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1. INTRODUCTION

THE EMSI LANGUAGE IS A SYMBOLIC LANGUAGE WHICH CAN BE USED TO CONTROL THE
EMS STUDIO FROM ITS COMPUTER (PDP 15/4Ø).
THE EMSI STATEMENTS SPECIFIES THE SETTING OF THE STUDIO PARAMETERS SUCH
AS FREQUENCIES, AMPLITUDES, CONNECTIONS BETWEEN VARIOUS DEVICES IN THE
STUDIO AND SO ON.
THE INPUT TEXT MAY BE PRESENT ON ANY INPUT MEDIA EXCEPT MAGNETIC TAPE.
THUS A USER MAY PUNCH HIS TEXT ON AN OFF-LINE TELETYPE AND THE RESULTING
PAPERTAPE CAN BE READ IN BY THE PAPERTAPE READER ON THE COMPUTER: THIS
TEXT IS TRANSLATED INTO THE INTERNAL DIGITAL FORM USED BY THE STUDIO
(COMPILATION), I.E.
THE EMSI PROGRAMS CHECK THE INPUT TEXT FOR ERRORS AND PRODUCES OUTPUT IN
THE FORM OF STUDIORECORDS ON MAGNETIC TAPE AND OUTPUT TEXT WITH THE LINES
NUMBERED.
IT IS POSSIBLE TO RUN THE EMSI PROGRAMS INTERACTIVELY, I.E. IT IS POSSIBLE
TO PRODUCE A RECORD ON THE MAGNETIC TAPE, LISTEN TO THE RESULT AND IF NO
GOOD MAKE CORRECTIONS AND ADDITIONS TO THE INPUT TEXT, LISTEN TO THE RESULT
ONCE MORE AND IF GOOD SAVE THE RECORD LISTENED TO AND CONTINUE TO MAKE NEW
ONES. THE LENGTH OF A PIECE IS UNLIMITED, THE USER JUST ADDS NEW RECORDS TO
THE PREVIOUS ONES.
THE LANGUAGE CONTAINS CONDITIONAL STATEMENTS WHICH MAKE IT POSSIBLE TO
CONDITIONALLY CONTROL THE COMPILATION OF THE INPUT TEXT. THE "MACRO" OPTION
MAKES IT POSSIBLE FOR THE USER TO REDUCE THE AMOUNT OF INPUT TEXT.

EMSI STRUCTURE

THE SETUP OF THE STUDIO PARAMETERS THAT CAN BE DONE MANUALLY IN THE STUDIO
CAN BE DONE IN SYMBOLIC FORM IN THE EMSI LANGUAGE. THE USER CAN SPECIFY THE
SOUND PRODUCING SOURCES (FREQUENCY GENERATORS, NOISE GENERATORS), THE SOUND
MODIFYING DEVICES (FILTERS, RINGMODULATORS, AND SO ON) AND THE CONNECTIONS
BETWEEN THESE AND THE OUTPUT CHANNELS, TO THIS THE USER TO ALL AMPLIFIERS
IN THE STUDIO CAN ADD ENVELOPE CURVES AND TO ALL FREQUENCY GENERATORS
GLISSANDI CURVES. WHEN THE USER WRITES HIS INPUT TEXT, THE INFORMATION FROM
THIS IS TRANSLATED TO SO CALLED "SORTRECORDS" (SEE APP.3) ON A DISK UNIT
CALLED THE 'TEMP' DISK (TEMPORARY DISK UNIT).

