA 80 PC-board.

7.4. Lateral pitch control rest space utilization

To better understand this rest space utilization, it is useful to replace the continuous modulation of fig. 7.2.1. with single pulses of varying magnitudes. Fig. 7.4.1. It once again shows two adjacent grooves.The time between t_1 and t_1', between t_2 and t_2' etc. is always half a turntable revolution. At the time t_1 the preview head alerts the lathe that a signal S_1 will have to be cut half a revolution later. The pitch control therefore has to create the space the diagram shows. At t_2 there follows a signal S_2, smaller than S_1. This may be accommodated in the remaining space following S_1 without any additional pitch control. It must therefore be assured that such a signal does not produce any additional control signals from the computer. At time t_3 there follows a signal S_3, which is much larger than S_1. Here, too, the relationship is readily visible.

S_3 now substituts for S_1 as the pitch determining signal, and the necessary space conforming to the groove drawn as a dashed line is created at t_3. It is more difficult to visualize the last and far more frequently found signal relationship indicated as a dash-dot line. At time t_4 a signal S_4 occurs which, although greater than S_1, requires less pitch control signal than is needed to accommodate S_1, since it utilizes some of the rest space provided for S_1. This control signal must be put into memory until S_1 has been cut.

...7.4. This surprising event is visualized as the dash-dor groove. Put differently: in order to utilize the rest space after cutting an initial signal, the ensuing signal must be sorted according to both magnitude and time relationship, in order to obtain a suitable pitch control signal. The block diagram fig. 7.4.2. shows a simplified version of the circuit which the RAS PC-board utilizes for this purpose.

The signal identified as BASIC DEPTH is a dc-voltage with which the basic pitch is set. Both signals BASIC DEPTH and PCD LAT are added at summing point 1 and an intermediate pitch control signal is obtained which must be processed according to the various signal relationships shown in fig. 7.4.1. to obtain the real VARIABLE PITCH control signal. In the comparator 2 which is equipped with a gate, the IS is compared with the VARIABLE PITCH actual control signal. When IS is smaller than VARIABLE PITCH, the gate remains open. This circuit prevents smaller signals (like the dotted line in fig. 2.4.1.) from influencing the pitch control. When IS is greater than VARIABLE PITCH, then it is fed through the closed gate to the subtraction stage to be described later and into the sampled memory 5. It is here, that the peak IS value during 1/6th of a turntable revolution is stored in memory and held for exactly one half of a revolution of the turntable. The VARIABLE PITCH signal is identical at

...7.4 any given moment to the largest temporarily stored IS signal. Referred to the impulse example in fig. 7.4.1., this step insures that control is always influenced by the highest instantaneous signal, here drawn as a dashed line for the signal S_3.

VARIABLE PITCH is furthermore fed to another sampled memory 4, which acts as an integrator and obtains the mean value for half a turntable revolution and provides information about the rest space which has been created. This signal is fed to the subtracting stage 3 and provides an ever decreasing signal. Ignoring the fact that we are dealing here with sampled or time dependent processes, one can imagine that the signal fed back via the integrator 4 is a signal which constantly seeks to decrease the rest space.
It may be of interest to know why the seemingly constant basic pitch is included in this complex control system. This becomes clear when one views BASIC DEPTH analogously to PCD LAT as control signals which have the analogous task of supplying a portion of the pitch control magnitude. In the circuit arrangement shown this is done by the computer, which means that for certain level sequences,when the rest space is to be reduced as fast as possible, the ACTUAL PITCH may become zero. This results in the carriage coming to a complete halt during the cutting process, even though a constant basic pitch was set before cutting. In this simplified presentation we have investigated the horizontal component only.

7.5. Pitch control derived from the lateral component

For the lateral component of the vertical(depth) control, one basically requires a second, almost identical system. It is on the STS 80 PC-board. Only the vertical component of the PCD VERT control signal is utilized here as the input signal. The output of its peak value memory circuit activates the pitch control as described previously.

7.6. Groove depth control

A third combination of a sampling peak value memory with a sampled integrator curcuit but without sampled feedback for the rest space utilization is located on the TST 80 PC-board. This unit generates the depth control signal. Its input signal is again PCD VERT. But by contrast to the control systems shich control the pitch drive, the output signal here comes from the sampled integrator. The reason for this is that the pitch drive itself acts as an integrating element for the control signal. This is not, however, the case with the moving coil system of the depth control. The VARIABLE DEPTH control signal comes via pin A 3 to the TAS PC-board. Here the current is squared and then fed to the coil of the depth control in the cutter suspension. The cutting depth and the force which causes it relates according to a square law. To obtain a linear relationship between depth and its drive current, the control signal must be squared.

