DEVICE AND TIME SYMBOLS IN EMS-I

Abbreviations with capitals are fix.
Abbreviations with small letters are variable up to 6 letters.

A		Entry in AM and RM
AM	Amplitude modulator	
B		Entry in AM and RM
chan		Output channel
CD	Channel distributor	
CHA	Channel	
entry		Entry A or B in AM and RM
ENV	Envelope	
ESTEP	Envelope-step	
FF	Frequency filter	
frequ		Frequency
FS	Frequency shifter	
GLIS		Glissando
GSTEP		Glissando-step
level		Level
LT	Local time	
NG	Noise generator	
no		Number
noiset		Type of noise
REV	Reverberation	
revtim		Reverberation time
RM	Ring modulator	
FG	Frequency generator	
FG3	Frequency generator 1-3	
FG6	Frequency generator 4-6	
FG9	Frequency generator 7-9	
FG12	Frequency generator 10-12	
FG15	Frequency generator 13-15	

FG18	Frequency generator 16-18	
FG21	Frequency generator 19-21	
FG24	Frequency generator 22-24	
wave		Waveform
Z		Sets level to zero
>	Connect	
#	Disconnect	

1. The Console

1.1 The different ways of operation

1.2 The tasks of the console

1.3 The Display

1.4 The Input (Set)

1.1 The Console

The studio has three different but simultaneously working systems of operation. It is possible to work with

1) the console plus the off-line-digital tape recorders
2) the console plus the computer
3) the computer only

1.2 The tasks of the console

The console has several tasks. It is a pedagogic instrument, and an instrument to search sounds, but primarily it is an editing instrument. On the console the "music-structure" is indicated by device settings made by the composer, whether he has made these via the console or with help from the computer. Primarily the console has only these two tasks: to feed data into the digital tape recorder and to indicate which these data are.

1.3 The indication

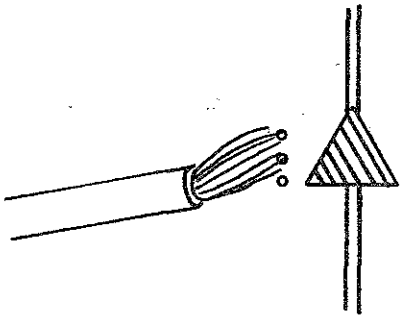
The indication is made with the help of signal lamps. If one or more lamps are lighted it means that data is available and can be fed. If no lamps are lightened no data is fed, i.e. nothing but zeroes are fed. The fact that the studio is feeding both lightened lamps - ones - and not lightened lamps - zeroes - can be used for instance to erase on the digital tape. If you are recording only zerioes you have erased all possible number ones.

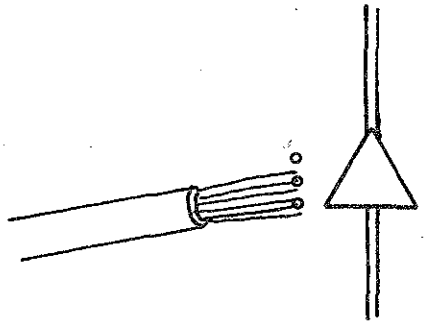
1.4 Set

EMS-1 programming	Operation
	1. Close the two parts of the contact with a conducting object

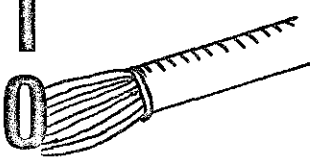
Input of data is made by closing a contact with a conducting object and thus setting a "flip-flop" in one-position. The lamp is lightened when the flip-flop is in position one. The contacts are of three different types. The frequency generators have one type of contact (these being the first we constructed have turned out to be neither very practical nor cheap) and the rest of the console has another type, but in two different designs.

On the first type of contacts the conducting parts are the two screws and the metal pieces that they are holding. On the second type it is the two gilted nails and on the third type the three nails. The difference between the two latest types is that you can set the flip-flop only in position one, using the contact with the two nails, but you can set the flip-flop both in position one and position zero with the help of the three nails. To set the flip-flop in position one you make contact between the top nail and the middle nail, while contact between the middle and the bottom nail puts the flip-flop in position zero.

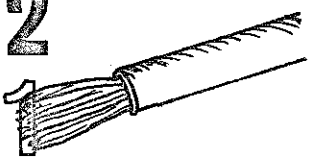




8
4
2
1
0



8
4
2



0

2. Sound Generating Devices

2.1 Frequency generators

2.1.1 Frequency

2.1.2 Level

2.1.3 Waveform

2.2 Noise generator

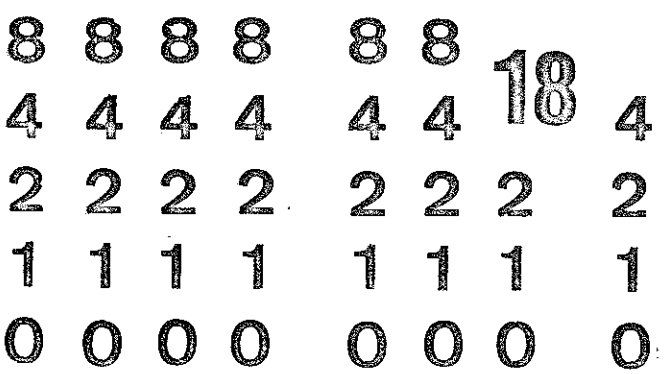
2.3 Analogue tape-recorders as sound-source

2.1 Frequency generator

FG

EMS-I programming	Operation
1. FG(no, , ,) 2. (,frequ, ,) 3. (, ,level,) 4. (, , ,wave) 5. (, , ,)> Complete phrase: FG(no,frequ,level,wave)>	1. Choose frequency generator 2. Set frequency 3. Set level 4. Set waveform 5. Connect the signal

The console has in all 24 frequency generators.
The frequency generators are operated by columns of digits for frequency, level, and waveform.



2.1.1 Frequency generator

FREQUENCY

EMS-1 programming	Operation
	1. Set frequency
Ex. 1. (,5620, ,)	Ex. 1. Set 5620 Hz
Ex. 2. (,15999, ,)	Ex. 2. Set 15999 Hz (max. value)

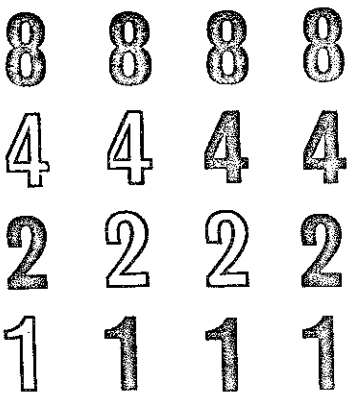
The first four columns show the frequency, which is measured in Hz. The first column to the left indicates thousands Hz, the second column hundreds Hz, the third column tens and the fourth column units. Each column is built up in a binary coded decimal system, which showed to be much less expensive than a decimal system. The difference is that while the decimal system operates with all numbers from 0 to 9, this system uses only the numbers, 1, 2, 4, and 8 plus a 0 for nullification of the flip-flop. If you want the number 5 you must set the flip-flop of both the 4 and the 1. The sum is the number 5. The number 7 becomes 1+2+4. The ones-, tenth-, and hundredscolumns must not have higher value than 9. In the 1000-columns it is allowed to have the number 15. If you use higher values than 9 in the other columns the frequency will not be the set one.

2.1.2 Frequency generator

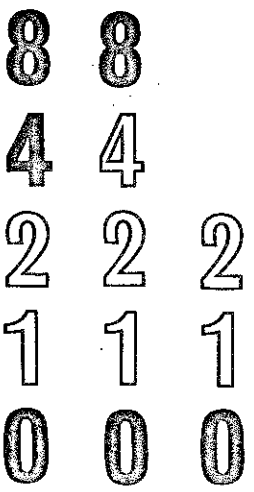
LEVEL

EMS-1 programming	Operation
	1. Set level
Ex. 1. (, ,100,)	Ex. 1. Set 100 dB
Ex. 2. (, ,37.75,)	Ex. 2. Set 37.75 dB
OBS! Full stop not comma before decimals.	

The level is indicated in dB and operated with two and a half columns. The column to the left indicates tens dB, next column ones dB and the half column 1/4 dB. In the last case upside down number 4 correspond to 1/4 dB. Upside down 2 corresponds to 1/2 dB and both together to 3/4 dB. The highest level allowed for a frequency generator is 100 dB.



Example 1.