IT IS POSSIBLE TO LISTEN TO THE SOUNDS GENERATED FROM THESE SORTRECORDS WITH
A 'PLAY' COMMAND: THE SOUNDS ON THE 'TEMP' DISK IS CALLED A SOUND OBJECT.
WHEN THE USER IS SATISFIED WITH A SOUND OBJECT HE CAN TRANSFER IT TO ANOTHER
DISK UNIT CALLED THE 'MIX' DISK WHICH CONTAINS THE SORTRECORDS FROM ONE OR
MORE SOUND OBJECTS. THE INFORMATION ON THE MIX DISK IS CALLED A BLOCK.
THIS MAY EVENTUALLY BE RECORDED ON MAGNETIC TAPE (MT) TOGETHER WITH A MT-
'LABEL', WHICH MAKES IT POSSIBLE TO FIND THE BLOCK LATER ON.
WITHIN A BLOCK A LOCAL TIME IS SPECIFIED, WHICH STARTS WITH ZERO AT THE
BEGINNING OF THE BLOCK. A SOUND OBJECT CAN BE TRANSFERRED TO THE MIX DISK
WITH A LOCAL TIME SPECIFIED, I.E. THE SOUND OBJECT IS TO START AT THIS TIME
RELATIVE THE START OF THE MIX BLOCK START. A SOUND OBJECT CAN BE TRANSFERRED
MORE THAN ONCE TO THE MIX DISK WITH DIFFERENT LOCAL TIMES EACH TIME.
THE EMS1 TEXT MUST NOT BE WRITTEN IN TIME SEQUENCE.

1.1 ORGANISATION OF A RUN

THE USE OF THE EMS1 SYSTEM CAN BE ARRANGED DIFFERENTLY DEPENDING ON WHETHER
IT IS INTERACTIVE OR NON-INTERACTIVE, AND WHETHER IT IS AN INITIAL OR
CORRECTIVE RUN.

AN INITIAL RUNS IS PERFORMED THE FIRST TIME THE INPUT TEXT IS PRESENTED
TO THE COMPUTER. THE PROGRAM WILL PRODUCE BOTH A MAGNETIC TAPE WITH
EMS CODE, USED TO PLAY THE PIECE ON THE STUDIO, AND AN OUTPUT TEXT, WHICH
IS THE RECORDED INPUT TEXT WITH LINE NUMBERS INSERTED.

DURING A LATER CORRECTIVE RUN, THE OUTPUT TEXT FROM THE PREVIOUS RUN MAY
BE USED AS INPUT AND CORRECTIONS ADDED IN AN INTERACTIVE MODE. ALTERNATIVELY,
THE EDIT UTILITY PROGRAM CAN BE USED TO INSERT ALTERATIONS BEFORE THE TEXT
IS RECOMPILED. THE LINE NUMBERS ARE USED AS REFERENCE POINTS FOR FINDING
COMMANDS IN THE EDIT PROGRAM.

DURING AN INTERACTIVE RUN, TEXT IS TYPED IN AT THE DISPLAY TERMINAL (TV)
OR POSSIBLY A TELETYPE, AND MESSAGES ABOUT ANY FORMAL ERRORS ARE RETURNED
TO THE TERMINAL, WHICH IS THEN PLACED IN CORRECTIVE MODE. THE USER THEN IS
EXPECTED TO CORRECT THE ERROR IMMEDIATELY. IT IS ALSO POSSIBLE TO HAVE
THE LAST SETUP, OR ANY SEQUENCE OF SETUPS FROM THE PIECE, PLAYED BACK.

IN NON-INTERACTIVE MODE, AN ENTIRE SEQUENCE OF TEXT HAS BEEN PREPARED
BEFOREHAND, EITHER BY PUNCHING A PAPER TAPE OFF LINE, OR BY USE OF THE
PIP AND EDIT UTILITY PROGRAMS. THE TEXT IS THEN COMPILED AT THE COMPUTER
FROM BEGINNING TO END, AND ANY ERROR MESSAGES WILL BE LISTED ON THE LINE
PRINTER OR A TELETYPE. THIS HAS THE ADVANTAGE THAT THE EMS STUDIO NEED
NOT BE AVAILABLE AND THAT THE COMPUTER TIME USED IS CONSIDERABLY LESS.
THE ERRORS CAN THEN BE CORRECTED BY USE OF THE EDIT PROGRAM OR DURING AN
INTERACTIVE, CORRECTIVE RUN.