7.7. Intentional change of groove spacing and depth

The STO 80 unit incorporates two identical rotary switches: one is the LATERAL and the other the VERTICAL OFFSET. Both switches serve to alter the mathematically correct relationship between preview and modulation signal. While the first does this for the land control (lateral component) the latter controls the depth (vertical component). Both switches alter the preview signal from -1.5 dB to +3 dB in several steps. For normal cutting, both switches are to be set to their zero position.

They only fulfil special requirements in combination with different settings of the basic depth and/or land.

If there is a playing time problem, i.e. when the zero position of the varigroove controls is not sufficient for the program length, one should first operate the third rotary switch of the STO 80 unit. It has 4 positions indicated as zero,A,B and C and it influences the dynamic behavior of varigroove in such a way, that it pregressively increases the rest space utilization in its A, B and C positions, while only running a rather minor risk of overcuts, which do not exist at all in the zero position, but which may be neglected in most cases.

➡ Note: Due to the dynamic behavior of the LAND ECONOMY switch, it is not measurable under static conditions with pure sine wave signals.

The MS 541 Connector permits the following signals and remote control funtions to be connected to the VMS 80 Lathe:

1.1 .GROOVE SPACING AND DEPTH CONTROL SIGNALS

Preview LEFT Hi, Low and shield }
Preview RIGHT Hi, Low and shield } Balanced and floating audio inputs.

1.2. GROOVE SPACING AND DEPTH CONTROL REMOTE CONTROL OPERATIONS

It is possible to remote control the following functions: "Lateral Offset", "Vertical Offset" and "Land Economy". For this one may either remove the PC board STO 80 from the VMS 80 (MS) and use it at a remot location or one may order a special plug-in module (size A2B) SKA 22561 for this purpose, in which case the STO 80 must be removed from the VMS 80 Lathe.

The remote control is effected by means of 2-bit and 4-bit codes which bear the following designations:

A_L, B_L, C_L, D_L = Lateral Offset

A_V, B_V, C_V, D_V = Vertical Offset

A_E, B_E = Land Economy

2.1. Remote control of the VMS 80 lathe functions

The push button commands START, STOP, FAST, MARKER* and ADD LAND may all be remote controlled. The remote control momentary closure buttons may be wired in parallel to the identical buttons on the BE 80 Operating Panel normally open contacts to 0 Volts), allowing operation both from the remote point and the BE 80 Panel.

When using lighted remote push buttons, it is possible to obtain true tally indication. The lamp should be a 12 V/ 40 mA type. One pole of each lamp will be connected to the + 15 V supply on the MS 541 connector, while the other is connected at the connector through a 75 ohm, 1/8 W resistor to the corresponding lamp connection for the function intended.

* MARKER button or TIME/SPIRAL resp.

2.2. AUTOMATIC BANDING UNIT USING A LIGHT BARRIER

In order to avail oneself of the automatic banding function triggered by leader tape on the master tape, the VMS 80 offers the following light barrier connections:

LS RCV (Light barrier receiver)
LS 0 V (Light barrier 0 volt)
For the connection of a phototransistor

The light source may be powered, depending on the type of lamp used, either from the +15 V operating voltage found on the MS 541 connector, or the power supply associated with the tape machine itself.

If it is desired that the light source only light when a tape-to-disk transfer is taking place, it is possible to connect one of its leads to a suitable powering voltage and the other to a control point provided for this purpose:

LS EMT (Emitter).

For the case where the light source is powered from the supply of the tape machine, the 0 volt potential of that supply is to be connected to the 0 volt connection of the MS 541 connector. When doing this, it is important that the shields of modulation and preview signal lines be grounded only at one end -- either the console or the tape machine -- to prevent ground loops.