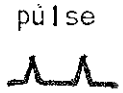


Example 2

2.1.3 Frequency generator

WAVEFORM

EMS-1 programming	Operation
Ex. 1. (, , ,1) 2. (, , ,2) 3. (, , ,3) 4. (, , ,4) 5. (, , ,5) 6. (, , ,6) 7. (, , ,7) Example of complete phrase: FG(no,frequ,level,5)	1. Set waveform

No	1	2	3	4	5	6	7
	sine	parabola	triangle	sawtooth	square	single pulse	double pulse
							
	4	4	4	4	4	4	4
	2	2	2	2	2	2	2
	1	1	1	1	1	1	1
	0	0	0	0	0	0	0

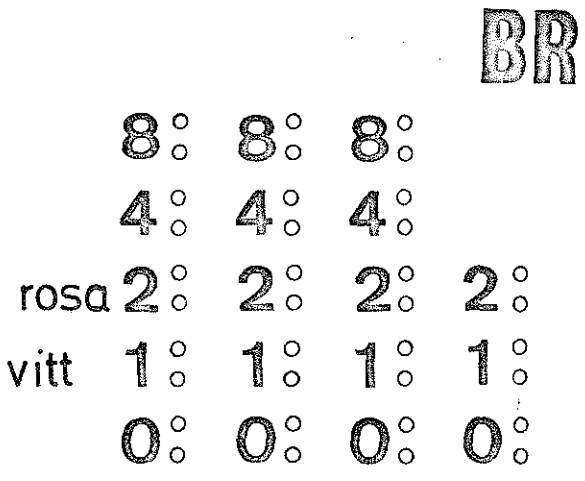
The column to the right of the level columns control the waveform. The frequency generator has 7 different waveforms. Each of these correspond to a number between 1 and 7 in the column.

2.2 Noise generator

NG

EMS-1 programming	Operation
1. NG(1, ,) 2. (1,level,) 3. (1, ,noiset) 4. (, ,)> Example: NG(1,7Ø,PINK)... NG(1,73,WHITE) NG(1,67,PINK,WHITE)	1. Choose noise generator 2. Set level 3. Set type of noise 4. Connect the signal

The device-panel of the noise generator consists of a level-panel, alike the one of the frequency generators, and a column for choise of type of noise. This column is to the left of the 2 1/2 columns for choise of level. The figure 2 corresponds to pink noise and the figure one to white noise.



2.3 Analogue tape recorder

PLAYBACK

EMS-I programming	Operation
	1. Choose analogue tape recorder 2. Connect the signal to channel 1 via AT1 channel 2 " AT2 channel 3 " AT3 channel 4 " AT4 3. Set level on resp. channels 4. Push LYSSNA KONTINUERLIGT (listen continuously) 5. Start the analogue tape recorder for playback

Also the analogue tape can be considered as a sound source. The analogue tape recorders have at present no device panel. The analogue tape recorders can be connected to the different channels via the connection panels indicated by AT. You should observe that the sound from the analogue tape cannot be registered on the digital tape. If you want to mix analogue tape with the digital tape these two tape-types can be synchronized.

3.1 Frequency shifter FS

EMS-1 programming	Operation
1. FG(20,) 2. FG(20,frequ) 3. FG(20,frequ)>FS;	1. Choose frequency generator 20 2. Set frequency 3. Connect FS

The frequency shifter is constructed in such a way that the frequency generator no 20 controls the frequency of all the other frequency generators. The control is made through reducing the frequencies of the other generators with the frequency of no 20. If you want to shift a "tone" upwards in whole Herz-steps, you reduce the frequency of no 20 with 1 Hz per step. Observe that if the difference in frequency becomes a negative number, this is interpreted into a positive one. If for example the frequency of no 20 is 600 and the frequency of another generator is 500, the difference -100 Hz is changed into 100 Hz. The frequency generator no 20 is connected to FS via the summing panel. The connection is found beside an indication pointing to the word "FROA".

3.2.1 Reverberation

Listening

REV

EMS-I programming	Operation
	1. Choose reverberator 2. Connect a signal to the reverberator 3. Set reverberation time 4. Set input time in index register 5. Set level appr. one sec. after 2. 6. Push TIDLYSSNA (time listen)

The reverberation has level columns and time columns on the device panel. The column to the far left controls the reverberation time of the reverberator. Smallest decimal number is 0 and highest is 15, which gives reverberation times between 2 and 4.5 secs. The the right of the time column follow the level columns. Observe that the reverberation needs time to adjust to a new value. Therefore it is suitable to indicate on the digital tape about one second before the reverberator shall receive the signal. This value shall then be found on all records until the reverberation time is over. At present a maximum level of 90 dB is recommended.

There are four reverberators. At present two of these can be remotely controlled from the magnetic tape off-line or on-line via the computer as to level and reverberation. For REV(3) and REV(4) the reverberation time must at present be set manually. The four reverberators are normally, without any special procedures, connected to be heard in the loudspeaker groups 1 - 4, resp. No level need be set on the channels. The reverberators can also be connected to certain other devices.

About reverberation in connection with moving sound see chapter 5.

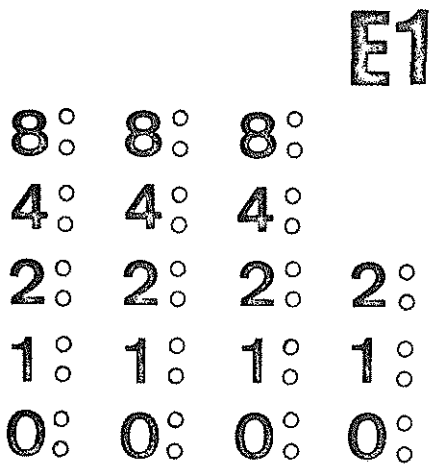
TABLE OF REVERBERATION TIMES

time (seconds)	set value
2.0	Ø to 8
3.0	10
4.0	14
4.5	15

3.2.2 Reverberation

Registration

EMS-I programming	Operation
1. REV(no, ,) 2. (,revtim,) Complete phrase:REV(no,revtim,Ø)	A. Appr. 1 music second before the reverberator is to start sounding 1. Choose reverberator 2. Set reverberation time 3. Continue registration
4. REV(no, ,) 5. (, ,level) 6. 7. >(, ,) Complete phrase: FG6>REV(no,revtim,level);	B. At the music time when the reverberator shall start sounding 4. Choose reverberator 5. Set level 6. Set input time in Time register 7. Connect the signal to the reverberator 8. Push REGISTRERA (record) 9. Set the level of the signal to the reverberator to zero 10. Continue registration
11. REV(no, ,) 12. (, ,Ø) 13. (,Ø,) 14. #REV(no, ,) Example of complete phrase: FG6#REV(2,Ø,Ø);	C. At the music time when the reverberator shall stop 11. Choose reverberator 12. Set level to zero 13. Set reverberation time to zero 14. Disconnect the signal to the reverberator 15. Continue registration



3.2.3 Reverberation time

EMS-I programming	Operation
1. REV(,revtim,)	1. Set reverberation time in the left of the four columns of the reverberator
Example of complete phrase: REV(no,4,level)	

Table of reverberation times

time (seconds)	set value
2.0	Ø to 8
3.0	1Ø
4.0	14
4.5	15

3.2.4 Input time

EMS-1 programming	Operation
	1. Set desired input time in index register

3.3 Frequency filter

FF

EMS-1 programming	Operation
1. FF(no, ,) 2. (,chan,) 3. (, ,level) 4. (, ,)> Complete phrase: FF(no,chan,level)>	1. Choose filter[x)] 2. Choose filter channel 3. Set level 4. Connect the signal Observe that the two filters have an indication instrument for each filter channel. At each of these channels its number and medium frequency is marked. x) filterchannel = great tierce 3 filter channels beside each other = 1 octave

The filter has level columns and selectors of frequency range on the device panel. The frequency range is divided into 28 tierce-filter channels, i.e. each channel lets through 1/3 octave.

Tierce-filter channel no	Central frequency in Hz
1	31
2	40
3	50
4	63
5	80
6	100
7	125
8	160
9	200
10	250
11	315
12	400

Continuation

3.3 Frequency filter

FF

Tierce-filter channel no	Central frequency in Hz
13	500
14	630
15	800
16	1000
17	1250
18	1600
19	2000
20	2500
21	3150
22	4000
23	5000
24	6300
25	8000
26	10000
27	12500
28	16000