A NORMAL WAY TO WORK INTERACTIVELY COULD BE TO SPECIFY A SOUND OBJECT,
LISTEN TO THE RESULT, IF NOT SATISFACTORY CHANGE SOME OF THE PARAMETERS,
LISTEN TO IT AGAIN, AND SO ON, UNTIL THE SOUND OBJECT IS SATISFACTORY.
THE OBJECT CAN NOW BE ADDED TO THE PREVIOUS OBJECT ON THE MIX DISK WITH
A 'MIX' COMMAND. IT IS POSSIBLE TO LISTEN TO THE MIX BLOCK WITH A 'PLAY(MIX)'
COMMAND. IT IS POSSIBLE TO OVERWRITE SORTRECORDS ON THE MIX DISK WITH SORT-
RECORDS FROM THE 'TEMP' DISK. THE RULE IS:

IF TWO SORTRECORDS ARE GIVEN TO THE SAME DEVICE AT THE SAME LOCAL TIME,
THE SORTRECORD INPUTTED LAST WILL BE KEPT AND THE OTHER(S) TAKEN AWAY.
WHEN A MIX DISK BLOCK IS SATISFACTORY IT CAN BE RECORDED ON THE MT WITH
AN 'END' COMMAND. NOTE THAT THE COMMANDS PLAY, PLAY(MIX) ALSO GENERATES
CODE ON THE MT BUT CODE TO BE PERMANENTLY RECORDED IS RECORDED WITH THE
'END' COMMAND AND THUS ALWAYS FROM THE MIX DISK.
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2. EMS1 SYNTAX

CONTENTS:

2.1 NOTATION

METASYMBOL	STANDS FOR
-->	IS DEFINED AS
/	OR (ALTERNATIVE SEPARATOR)
[ ]N1-N2	N1,N1+1,..... OR N2 EDITIONS OF THE CONTENTS BETWEEN THE BRACKETS
[ ]N1-^	INFINITE N2
[ ]N	N1=N2=N
[ ]	N1=0, N2=1
N1-N2	INTEGER N, FOR WHICH N1<=N<=N2
TEXT	CHARACTER STRING NOT CONTAINING) OR (

THE REST OF THE SINGLE CHARACTERS BETWEEN SPACES DENOTE THEMSELVES,
AND THE REST OF THE CHARACTER STRINGS DENOTE COMPOSITE SYNTACTICAL
OBJECTS AND CAN ALWAYS BE FOUND TO THE LEFT OF A -->.

2.2 SYMBOLS

THE SYMBOLS (LABELS, MACROS) ACCORDING TO 7.3,7.12 AND 7.62 BELOW
MAY NOT BE ONE OF THE FOLLOWING PERMANENT SYMBOLS:

A ALL AM AMP APP AT B BEGIN CALL CD CHA CLEAR DELETE END ENV
ERASE ESTEP EXIT FF FG FG3 FG6 FG9 FG12 FG15 FG18 FG21 FG24 FS GLIS
GSTEP IFDEF IFNEG IFPOS IFUND IFZER IN KEEP LIST LOOK LT MESS MEX MI
NG NOLIST OLD PINK PLAY REPL REV RM SAVE SKIP STDTIM T TOP TRAPP TR
WHITE WRITE Z

2.3 CHARACTER SET

DEFINE THE FOLLOWING BASIC CHARACTER SET:

BASIC-CHAR => LETTER / DIGIT / + / - / * / SLASH / = / . / , / ! /
: / (/) / < / > / # / & / " / $ / % / ! / ? / ^ / @ /
CARRIAGE-RETURN

THEN THE FOLLOWING CHARACTER SET IS AVAILABLE FOR THE EMS1 TEXT:

EMS1-CHAR => BASIC-CHAR / '

THE ' FUNCTIONS AS A COMMENT SWITCH AND THE FOLLOWING CHARACTER SET
MAY BE USED IN COMMENTS (SEE 5 BELOW):

COMMENT-CHAR => BASIC-CHAR / SPACE / TAB

OTHER CHARACTERS NOT USED FOR SPECIAL PURPOSES (LIKE 'CONTROL C')
ARE IGNORED.