3.1. AUTOMATIC START AND STOP OF THE TAPE PLAYBACK MACHINE

To start the master tape automatically (end of the LEAD-IN groove), or to stop it (start of the LEAD-OUT), the VMS 80 provides voltage-free relay contacts connected to the MS 541 connector as follows:

TAPE STOP 1 (transfer contact)
TAPE STOP 2 (normally open contact)
TAPE STOP 3 (normally closed contact)

TAPE START 1
TAPE START 2
(normally open contacts)

3.2. DIGITAL CONTROL OUTPUTS FOR RADIUS DEPENDENT SWITCHING FUNCTIONS

The VMS 80 produces digital 4-bit binary encoded signals which change in decreasing steps starting at the lacquer blank outside diameter and going towards the center. A 12" LP's usable recorded radius is divided into 15 steps. These steps permit level, equalization or tracing compensating functions to be made radius dependent.

Four outputs are available, which count backwards in binary steps from 15 at the outside diameter. A HIGH signal equals +14 V at the output; a LOW signal is 0 volt . These outputs are to be terminated in a high impedance (approx. 100 kohms). They are designated as follows:

A_R (Least significant bit)

B_R " " "

C_R " " "

D_R (Most significant bit)

Limits of the control range:

	A_R	B_R	C_R	D_R
≧ 14"	H	H	H	H
dia. 374 mm (14.7")	L	H	H	H
	H	L	H	H
"	H	L	H	H
"	H	L	H	H
dia.112 mm (4.4")	L	L	L	L

3.3. SPIRAL DEPENDENT CONTROL OUTPUT

The output "*MARKER EXTERN H" reports the appearance of a SPIRAL groove between cuts by supplying a logic HIGH signal (+14 V into 100 kohm load). It may be used for the alternate switching between two level and equalization channels, as are provided on many NEUMANN Tape-to-Disk Transfer Consoles, or it may be combined with suitable circuitry to provide spirals of differing length according to a prearranged program , etc.

*MARKER or TIME/SPIRAL resp.

4. SIGNAL OUTPUTS FOR SPECIAL USES

"ADD LAND EN H": Control input which for a HIGH input (+14 V) and an open ADD LAND potentiometer (BE 80), provides for increased lead screw speed for the suppression of preview echo, or for a LOW input, blocks this same increased lead screw function. (CAUTION: only to be injected via series resistor since the potentiometer ADD LAND also forces this function in its counterclockwise position! (priority).

SYNC START COM H: Dual path signal lead to provide for a sync start of two VMS 80 Lathes operated in parallel. That Lathe which first reaches the lead-in diameter waits there with its cutterhead in the READY position until the second machine has reached that same point. They both begin to cut simultaneously.

16 f_D: Digital output for the control of rpm synchronous functions.

(16 pulses per revolution; +14 V_{p-p}).

That equals, for 33 1/3 rpm ≘ 0.55 rps x 16 = 8.8 Hz.

2.17 Hz: Digital output for the synchronizing of time dependent functions +14 V_{p-p}). Is also used as the blinking frequency for certain push button lamps.

PIN CONNECTIONS OF THE MS 541 CONNECTOR

1 a, b, c	=	0 V
2 a	=	START BUTTON
2 b	=	MARKER BUTTON*
2 c	=	FAST BUTTON
3 a	=	STOP BUTTON
3 b	=	ADD LAND BUTTON
4 a	=	START LAMP
4 b	=	*MARKER LAMP
4 c	=	FAST LAMP
5 a	=	STOP LAMP
5 b	=	ADD LAND LAMP
5 c	=	ADD LAND EN H
6 a	=	LS RCV
6 b	=	LS 0 V
6 c	=	LS EMT
7 a	=	TAPE STOP 1
7 b	=	TAPE STOP 2
7 c	=	TAPE STOP 3
8 a	=	TAPE START 1
8 b	=	TAPE START 2
8 c	=	*MARKER EXT H
9 a, b, c	=	+ 15 V

* MARKER or TIME/SPIRAL resp.

10 a	=	A_R
10 b	=	A_L
10 c	=	A_V
11 a	=	B_R
11 b	=	B_L
11 c	=	B_V
12 a	=	C_R
12 b	=	C_L
12 c	=	C_V
13 a	=	D_R
13 b	=	D_L
13 c	=	D_V
14 a	=	16 f_D
14 b	=	2.17 Hz
14 c	=	SYNC STRT COM H
15 a	=	PREV L A
15 b	=	PREV L B
15 c	=	SHIELD
16 a	=	PREV R A
16 b	=	PREV R B
16 c	=	SHIELD
17 a	=	A_E
17 b	=	B_E
18 a,b, c	=	0 V

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