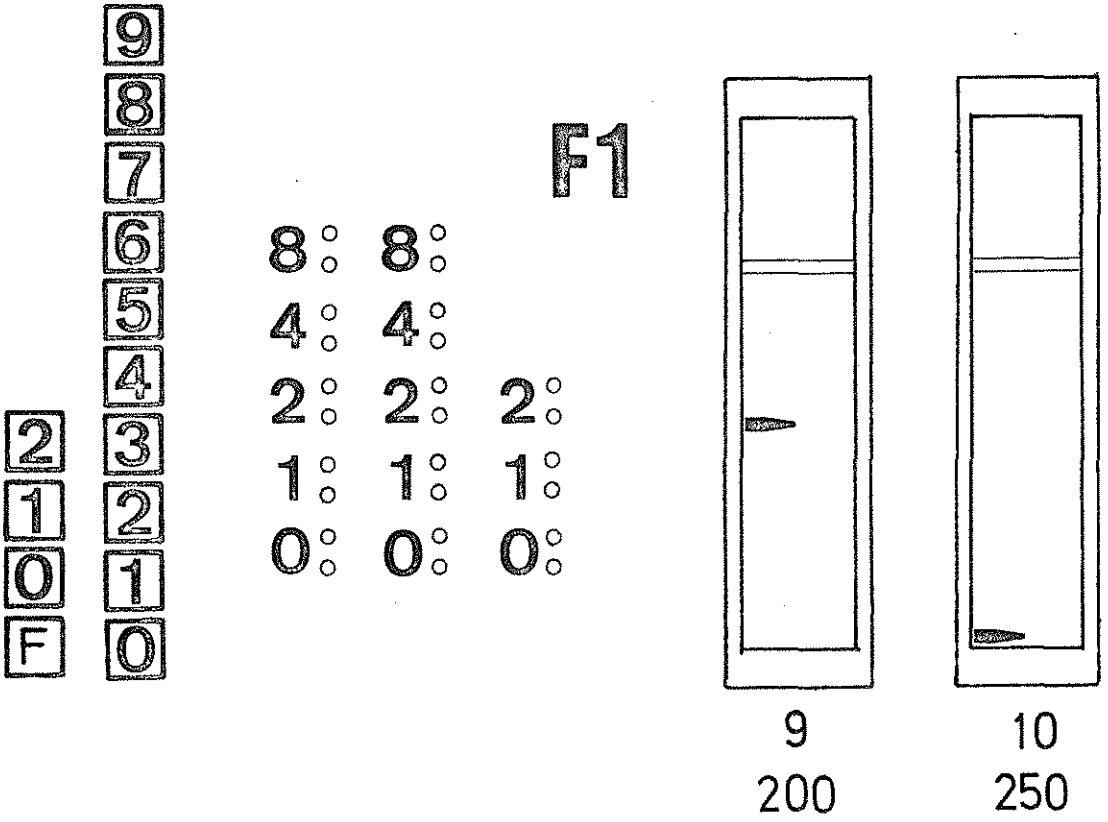
The frequency range selector consists of two columns. The one to the left is for tens and the one to the right for units. The columns are constructed by push buttons and are decimal, so that if you want the number 7 you press the buttons 07. Moreover every tierce-filter channel has an indication instrument. These 28 instruments show more surveyably which tierce-filter channels are connected and which approximate level positions they have. The red line on the scale corresponds to 100 dB.

If you wish to let a sound through a tierce-filter channel press down the number of the filter on the push-button panel and set the lvel on the level columns. You can check the level position on the instruments. If you wish to work simultaneously with several channels repeat this operation with the next desired tierce-filter channel. The previous position will be hold until you either set the level to zero or change it. Observe that when you set the whole console to zero or switch off the power to the studio, the filters will automatically be set to zero.

Continuation

3.3 Frequency filter

FF



3.4.1 Ringmodulator 1 and 2

RM(1)

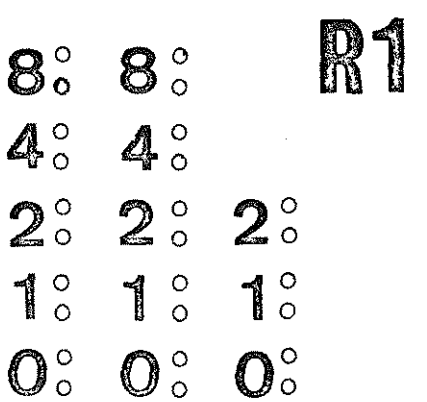
RM(2)

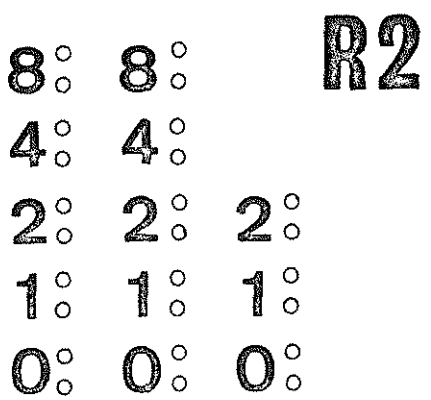
EMS-1 programming	Operation
1. RM(no,entry,) 2. (, ,level) 3. (, ,)> Complete phrase: RM(1,A,1ØØ)>	1. Choose ring modulator and entry A or B 2. Set level 3. Connect the signal

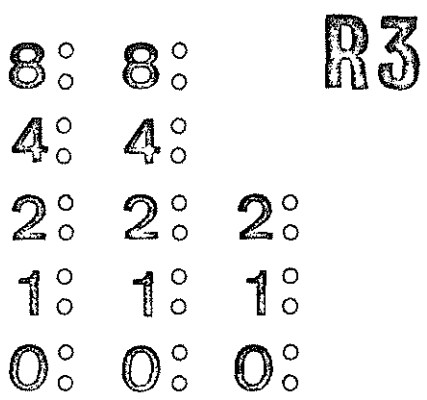
The ringmodulator has only level columns in the device panel. There are at present three ringmodulators in the console. RM1 A and RM 2 A have direct connection from the frequency generators 21 resp. 22. Ringmodulator 3 can only be connected to the exits of RM 1 and RM 2. This connection is fix and the only thing you have got to do to use RM 3 is to set level in the level columns and connect the signal from the connection panel for RM 3 to for example the channel outputs 1, 2, or 4. Observe that the ringmodulator must receive signal in on both its entries to give any out signal.

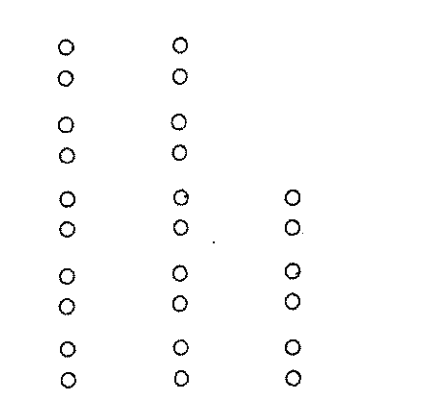
3.4.2 Ringmodulator 3
RM(3)

EMS-I programming	Operation
1. RM(3, ,) 2. (, ,level) 3. (, ,)> Complete phrase: RM(3, ,level)>	1. Choose RM3 2. Set level on RM3 3. Connect the signal Observe that RM3 is fix connected to the exits on RM1 and RM2. Both thses exits must receive a signal if RM3 shall provide any signal, i.e. totally four in-signals are required (two to each of RM1 and RM2) of which two or more can be the same.









3.5 Amplitude modulator

AM(1)

AM(2)

EMS-I programming	Operation
1. AM(no, ,) 2. (, ,level) 3. (, ,)> Complete phrase: AM(no,entry,level)>	1. Choose amplitude modulator and entry 2. Set level 3. Connect signal

The amplitude modulator has only level columns in the device panel. The reason is that the sounding result is changing depending on which signals are sent into the amplitude modulator. Consequently, the device itself cannot be controlled. In the console are at present two amplitude modulators, having each its device- and connection panel. The signal to the amplitude modulators is connected via the connection panels, but you can also connect frequency generator 23 to AM1 A and frequency generator 24 to AM2 A with a direct connection. Observe that a signal on the B-entry passes through the device even if the signal on the A-entry is missing.

3.6 Attenuators

EMS-I programming	Operation
1. AMP(no,) 2. (,level) Example of complete phrase: RM(2,level)	1. Choose attenuator 2. Set level

Each device has an attenuator where the signal level is set. The level is described in decibel (dB). Lowest level (silence) is 0 dB and highest (maximum intensity) is 100 dB. The smallest step is 1/4 dB. In cases where the signal level becomes too low (for example after filtration) the signal can be amplified by setting the attenuator on a higher level than 100 dB, however, at the most 120 dB. The signal level must never exceed 0 dB measured on the mixer's modulating instrument.