2.4 CARRIAGE RETURN AND RIGHT PARANTHESIS

CARRIAGE RETURN MAY BE USED
A/ AFTER) OR > OR # OR < OR ;
B/ INSTEAD OF ;
IN THE EMS1 TEXT AND ANYWHERE IN THE COMMENTS.

RIGHT PARANTHESIS) MAY ANYWHERE BE FOLLOWED BY SEMICOLON ; .
THE SAME RULES APPLY FOR THE MACRO END-DELIMITER ".

2.5 COMMENTS

COMMENTS CAN BE INSERTED ANYWHERE IN THE EMS1-TEXT AND HAVE THE FORMAT

COMMENT => ' [COMMENT-CHAR]º-^ '

(SEE 3 ABOVE).

2.6 CONTEXT DEPENDENCE.

THE FOLLOWING CONTEXT DEPENDENCIES EXIST IN THE EMS1 LANGUAGE
AND ARE NOT FULLY MAPPED INTO THE CONTEXT-FREE SYNTAX BELOW:

1. A LABEL USED IN A PLAY COMMAND (7.16) MUST BE EARLIER DEFINED
IN A BLOCK (7.3)
2. A MACRO NAME (7.12) MUST BE EARLIER DEFINED IN A MACRO DEFINITION
(7.6)
3. A FILE (7.17) MUST BE SAVED BEFORE IT IS CALLED
WITH 'CALL' OR 'TOP' (7.7).
4. A VARIABLE SYMBOL MUST BE DEFINED IN AN ASSIGNMENT BEFORE IT IS USED IN
A TERM, COMMAND OR RIGHT HAND PART OF AN ASSIGNMENT

5. THE VALUES OF SEC,MS,FREQ,LEVEL ARE RESTRICTED AS FOLLOWS:
```
        0<=SEC <=16677        SECONDS
        0<= MS <=99999        MILLISECONDS
        0<=FREQ<=15999        HERTZ
        0<=LEVEL<=128         DECIBELS
```
6. THE PERMITTED CONNECTIONS (AND DISCONNECTIONS) ARE RESTRICTED
   ACCORDING TO THE CURRENT STATE OF THE STUDIO. THIS ALSO HOLDS
   FOR SOME OF THE HIGHER UNIT NUMBERS.
   .EJECT
2.7 S Y N T A X


```
1.  EMS1-PROGRAM -> BLOCK [ [ K E E P TYPE ] BLOCK ]0-A
2.  BLOCK -> P A R T BLOCK-PAR [ ELEMENT / MACRO-DEF /
              TEMP-COMMAND ]1-A E N D [ BLOCK-PAR / ; ]
3.  BLOCK-PAR -> ( LABEL )
4.  LABEL -> SYMBOL
5.  ELEMENT -> COMMAND / CHAIN / ASSIGNMENT / CONDITIONAL / MACRO ; /
              L T ( TIME ) [ ; / > CHAIN ]]
6.  MACRO-DEF -> MACRO = " [ ELEMENT / TEMP-COMMAND / M E X ; ]1-A " ;
7.  TEMP-COMMAND -> C A L L FILE / E R A S E FILE / I N LINES /
                    L O O K LINES / P L A Y PTYPE
                    R E P L FILE / S A V E FILE / S K I P LINES /
                    T O P FILE / T R A P P ; / T R Y [ ( TIME ) / ; ]]
8.  COMMAND -> A P P ; / C L E A R TYPE / D E L E T E LIST / K E E P TYPE /
              M E S S ( TEXT ) / M I X [ ( TIME ) / ; ]] /
              [ N O ] L I S T ; / S T D T I M ( MS ) / W R I T E LIST
9.  CHAIN -> LINK [ [ > / # ] LINK ]2-A
10. ASSIGNMENT -> SYMBOL = AREX ;
11. CONDITIONAL -> [ COND-HEAD COND-TEXT ]1-A <
12. MACRO -> SYMBOL
13. TIME -> [ SEC ] [ , MS ]
14. PTYPE -> TYPE / ( BLOCK-POINTER [ , BLOCK-POINTER ] )
15. TYPE -> ( A L L ) / ( M I X ) / ;
16. BLOCK-POINTER -> LABEL
17. FILE -> ( SYMBOL [ , EXT ] )
18. LIST -> ( SYMBOL [ , SYMBOL ]0-A )
19. LINK -> GROUP [ ENV-CHAIN ] / POINT
20. AREX -> [ ADOP ] PRIMARY [ ADOP PRIMARY ]0-A
21. COND-HEAD -> I F [ D E F / N E G / P O S / U N D / Z E R ]] ( SYMBOL )
22. COND-TEXT -> [ ELEMENT ]1-A
23. LINES -> ( POSNUM ) / ;
24. ENV-CHAIN -> [ [ > ] ENV-LINK ]1-A
25. TERM -> AM-TERM / AMP-TERM / AT-TERM / CD-TERM / CHA-TERM / FF-TERM /
           FG-TERM / NG-TERM / REV-TERM / RM-TERM / STEP-TERM
26. PRIMARY -> SYMBOL / POSNUM
27. ADOP -> + / -
28. GROUP -> TERM [ & TERM ]0-A
29. ENV-LINK -> ENV-TERM / GLIS-TERM / D-TERM / Z-TERM / STEP-TERM
30. EXT -> [ ALFANUM ]3
31. POSNUM -> [ DIGIT ]1-5 [ . [ DIGIT ]0-5 ] / . [ DIGIT ]1-5
32. ENV-TERM -> E N V ( LEVEL , LEVEL , MS [ , [ FORM ] [ , MS ] ] )
33. GLIS-TERM -> G L I S ( LEVEL , LEVEL , MS [ , [ FORM ] [ , MS ] ] )
34. AM-TERM -> A M ( [ M2 ] [ , ENTRY [ , LEVEL ] ] )
35. AMP-TERM -> A M P ( [ M2 ] [ , LEVEL ] )
36. AT-TERM -> A T ( [ M4 ] [ , LEVEL ] )
37. CD-TERM -> C D ( [ M5 ] [ , [ M4 ] [ , LEVEL ] ] )
38. CHA-TERM -> C H A ( [ M4 ] [ , LEVEL ] )
39. FF-TERM -> F F ( [ M2 ] [ , [ FCNR ] [ , LEVEL ] ] )
40. FG-TERM -> F G ( [ FGNR ] [ , FREQ [ , LEVEL [ , WAVE ] ] ] )
```

```
41.  NG-TERM => N G ( [ 1 ] [ , LEVEL [ , COLOUR [ , COLOUR ] ] ] )
42.  REV-TERM => R E V ( [ M4 ] [ , REVTIM [ , LEVEL ] ] )
43.  RM-TERM => R M ( [ M3 ] [ , ENTRY [ , LEVEL ] ] )
44.  REVTIM => [ SYMBOL / 1-15 ]
45.  POINT => F S / F G POINTNR
46.  LEVEL => [ PRIMARY / O L D [ ADOP PRIMARY ] ]
47.  SEC => SYMBOL / 0-16677
48.  MS => [ SYMBOL / 0-99999 ]
49.  FREQ => [ FREQSYM / O L D [ ADOP FREQSYM ] ]
50.  FORM => SYMBOL / -9-9
51.  M2 => SYMBOL / 1 / 2
52.  M3 => M2 / 3
53.  M4 => M3 / 4
54.  M5 => M4 / 5
55.  FCNR => [ SYMBOL / 1-28 ]1 [ > [ SYMBOL / 1-28 ]1 ]
56.  FGNR => [ SYMBOL / 1-24 ]1 [ > [ SYMBOL / 1-24 ]1 ]
57.  ENTRY => [ A / B ]
58.  FREQSYM => 0-15999 / SYMBOL
59.  COLOUR => [ W H I T E / P I N K ]
60.  WAVE => SYMBOL / 0-7
61.  POINTNR => 3 / 6 / 9 / 1 2 / 1 5 / 1 8 / 2 1 / 2 4
62.  SYMBOL => LETTER / [ ALFANUM ]0-5
63.  ALFANUM => LETTER / DIGIT
64.  LETTER => A / B / C / D / E / F / G / H / I / J / K / L / M /
             N / O / P / Q / R / S / T / U / V / W / X / Y / Z
65.  DIGIT => 0 / 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9
66.  T-TERM => T ( MS )
67.  Z-TERM => Z
68.  STEP-TERM => [ E / G ]1 S T E P ( MS )
```