4. Connections

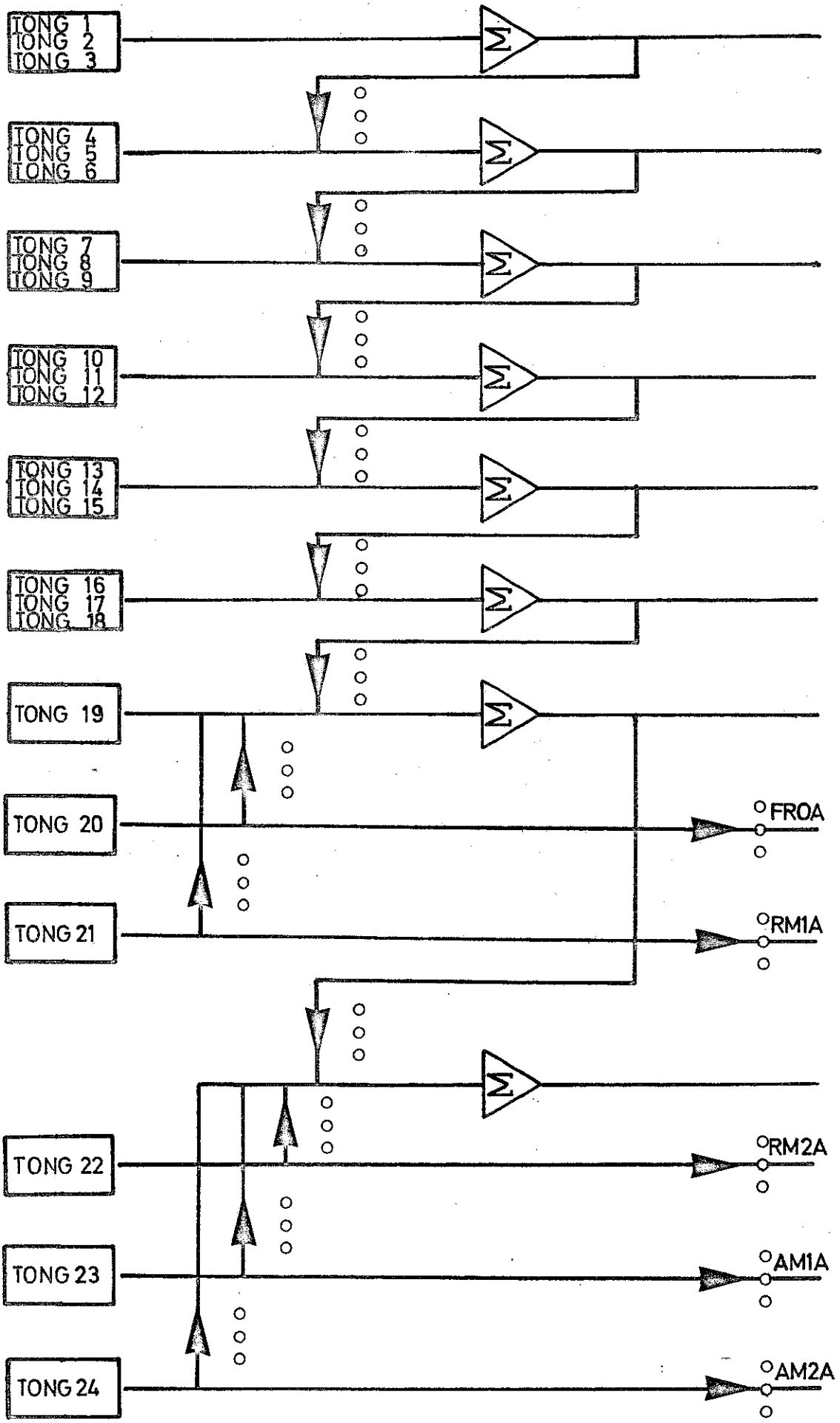
4.1 Choose

4.2 Connection panel

4.3 Connect

4.4 Summing panel for the frequency generators

4.5 Level control


TONG 1
TONG 2
TONG 3
TONG 4
TONG 5
TONG 6
TONG 7
TONG 8
TONG 9
TONG 10
TONG 11
TONG 12
TONG 13
TONG 14
TONG 15
TONG 16
TONG 17
TONG 18
TONG 19
TONG 20
TONG 21
TONG 22
TONG 23
TONG 24
Σ
FROA
RM1A
RM2A
AM1A
AM2A

EMS-1 programming			Operation
1. FG(1,	FG(23,	CHA(1,	1. Decide which device shall be used
FG(2,	FG(24,	CHA(2,	2. Locate the device on the console
FG(3,		CHA(3,	
FG(4,	NG(	CHA(4,	
FG(5,			
FG(6,	REV(1,		
FG(7,	REV(2,		
FG(8,	REV(3,		
FG(9,	REV(4,		
FG(10,			
FG(11,	FF(1,		
FG(12,	FF(2,		
FG(13,			
FG(14,	RM(1,		
FG(15,	RM(2,		
FG(16,	RM(3,		
FG(17,			
FG(18,	CD(1,		
FG(19,			
FG(20,			
FG(21,			
FG(22,			

The studio has the following devices:

Sound generating:

24 frequency generators with wave-shapers

1 noise generator with white and pink noise

Processing:

4 reverberators spiral type

2 filters, each with 28 filter channels

3 ring modulators

2 amplitude modulators

1 frequency shifter

Recording:

4 channels for 1, 2, and 4-channel recordings

1 mixer-table for manual control of the four channels and four registering level meters

Outputs:

2 channel distributors with each 4 attenuators for direct sound and 4 for reverberated sound

4.2 Connection panel

EMS-1 programming	Operation
1. See column 2 in the table below	1. Choose connection panel

A connection panel is used to connect a signal from a device to another. By choosing the connection panel belonging to the device where the signal comes from, you have decided where from the signal shall be connected. It then remains to decide to which device the signal shall be connected. This is made by lightening the lamp on the connection panel that indicates the device you want the signal connected to.

Example: The signal from the frequency generator 5 is connected to ring modulator number 1, B-entry, by lightening the lamp for RM1 B on the panel FG6.

The device panels and the connection panels have the same notation. For instance the connection panel has the notation FG3 for the frequency generators 1, 2, and 3. In the same way the frequency parameters 4, 5, and 6 are connected to the connection panel notated FG6. Each device has its own code as follows:

Frequency generator	1-3	FG3	FG3 (EMS-1)
"	4-6	FG6	FG6
"	7-9	FG9	FG9
"	10-12	FG12	FG12
"	13-15	FG15	FG15
"	16-18	FG18	FG18

Frequency generator 19-21	FG21	FG21 (EMS-1)
" " 22-24	FG24	FG24
Noise generator	NG1	NG(1)
Reverberator 1	REV1	REV(1)
" 2	REV2	REV(2)
" 3	REV3	REV(3)
" 4	REV4	REV(4)
Frequency filter 1	FF1	FF(1)
" " 2	FF2	FF(2)
Tape recorders, analogue, play-back	AT1	AT(1)
Tape recorders, analogue, play-back	AT2	AT(2)
Tape recorders, analogue play-bak	AT3	AT(3)
Tape recorders, analogue play-back	AT4	AT(4)
Ring modulator 1	RM1	RM(1)
" " 2	RM2	RM(2)
" " 3	RM3	RM(3)
Amplitude modulator 1	AM1	AM(1)
Amplitude modulator 2	AM2	AM(2)
Channel distributor 1, control of sounds in the room	CD1	CD(1)
Channel distributor 2, control of sounds in the room	CHA1	CHA(1)
-"-	CHA2	CHA(2)
-"-	CHA3	CHA(3)
-"-	CHA4	CHA(4)

Apart from Channel distributor and Channel all these devices have their corresponding connection panels.

Not all devices can at present be connected to all the others. Connection that can be used are marked with a red line.

EMS-1 programming	Operation
Examples: 1. 2. >> 3. Example of complete phrase: RM(1)>FF(1);	1. Choose the connection panel belonging to the device 2. Connect the signal 3. Control the level of the signal on the entry to next device (See level control)

4.4 Summing panel

EMS-I programming	Operation
1. 2. FG3>FG6>FG9>FG12>FG15>FG18>FG21> FG24; FG(20>21)>FG21; FG(22>24)>FG24; 3. Example: FG(24)>FG24>CHA(1);	1. Choose exit from summing panel 2. Connect in series the different frequency generators 3. Connect the signal further via the connection panel belonging to the choosen exit on the summing panel Observe that the exit chosen depends on the number of generators. If 6 generators are need choose exit no 2 for example, if 9 are needed, choose exit no 3, etc. Note that the last 5 generators must be connected each for itself.

The frequency generators have a summing panel of their own where the groups of frequency generators can be summed. Each group of frequency generators consist of three. On the summing panel each group-sign - a triangle enclosing a summation sign - corresponds to the connection panel. The frequency generators have together 8 connection panels, all to be found as triangles on the summing panel. When you want to connect the generator groups, you close the contact between these triangles so that an arrow-shaped lamp is lit. As there are 8 generator groups there are 7 such arrow-contacts to close to connect all 24 generators.

However, the last 5 generators have been given special tasks. Thus

generator no 20 can be connected to the frequency shifter
" " 21 " " " " " ring modulator 1, entry A
" " 22 " " " " " " " 2, entry A
" " 23 " " " " " amplitude modulator 1, entry A
" " 24 " " " " " " " 2, entry A

Due to these double connection possibilities for the five last generators you must consider that these shall be connected each for itself if you want to connect them with the other generators.