NOTE TO 7.9:
A CHAIN ENDS WITH A ; IF THE LAST CHARACTER NOT IS A).
 .EJECT
3.   EXPLANATION OF THE EMS1 LANGUAGE

3.1 DEFINITIONS

        VALUES CAN BE OF TWO TYPES: INTEGER OR FRACTIONAL. AN INTEGER IS
        A NUMBER WITHOUT DECIMALS, A FRACTIONAL A NUMBER WITH AN INTEGER
        PART, A DECIMAL POINT AND A DECIMAL FRACTION.
        AN INTEGER MAY CONTAIN ONE TO FIVE DIGITS, A REAL MAY CONTAIN
        ONE TO FIVE DIGITS BOTH BEFORE THE DECIMAL POINT AND AFTER IT.
        EX. INTEGERS: 1 440 16000 FRACTIONALS: 80.25   40.5
        FRACTIONALS ARE USED TO SPECIFY QUARTER OF DECIBELS. THEREFORE THE
        FRACTIONAL PART IS ALWAYS ROUNDED TO THE NEAREST QUARTER INTEGER.

        EX. 1.20235 WILL BE ROUNDED TO 1.25
             1.1   WILL BE ROUNDED TO 1.0
        A SYMBOL CONTAINS ONE TO SIX CHARACTERS FROM THE FOLLOWING SET:
             THE LETTERS A TROUGH Z
             THE DIGITS 0 TROUGH 9
        THE FIRST CHARACTER OF A SYMBOL MUST BE A LETTER
             EX. LEGAL SYMBOLS: DB   SUMB1   V1A
                 ILLEGAL SYMBOLS: 100DB   .AB   *SYM

3.2 PERMANENT SYMBOLS

        THE EMS1 LANGUAGE USES A SET OF RESERVED SYMBOLS WHICH HAVE A SPECIAL
        MEANING TO THE EMS1 SYSTEM. THESE SYMBOLS ARE DEFINED BY THE EMS1

PROGRAMS WHEN THE SYSTEM IS LOADED AND CAN NOT BE CHANGED OR USED FOR
OTHER PURPOSES THAN IS DESCRIBED IN THIS MANUAL.
A COMPLETE LISTING OF THE PERMANENT SYMBOLS IS FOUND IN APP. 2
THE MEANING OF THE SYMBOLS ARE DISCUSSED IN CHAPTERS 4-8.

3.3 ASSIGNMENT OF VALUES TO SYMBOLS

IT IS POSSIBLE TO ASSIGN A NUMBER TO A SYMBOL IN THE FOLLOWING WAY:
        EX. GIVE THE SYMBOL 'SYM' THE VALUE 20
            WRITE: SYM=20
            GIVE THE SYMBOL 'DB' THE VALUE 50.75
            WRITE: DB=50.75
SYMBOLS WITH ASSIGNED VALUES ARE CALLED VARIABLES. VARIABLES MAY BE
USED ANYWHERE IN THE TEXT INSTEAD OF A NUMBER.
        EX. THE FOLLOWING TWO LINES WILL PRODUCE THE SAME RESULT:
            FG(1,1000,100,1)
            NR=1;FR=1000;FG(NR,FR,100,1)
A VARIABLE MAY BE CHANGED FROM ONE VALUE TO ANOTHER ANYHERE IN THE TEXT
EXCEPTION:IF A VARIABLE IS ASSIGNED IN THE FOLLOWING WAY IT IS NOT
POSSIBLE TO CHANGE.
        EX. SYM==2
I.E. IF TWO EQUAL SIGNS ARE USED INSTEAD OF ONE A VARIABLE WILL BE
MARKED PERMANENT, AND ANY FURTHER ATTEMPT TO MODIFY IT WILL BE
NOTED AS AN ERROR.
        EX.NR=10;FR==440;FG(NR,FR,100,2) NR=11;FG(NR,FR,100,2)
        NR IS FIRST ASSIGNED TO '10' SO THE FIRST TIME 'NR' IS USED IT
        HAS THE VALUE '10' BUT THEN THE VALUE OF NR IS CHANGED TO '11'
        SO THAT THEREAFTER THE VALUE OF 'NR' IS '11' UNTIL IT IS
        CHANGED AGAIN. A STATEMENT LIKE: FR=880 WOULD HAVE NO EFFECT
        BECAUSE 'FR' CANNOT BE CHANGED IN THIS CASE.