When several generators are mixed on the same exit the highest allowed level setting on each generator is lower than 100 dB. Otherwise there is a risk that the following devices are overloaded, the signal level being too high. It cannot be indicated as a rule which level can be allowed as it is not possible to predict how the signals are added. But you can say that if a number of frequency generators are mixed and all set on the same level and this is chosen according to the table below, it is out of question that the signal level is too high. But on the other hand, it easily happens that it gets too low, as the table assumes the worst case of signal addition. The only way to decide the total signal level is to measure it on the modulating instruments and this must always be made in connection with the signal being further connected. (See 4.2, 4.3, 4.4, and 4.5)

Number of frequency generators	Absolutely safe level
1	100
2	94
3	90
4	88
5	86
6	84
7	83
8	82
9	81
10	80
11	79
12	78
13	78
14	77
15	77
16	76
17	76
18	75
19	75
20	74
21	74
22	73
23	73
24	72

dB, decibel

Decibel is a logarithmic unit of measurement indicating the relation between two effects, for example acoustic or electric. The relation N between two effects P_1 and P_2 expressed in dB is defined as

$$N = 10_{10}\log \frac{(P_1)}{P_2}$$

Often an effect relation is measured through measuring of another quantity than the effect. If for example the acoustic pressure is measured it has to be considered that the sound intensity (sound effect) is proportional to the square of the acoustic pressure. The relation between two sound intensities, if the corresponding acoustic pressure L_1 and L_2 has been measured, becomes

$$N = 10_{10}\log \frac{(L_1^2)}{} = 20_{10}\log \frac{(L_1)}{L_2}$$

If two electrical voltages V_1 and V_2 are measured over the same resistance you will obtain in the same way

$$N = 20_{10}\log \frac{(V_1)}{V_2}$$

In practice other relations between effects are often wrongly indicated in dB. Thus a voltage relation according to the preceeding case is often indicated without the voltages being measured over the same resistance. This is done when for example the voltage amplification of an amplifier is indicated in dB. (You can also indicate the effect amplification of the amplifier, which usually has another value.)

You must always remember that dB is a relative measurement. To say for instance that a voltage has the value 100 dB is totally without meaning, if you don't indicate at the same time what it is compre to (i.e. another voltage).
When this is done anyway, the reference normally is implied, for example the zero-level of 0.775 V effective value which is usual in radio and other recording connections.

It is important to keep count of and distinguish between the different quantities

indicated in dB in the studio. They are:

1. Electric signal level (electric voltage)
2. Amplification (attenuation)
3. Acoustic signal level (acoustic pressure)

Between these three magnitudes is no specific connection unless all links in a signal chain are defined (signalsource, amplifiers, loudspeakers, space, etc.).

1. The electric signal level is measured on the four output level instruments and is indicated relative to a top value of the voltage of 1.1 V (corresponds for a sine wave to an effective value of 0.775 V voltage), i.e. 0 dB on the instruments indicates a measured voltage with the top value 1.1 V. The instruments can be connected to measure the signal level anywhere in the system.

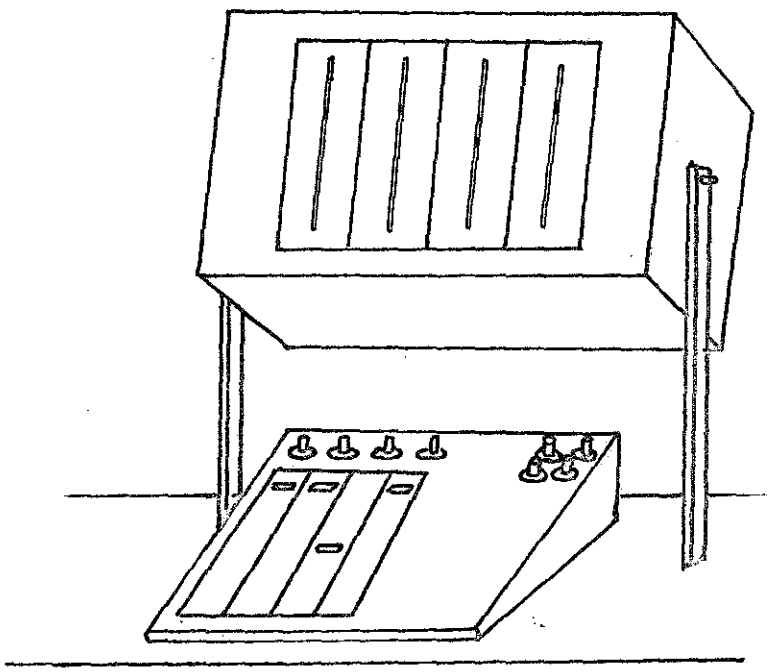
2. As both an attenuation and an amplification are only a relation between an out-dimension and an in-dimension there is no principal difference between them and they can be indicated in the same way. Observe that the dB-value can be positive or negative (depending on whether the relation is larger or smaller than 1).
   To avoid negative numbers in stating the level of the attenuators, their amplification is given relative to an imagined amplification of 10^{-5} times, which thus corresponds to the level setting of 0 dB.
   The setting 100 dB corresponds to the amplification one time, i.e. the signal passes the attenuator without being either strengthened nor weakened. 120 dB becomes amplitude amplification of 10 times, etc. Observe that the signal level has no direct connection to the level setting of the attenuator. This is only indicating how an in-signal is treated by the attenuator before it reaches its exit.

3. The acoustic signal level is normally indicated in comparison to the sound-pressure 2.10^{-5} N/m^2. A "sound pressure" of 100 dB concequently means a sound-pressure of $10^5 \times 2.10^{-5}$ N/m^2 = 2N/m^2. As mentioned before, there is no direct connection between the acoustic and the electric signal level. The characteristics of all parts of the electro-acoustic chain must be known if it shall be possible to say something about the relation, for instance the amplification chain into which the electric signal is fed, the characteristics of the loud-speakers, among other things the number of them and their electro-acoustic

efficiency, the characteristics of the room where the loudspeakers are placed, for instance its size, etc.
To the three magnitudes mentioned above, another two signal levels can be added; the modulation of the analogue magnetic tape, which has also no direct connection with any of the previous magnitudes, and the experienced volume or listening volume. The volume (or actually the volume experienced by a fictive normal person) is via the listening curves belonging to the acoustic signal level, and is as it should be indicated in the magnitude Phon. The Phon-scale and the dB-scale for sound pressure agree (are the same number) for a sine-tone with the frequency 1 kHz.

4.5 Level checking

EMS-I programming	Operation
	1. Connect the signal to be checked to any free channel. 2. Set level of the channel to 100 dB. 3. Connect to an attenuator ruler via the input selector. 4a. Connect measuring and monitoring switch to UT A. (out A) 4b. Connect measuring and monitoring switch to IN A and set the ruler to max. 5. Push LYSSNA (listen) 6. Measure level (and listen) 7. Adjust the level 8. Disconnect (reset)



5. Outputs

5.1 Channels 1-4

5.2 Channel distributor, moving sound

5.3 Moving sound number two

5.4 Moving sound in EMSI

5.5 Reverberation distributor

5.6 A comparison with how the studio previously was connected for moving sound and reverberation

5.1 Channels 1-4

CHA

EMS-1 programming	Operation
1. CHA(no,) 2. (,level) 3. >CHA(,); Example of complete expression: FG3>CHA(1,100);	1. Choose channel 2. Set level 3. Connect sound-source to the channel

The console has 4 output channels. The channels used must be given a level-value to enable the signal to go out to the loudspeakers or to the analogue tape recorder.

A sound can be placed halfway between two loudspeakers. It is then connected to both corresponding channels and these are given the same level. By connecting different sound-sources to one or several channels in different combinations, it is therefore possible to place many sounds in different places in the room. All channels are set on for example 100 dB (no relative amplification).

Connection to	places the sound in
CHA(1)	front left corner
CHA(1)&CHA(2)	straight forward
CHA(2)	front right corner
CHA(2)&CHA(3)	straight to the right
CHA(3)	rear right corner
CHA(3)&CHA(4)	straight backwards
CHA(4)	rear left corner
CHA(4)&CHA(1)	straight to the left
CHA(1)&CHA(2)&CHA(3)&CHA(4)	the middle

Example (how to connect six frequency generators to each channel):

```
FG3>FG6>CHA(1,1ØØ);
FG9>FG12>CHA(2,1ØØ);
FG15>FH18>CHA(3,1ØØ);
FG21>FG24>CHA(4,1ØØ);
FG(20<-21)>FG21;FG(22<-24)>FG24;
```

5.2 Channel distributor
Moving sound

EMS-1 programming	Operation
1. CD(1, ,)	1. Choose channel distributor
2. CD(1,1,level)	2. Set level for output no 1
3. CD(1,2,level)	3. " " " " " 2
4. CD(1,3,level)	4. " " " " " 3
5. CD(1,4,level)	5. " " " " " 4
6. >CD(, ,)	6. Connect sound-source to the channel distributor
Example:	
FG12>CD(1);	
CD(1,1,9Ø);CD(1,2,8Ø);	
CD(1,3,7Ø);CD(1,4,6Ø);	

The channel distributor panels consist only of device panels with level columns. From the connection panel of each device the signal can be connected to channel distributor 1-8. Each channel distributor has fixed connection to all four loud-speaker outputs. By setting different levels on the different outputs it can be simulated that the sound-source moves, stepwise or continuously. With channel distributor no 1 one sound can be placed in the room. To place two different sounds in the room at the same time, but in different places in the room, the sound no 2 must use "channel distributor no 2". The studio is designed to have maximum 8 different sounds "moving" simultaneously. It is also possible to use channel distributors to connect one sound to a loudspeaker output, where there already is a sound, in order to vary the level of the first sound, independently of the second. At present two channel distributors are connected. See further 5.3.

5.3 Moving sound no 2

EMS-I programming	Operation
1. CHA(1,level) 2. CHA(2,level) 3. CHA(3,level) 4. CHA(4,level) 5. >CHA(1)&CHA(2)&CHA(3)&CHA(4); Example: FG24>CHA(1,6Ø)&CHA(2,7Ø)&CHA(3,8Ø) &CHA(4,9Ø);	1. Set level for channel 1 2. " " " " 2 3. " " " " 3 4. " " " " 4 5. Connect a sound-source to the channels

As channel distributor or moving sound no 2 the four channels are used. When these are used as channel distributor the sound-source shall be connected to each of the four channels.

The sound is distributed in the room by setting different levels on the four channels. Consequently, it is possible to either place several not-moving sounds on the channels (see 5.1), or to use them for a moving sound.

5.4 Moving sound in EMS-I

EMS-I programming	Significance
1. FG3>FG6>FG9>FGI2>CD(I);	1. Connect sound-source to channel distributor I
2. MOVS(I, , , ,)	2. Set parameters for moving sound I
3. MOVS(,I>I2, , ,)	3. Enable doppler effect of the frequency generators connected to channel distributor I
4. MOVS(, ,level, ,)	4. Indicate overall level in dB for the direct sound
5. MOVS(, , ,level,)	5. Indicate reference level for the reverberation sound
6. MOVS(, , , ,dopfac)	6. Exaggerate or reduce the doppler effect
7. REV(I,revtim,); REV(2,revtim,); REV(3,revtim,); REV(4,revtim,);	7. Set reverberation time on all four reverberators
8. REV(I, ,level); REV(2, ,level); REV(3, ,level); REV(4, ,level);	8. Set level on the outputs of the four reverberators (max. 90 dB is recommended)
9a. MOVSRA(I,radius,angle,time,acctyp,step); 9b. MOVSXY(I,x,y,time,acctyp,step);	9. Start a movement for moving sound I
I0. FGI5>FGI8>FG2I>FG24; FG(20←2I)>FG2I;FG(22←24)>FG24; FG24>CHA(I)&CHA(2)&CHA(3)&CHA(4);	I0. Connect sound-source to moving sound 2
II. MOVS(2,I3>24,level,level,dopfac);	II. Enable doppler effect of corresponding frequency generators, set direct level, reverberation level and doppler effect
I2.	I2. Reverberation time and out-level from the reverberators are common for the moving sounds. Point 7-8 are made if these values are not already set in connection with the first moving sound
I3a. MOVSRA(2,radium,angle,time,acctyp,step); I3b. MOVSXY(2,x,y,time,acctyp,step);	I3. Start a movement for moving sound 2

A moving sound means a distribution of a signal to the four loudspeaker outputs. If reverberation is used it is also to be distributed to four channels. In EMS-I there is a notation in order to easily set all these eight levels. With the MOVS-term some main parameters for each moving sound are defined. With the MOVSRA- and MOVSXY-terms the sound is made to move by having successively new values sent out to the eight levels.
The composer must also

1) Connect a sound-source to each moving sound in action (point 1 and 10 above)
2) If he wants reverberation, set reverberation time and reverberation level (point 7-8 above)

The program which simulates moving sound is distributing this level on the four loudspeakers.

The MOVS-term for each moving sound contains an overall level for the direct sound. Suppose that the overall level is set to 100 dB. If the sound is situated exactly at a loudspeaker (the radius 1000) the corresponding out-level will get the value 100 dB and the others 0. Halfway between two loud-speakers on the same distance from the centre their two levels will be 97 dB, and the level of the others 0. Outside the unit radius one or two loudspeakers will get direct level, always less than 100 dB.
The MOVS-term for each moving sound also contains a reference level for the reverberation of this sound. The out-amplifiers of the reverberators must be given a level if the reverberation shall be heard (point 5 above). These levels are common for all sounds being reverberated. To reduce the noise a setting of for example 90 dB is recommended.
To compensate this the reference level of each moving sound is instead set 10 dB higher than the desired overall level.
It is important to adjust the in- and out-levels so that the reverberators are not over-modulated, but the noise is minimized.

If the overall level for the direct sound is set to 0 only the reverberated sound will be heard and vice versa.

5.5 Reverberation distributor RD

EMS-I programming	Significance
1. >CD(1); 2. RD(1,1,9Ø);RD(1,3,87); 3. REV(1,1Ø,9Ø);REV(3,12,9Ø);	1. Connect sound-source to channel distributor 2. Distribute the sound to the reverberators 3. Set level and reverberation time on the reverberators

To produce reverberating sounds manually it is at present necessary to connect one sound to one or several reverberators and set reverberation time and reverberation level. The reverberation is then heard on the loudspeaker outputs. Via programming with moving sound it is possible to put reverberation on each of the moving sounds. About the connection of these, see 5.4. In this case 4 attenuators are used per moving sound. These can at present be reached only via programming; not via the console. They are called RD(1,1), RD(1,2), RD(1,3), RD(1,4), RD(2,1), RD(2,2), RD(2,3), and RD(2,4). They are fixed connected from the inputs of channel distributor 1 resp the channels, to the reverberator inputs in the following way. Anything connected to CD(1) is automatically connected also to RD(1), etc.

CD(1)	RD(1,1)	REV(1)	CHA(1)	RD(2,1)	REV(1)
CD(1)	RD(1,2)	REV(2)	CHA(2)	RD(2,2)	REV(2)
CD(1)	RD(1,3)	REV(3)	CHA(3)	RD(2,3)	REV(3)
CD(1)	RD(1,4)	REV(4)	CHA(4)	RD(2,4)	REV(4)

From version V5 of EMS-I the RD-term is implemented. The user can then distribute reverberation in the room without using the terms for moving sound.

5.6 A comparison with how the studio previously was connected for moving sound and reverberation

During spring 1974 certain changes were made in the studio in connection with the implementation of moving sound no 2. What is said below can be of interest to those who have earlier produced compositions with the use of CD, AMP, and REV. Old digital tapes which are not using these devices can still be played without special arrangements. EMS' technical personnel can give advice in other cases. A temporary re-connection to the old system can be done in order to play old tapes.

Earlier, a sound connected to CD(1) continued to CHA(1) - CHA(4) and was therefore affected also by the level setting of the channels. With the new way of connecting, CD(1) goes directly to the loudspeaker outputs without being effected by CHA(1) - CHA(4). Compositions, which were previously generated with the use of CD(1) and with all channels on 100 dB therefore sound exactly as before. This was the most common use.

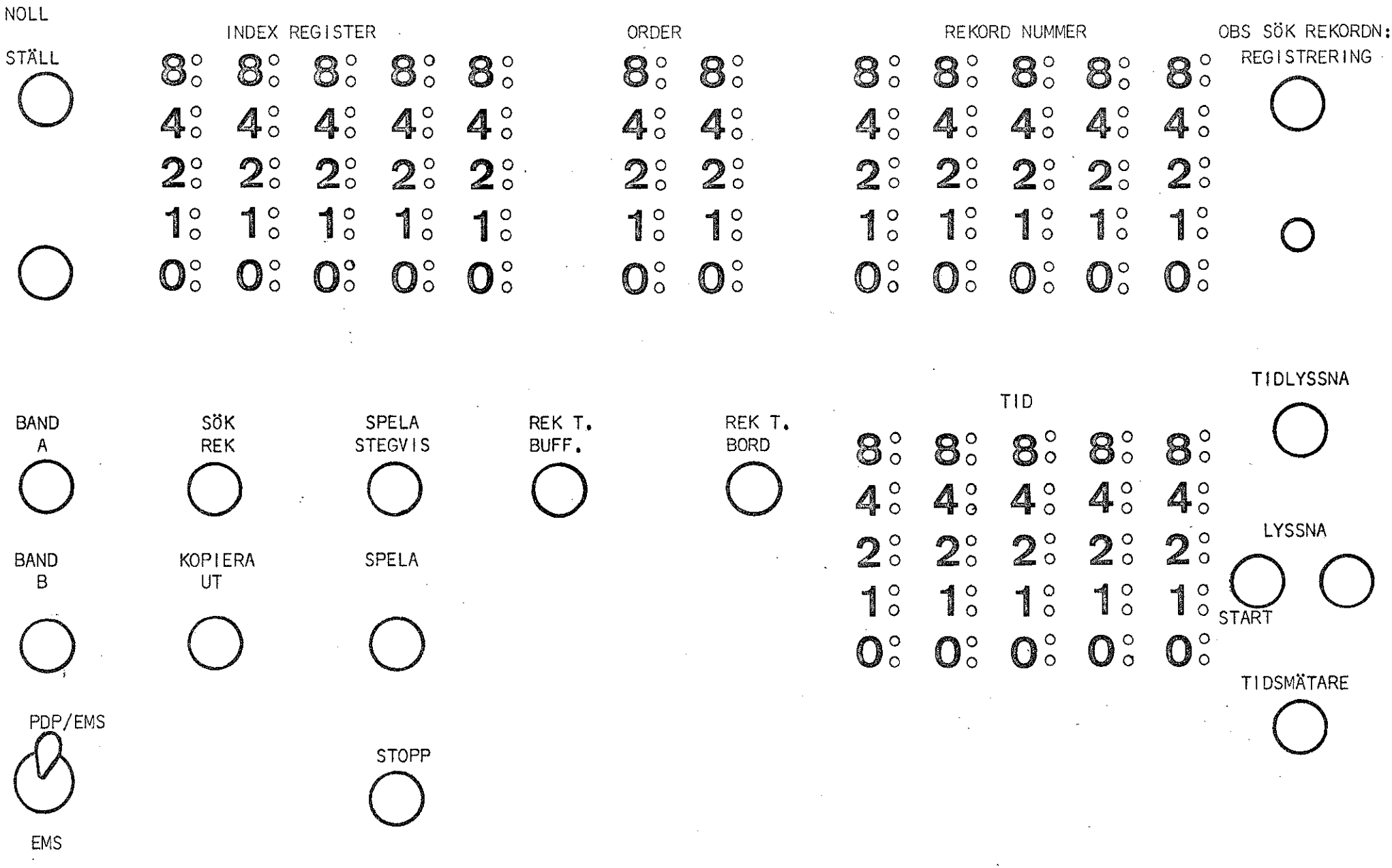
The amplifiers and the connection points AMP(1) and AMP(2) are nowadays used by REV(3) and REV(4) and can therefore not be used as before. Old compositions using these now gets the passing sound reverberated and also put out on the outputs 3 resp 4.