3.4 ARITHMETIC EXPRESSIONS

IN ADDITTION TO THE POSSIBILITY TO ASSIGN A VALUE ,WHICH IS A SINGLE
NUMBER, TO A SYMBOL IT IS ALSO POSSIBLE TO ASSIGN A VALUE WHICH IS THE
THE RESULT OF AN ARITHMETIC EXPRESSION. THE VALUES MAY BE NUMBERS AND
SYMBOLS MIXED. THE ARITHMETIC OPERATORS ARE: + - * AND /.
        EX. V1=10;V2=20; V3=30;   VAL=10+V1+V2-V3
        THIS GIVES 'VAL' THE VALUE '10' IN THIS CASE.
        EX. NR=NR+1
        THIS ADDS '1' TO THE VALUE OF NR. NOTE THAT THE VALUE OF 'NR'
        IS NOT CHANGED UNTIL THE WHOLE EXPRESSION IS EVALUATED.
AN ERROR CONDITION OCCURS IF A VARIABLE TO THE RIGHT OF THE EQUAL SIGN
IS NOT DEFINED EARLIER IN THE TEXT.
THE VARIABLES TO THE RIGHT OF THE EQUAL SIGN REMAIN UNCHANGED DURING
THE EVALUATION OF AN EXPRESSION.
A SYMBOL WILL GET THE SAME VALUETYPE AS THE FIRST VALUE TO THE RIGHT
OF THE EQUAL SIGN.
        EX. SYM=10.25+5
        'SYM' WILL BE A FRACTIONAL VARIABLE
        EX. SYM1=5+10.25
         SYM1 WILL BE AN INTEGER VARIABLE.
        EX   SYM2=VAR +17-NR
        THE VARIBLE 'SYM2' WILL BE OF THE SAME TYPE AS 'VAR'

THE MAXIMUM MAGNITUDE OF AN INTEGER IS 131071 AND OF A FRACTIONAL 32767

3.5 ASSIGNMENT OF A TEXTSTRING TO A SYMBOL

A WAY TO REDUCE THE AMOUNT OF INPUT TEXT IS TO USE THE STRING
ASSIGNMENT FEATURE. AN ASSIGNMENT IS DONE IN THE FOLLOWING WAY:
            EX. SOUND="FG(1,FREQ,,2)>CHA(1,100)"
            THE TEXT WITHIN THE TWO " IS ASSIGNED TO THE SYMBOL 'SOUND'
            WHENEVER THE SYMBOL 'SOUND' IS FOUND IN THE INPUT TEXT
            THE ASSIGNED TEXT IS COPIED AND COMPILED.
THE ASSIGNED TEXT MAY CONSIST OF MORE THAN ONE LINE.
A SYMBOL TO WHICH A TEXT STRING IS ASSIGNED IS CALLED A 'MACRO'
THE MACRO IS DISCUSSED IN DETAIL IN CHAPTER 8.