The four reverberators are nowadays fixed connected to a loudspeaker output each. The old connection paths from REV(1), REV(2), AMP(1), and AMP(2) still exist. Old compositions using REV(1) and REV(2) sound as before with the addition of reverberation also on the outputs 1 and 2, independent of the further connection.

The amplifiers RD are new.

6. The Digital Control System

6.1 Set to zero
6.2 The index register
6.3.1 Listen continuously
6.3.2 Time listen
6.3.3 Time measure
6.3.4 Time register
6.4.1 Digital tape recorders
6.4.2 Tape inserting into the digital tape recorder
6.4.3 Tape removal from the digital tape recorder
6.5.1 Register
6.5.2 Record number register
6.6.1 Record to buffer
6.6.2 Record to table
6.7 Seek record
6.8.1 Play
6.8.2 Play step-by-step
6.8.3 Indication of registered time
6.9 Stop
6.10.1 Copy out
6.10.2 Change of the last registered records
6.10.3 Change of a record which is not the last registered
6.10.4 Change of several records which are not the last registered
6.11.1 Order register
6.11.2 Set the order PLAY
6.11.3 Set the order CHANGE TAPE
6.11.4 Set the order STOP


NOLL
STÄLL
INDEX REGISTER
8 8 8 8 8
4 4 4 4 4
2 2 2 2 2
1 1 1 1 1
0 0 0 0 0
ORDER
8 8
4 4
2 2
1 1
0 0
REKORD NUMMER
8 8 8 8 8
4 4 4 4 4
2 2 2 2 2
1 1 1 1 1
0 0 0 0 0
OBS SÖK REKORDN:
REGISTRERING
TIDLYSSNA
TID
8 8 8 8 8
4 4 4 4 4
2 2 2 2 2
1 1 1 1 1
0 0 0 0 0
LYSSNA
START
TIDSMÄTARE
BAND A
SÖK REK
SPELA STEGVIS
REK T. BUFF.
REK T. BORD
BAND B
KOPIERA UT
SPELA
PDP/EMS
EMS
STOPP

6.1 Set to zero

EMS-1 programming	Operation
	1. Press NOLLSTÄLL (set to zero)

The operating panel has a button SET TO ZERO at top to the far left, with which all settings can be set to zero, including the filter settings on the console.

6.2 The index register

EMS-1 programming	Operation
	2. Set a number in the index register

The index register is a "neutral" register where numbers are given a sense depending on the following order to be set.
Example: Set 500 in the index register and give the order "TIDLYSSNA" (time listen), whereupon 500 means 500 ms. If the order instead is "SÖK REKORD" (seek record) 500 will mean record no 500.

6.3.1 Listen continuously

EMS-1 programming	Operation
	1. Press LYSSNA START (listen start) 2. Press LYSSNA STOPP (listen stop)

The tone sounds from the "starting" of the time measure until it is stopped. If LYSSNA does not light up when LYSSNA START (listen start) is executed, press first TIDMÄTARE (time measure) and try LYSSNA once again.

6.3.2 Time listen

EMS-1 programming	Operation
	1. Press TIDLYSSNA (time listen)

The tone sounds during the time set in the index register at the same time as it is automatically transferred to the Time register.

6.3.3 TIDSMÄTARE (time measure)

EMS-I programming	Operation
	1. Press TIDSMÄTARE (time measure)

The tone sounds as long as the TIDSMÄTARE (time measure) is pressed.
The final time is automatically set in the time register.

6.3.4 Time register

EMS-I programming	Operation
	1. Set time

The time register shows the time which will be registered if you give the order REGISTRERA (register). The time register also indicates the time a certain record contains if you play a record from the digital tape recorder.

In EMS-I there are two counter-parts to the time register:

1. By the LT-term (local time) you can in each "object" indicate an explicit time, when a device value shall be set or a connection be made.

   Example: LT(600)FG(no,frequ,level,wave)>FF(no,chan,level)>
   CHA(no,level);
   LT(1,)NG(1,,PINK);
   LT(1,2ØØ)FG(no,frequ);

   At the time 600 ms a few connections and values are set, out of which one is changed at the time 1.2 seconds. In a parallel course where the noise-generator is involved, the noise colour is changed at 1 second. It is consequently easy to treat parallel courses, and the LT-terms need not even be in chronological order.

2. The D-term (duration) sets a level to zero after an indicated time.
   Example: LT(2,)FG(no,frequ,level)>D(17ØØ);
   FGs are set to zero at 3.7 seconds.

6.4.1 Digital tape recorders

The Control signals generated via the console can be stored on two AMPEX TM II digital tape recorders. These tape recorders are called "off-line recorders" to distinguish them from the two digital tape recorders AMPEX TM16, which are connected to the computer "on-line". Consequently, it is possible to use the console plus the off-line tape recorders as one control system and the console plus the computer as another. It is also possible to let the computer produce tapes which are played back on the off-line recorders.

6.4.2 Insertion of tape into the digital tape recorders (TMII)

1. Open the window carefully be keeping the catch back. Observe that the window must not be dropped.
2. Push the tape reel onto the socket with the plastic ring inwards. If the tape is to be write-protected the ring shall be removed. See to it that the reel is pushed in as far as possible adn that it is straightly placed.
3. Screw up the reel with the centre knob so that it is tightly placed. Keep the reel firmly meanwhile.
4. Push the POWER button.
5. If the vacuum pump is on (the breaks on), switch it off with TAPE LOAD. Wait until the breaks are released.
6. Draw the tape according to the picture the shortest way and wind it ten turns on the collecting reel. See to it that the tape is inside the cover over the read- and write-head.
7. Lift a tape-loop over the capstan wheel according to the picture. See to it that the tape is on the correct side of the tape guides.
8. Let down a little tape loop about 1 decimeter into each vacuum column. Check that the tape is not twisted in the column.
9. Start the vacuum pump with TAPE LOAD so that the tape gets stretched. (The air-noise increases!)

6.4.2 Insertion of tape into the digital tape recorders (TMI1) continuation

10. Shut the window carefully. Observe the catch must be kept back until the window is completely shut. Then it can be released and the window is locked.
11. Push FORWARD during a couple of seconds.
12. Push REVERSE or REWIND so that the tape is rewound to the beginning-of-tape.
13. Control that FILE PROTECT is lighted if the tape shall be protected from writing.
14. Push REMOTE and the tape can be remotely controlled from the console.

6.4.3 Release of tape in the digital tape recorders (TMI1)

1. Push LOCAL.
2. Push FORWARD and let the tape wind forward for a moment.
3. Push STOP.
4. Push REWIND or REVERSE and let the tape wind back to the beginning-of-tape.
5. Open the window carefully. Don't let it drop against the stop.
6. Switch off the vacuum pump by TAPE LOAD. Wait until the breaks are released.
7. Wind the tape back on the reel. It is possible to first lift it off the capstan reel.
8. Ease off the centre knob of the reel socket and take off the reel. If the tape recorder is not to be used again, fasten the knob.
9. Shut the window carefully. If the knob is not fastened it will hit the window. The catch on the window must be kept back until the window is completely shut. It can then be released so that the window is locked.
10. Switch off the power by pressing POWER.

POWER	FILE PROTECT	REMOTE	LOCAL	HIGH DENSITY LOW		FORWARD	REVERSE	REWIND	STOP

6.5.1 Register

EMS-I programming	Operation
	1. Choose devices and set data on the console 2. See to it that Time[×] indicates the desired time 3. Order must have the correct data 4. Push REGISTRERA (register) OBS! All digital tape recorders must be ready for recording. [×] Time = time register = TID

The shortest time possible to register on the digital tape without having a pause between two recorded sounds is 18 ms. This is due to the fact that the digital tape recorder takes 18 ms to read a record. The registration can be made on the two digital tape recorders A and B (A is nearest to the entrance door). You choose which tape recorder you want to use by pressing either BAND A or BAND B on the console. A lightened lamp will show you which tape recorder is connected.

6.5.2 Record number register

The record number register indicates the numbering of the records of the tape recorder. After the command SÖK REKORD (seek record) and KOPIERA (copy) the record number register indicates the record which the tape recorder stands before.

After the command SPELA (play), REKORD TILL BORD (record to console), and SPELA STEGVIS (play stepwise), the record just played by the tape recorder will be indicated.

6.6.1 Record to buffer

EMS-1 programming	Operation
	1. Push the button REKORD TILL BUFFERT (record to buffer)

The record is transferred from the tape recorder to the buffer memory.

6.6.2 Record to console

EMS-1 programming	Operation
	1. Push the button REKORD TILL BORD (record to console)

The record is transferred from the buffer memory to the console.

6.7 Seek record

EMS-I programming	Operation
	1. Set the desired record number in the index register. 2. Push the button SÖK REKORD (seek record) The command SÖK REKORD is used to: a) find a record you want to listen to b) find a record you want to transfer to the buffer c) find a record you want to transfer to the console d) find the first record in a series of recor you want to copy out.

To be able to get orientated on the digital tape a numeration of the record has been made, i.e. a numeration of all changes on the console that the composer has done. One change is thus one record.

6.8.1 Play

EMS-I programming	Operation
	1. Seek record by pushing SÖK REKORD 2. Choose end record and set the number of this in the index register 3. Push REKORD TILL BUFFERT (record to buffer) 4. Push SPELA (play)

6.8.2 Play stepwise

EMS-I programming	Operation
	1. Seek record 2. Push REKORD TILL BUFFERT (record to buffer) 3. Push SPELA STEGVIS (play stepwise)× 4. If you want to listen to the next record, push SPELA STEGVIS again. ×The record is transferred to the console simultaneously with the next record being transferred from the tape recorder to the buffer memory.

6.8.3 Indication of registered time

EMS-I programming	Operation
	1. Seek record 2. Push REKORD TILL BUFFERT (record to buffer) 3. Push REKORD TILL BORD (record to console) 4. See what TID (time)[×] shows, when the time measure has stopped. [×]TID=time=time register

6.9 Stop tape recorder

EMS-I programming	Operation
	1. Push STOPP (stop)

It is possible to stop the digital tape during performance by the stop-button. The tape then stops in a record gap. If you should lose control over the tape recorder by playing past the last record, you can stop the tape recorder by pressing the button placed below NOLLSTÄLL (set to zero). However, you must back the tape manually into a part with registrations to be able to regain control.

Do <u>not</u> stop the tape recorder in any other way.

6.10.1 Copy out

EMS-1 programming	Operation
	It is possible to copy from A to B or from B to A. Suppose that a copying without record number change shall be made from B to A: 1. Seek the initial record on TAPE RECORDER A 2. Seek the initial record on TAPE RECORDER B 3. Set the end record + 1 in the index register (The initial record number remains in the record number register) 4. Push KOPIERA UT (copy out)

The command is used to copy the contents of one tape to another tape. Observe that the command is KOPIERA UT (copy out), i.e. out from the tape recorder which is connected when the command is given.

Example: We have 24 records registered on TAPE RECORDER A and we stand before the first record on TAPE RECORDER B. We seek on TAPE RECORDER A record number 1 and set record number 25 in the index register. Observe that by the operation KOPIERA UT, the tape recorder stops before the number set in index, while it by SPELA (play) stops after the number set in index. Thereafter we press KOPIERA UT. You can then see that Record number counts from 1 to 25, and that the signal lamps of the tape recorder are lighted for B and turned out for A. We ought to register a few extra records on TAPE B and check that we have got the 24 records.

If you want other record numbers than those on the original tapes set the record number register on for example number 6 after the two tapes have been wound into the right position. To get all 24 records over to TAPE B the index register must have a number five records greater than number 25. You consequently set number 30 in the index register. Thereafter you can press KOPIERA UT and then make sure that 24 records from number 6 to number 29 are registered on TAPE B.

6.10.2 Change of the latest registered records

EMS-1 programming	Operation
Example: Suppose that 20 records are registered. Record number shall be on 21. The last four records are erraneous. Seek record number 17 and correct the erraneous records one by one.	1. Seek record, the first of the records you want to change 2. Change and push REGISTRERA (register)

6.10.3 Change of a record which is not the last registered

EMS-I programming	Operation
	TAPE RECORDER B is ready for copying from A. Suppose that 20 records are registered on TAPE A. Record number 13 is erraneous and is to be changed. 1. Seek record no 1 on TAPE A 2. Set index register on no 13 3. Push KOPIERA UT (copy out) (Record no 1 to 12 are copied onto TAPE B) 4. Register the new desired record no 13 on TAPE RECORDER B (push REGISTRERA) 5. Seek record no 14 on TAPE A 6. The index register is changed to no 21 7. Push KOPIERA UT (copy out) 8. Register a few extra records. (We now have 20 records on TAPE B. No 13 is changed)

6.10.4 Change of several records, which are not the latest registered

EMS-I programming	Operation
	TAPE RECORDER B is ready for copying from A. Suppose that 20 records are registered on TAPE A. Record no 13 and 14 are erraneous and are to be changed. Two new records are also to be added. 1. Seek record no 1 on TAPE A 2. Set the index register on no 13 3. Push KOPIERA UT (copy out). Records no 1-12 are copied onto TAPE B 4. Register the four new records (push REGISTRERA). There are now 16 records on TAPE B 5. Seek record no 15 on TAPE A 6. Exchange no 15 in REKORD NUMMER (Record number) and replace it with no 17. (The two new records.) 7. The index register is to be changed to no 2 (the two new records). 8. Push KOPIERA UT (copy out) 9. Register a few extra records. (Observe that you don't change the position of the digit tape if you change the number in Record number. Record number is an indication.)

6.11.1 The command register

EMS-1 programming	Operation
	1. Set number code for command

The following commands can be set: 6.11.2 SPELA (play), 6.11.3 BYT BAND (change tape), 6.11.4 STOPP (stop).

Observe that the PLAY-command is set automatically at registering. The PLAY-command means that the tape shall play also the next record and is used in normal continuous registering. CHANGE TAPE command is used to change tape in the middle of a composition from TAPE A to TAPE B or vice versa. STOP is set in the last registered record. If a STOP-order has stopped the tape during a performance, the tape can be re-started with the commands REKORD TILL BUFFERT (record to buffer) and SPELA (play).

6.11.2 The command PLAY

EMS-1 programming	Operation
	1. Set 40 in command register

The hexadecimal number 40 is set in the command register by setting 4 in the first column and 0 in the second column.

6.11.3 The command CHANGE TAPE

EMS-I programming	Operation
	1. Set 4 C in the command register

The hexadecimal number 4C is set in the command register by the number 4 being set in the first column and the number 12 (4+8) in the second column.

6.11.3 The command STOP

EMS-1 programming	Operation
	1. Set 7 F in the command register

The hexadecimal number 7 F is set in the command register by setting the number 7 (1+2+4) in the first column and the number 15 (1+2+4+8) in the second column.

7. Mixer for Manual Level Adjustment

7.1 Input selector

7.2 Measuring and listening switch

7.3 In A and Out A

7.1 Input selector

EMS-1 programming	Operation
	1. Turn the input selector into the correct position

The manual mixing console has 4 input selectors for connecting one of the four outgoing channels from the console to one of the four sliding potentiometers. (A picture of the manual mixing console is on page 4.5)

7.2 Measuring and listening switch

EMS-I programming	Operation
	1. Set the measuring and listening switch in the correct position

With the four measuring and listening switches the modulation meters and the corresponding loudspeakers can be connected to different points in the manual mixing console, so that the level (and the sound) can be controlled.

7.3 IN A and OUT A

EMS-I programming	Operation

In the position IN A the modulation meter and the loudspeaker are connected before the A-side of the corresponding input selector (the half used for the studio channels) i.e. before the sliding potentiometer; in position OUT A they are connected after the sliding potentiometer.