3.6 COMMENTS

COMMENTS MAY APPEAR ANYWHERE IN THE TEXT ENCLOSED IN QUOTES (').
THE ONLY THING THAT IS DONE ABOUT COMMENTS IS THAT THEY ARE TRANSFERRE
TO THE OUTPUT TEXT BUT THE COMPILATION IS NOT AFFECTED.
EXCEPTION: A COMMENT STARTING IN POSITION 1 OF A LINE WILL BE
TOTALLY IGNORED.
            EX. 'THIS IS A COMMENT'

3.7 DELIMITERS.

DELIMITERS ARE SPECIAL CHARACTERS USED TO SEPARATE VARIABLES ,NUMBERS
AND OTHER SYMBOLS IN THE TEXT. THEY ARE LISTED IN APP. 3
BLANKS AND TABS MAY BE INSERTED ANYWHERE TO INCREASE
READABILITY BUT THEY ARE TREATED LIKE COMMENTS.
THE FUNCTION OF THE OTHER DELIMITERS ARE DISCUSSED IN THE FOLLOWING
CHAPTERS.

3.8 ELEMENTS AND TERMS

AN ELEMENT IS A NUMBER OR SYMBOL (NOT COMMENT OR BLANKS OR TABS)
BETWEEN TWO DELIMITERS.
AN ELEMENT MAY BE AN EMPTY ELEMENT IF THERE IS NO NUMBER OR SYMBOL
BETWEEN TWO DELIMITERS.
            EX.FG(NR,'ALREADY SET',100,5)
            FIRST ELEMENT: FG, SECOND ELEMENT: NR, THIRD ELEMENT : EMPTY
A PERMANENT SYMBOL WITH ITS PARAMETERS IS CALLED A TERM.
            EX. FG(1,440,50,3)   RM(1,A,100)   CHA(1,100) FG(1)
A TERM MUST BE WRITTEN ON ONE LINE ONLY.

3.9 OUTPUT TEXT

THE OUTPUT TEXT CONSISTS OF THE INPUT TEXT,ERROR CORRECTIONS (SEE 3.5),
AND MACRO EXPANSIONS (SEE CHAPTER 8) AND LINE NUMBERING.
THE LINE NUMBER FORMAT IS THE FOLLOWING:
            POS   CONTENTS
            1   '
            2-6   LINE NUMBER
            7   '
            8   BLANK

            EX. INPUT TEXT: FG(NR,F440,DB,WAVEF)>
                OUTPUT TEXT: '00005' FG(NR,F440,DB,WAVEF)>

3.10 ERROR CORRECTION

IF EMS1 IS RUN IN INTERACTIVE MODE ERRORS CAN BE CORRECTED
IN THE FOLLOWING WAY:
EX. INPUT TEXT: N=18; FG(N,FR,100,1)>RM(1,A,100)

WHERE THE SYMBOL 'FR' IS NOT DEFINED.
ERROR PRINTOUT: FG(N,FR   )
                    04 001 SYMBOL NOT DEFINED
THE START OF THE FIRST LINE 'FG' DENOTES FROM WHERE THE CORRECTION
SHOULD BE TYPED IN, AND THE END 'FR' WHERE THE ERROR WAS
DISCOVERED. FINALLY ')' DENOTES THAT AFTER THE CORRECTION HAS BEEN
ACCEPTED, TRANSLATION IS RESUMED AFTER THE RIGHT PARANTHESIS
WITH '>RM(1,A,100)'.
AFTER THE ERROR MESSAGE A ! IS PRINTED OUT TO TELL THE USER THAT
HE IS IN CORRECTION MODE. USER MAY NOW INSERT CHANGES INSTEAD OF THE
THE ERRONEOUS TERM.
THE USER WRITES: FR=880;FG(N,FR,100,1)
THE ANSWER FROM EMS1 IS ANOTHER ! .IT IS NOW POSSIBLE TO INSERT
MORE CORRECTIONS OR ADDITIONS TO THE INPUT TEXT. TO RETURN
FROM CORRECTION MODE MAKE A CARRIAGE RETURN ALONE. THE INPUT WILL NOW
CONTINUE FROM THE CHARACTER AFTER THE ERRONEOUS TERM. IN THIS
CASE: >RM(1,A,100)
THE THE RESULTING OUTPUT TEXT FROM THIS CORRECTION:
            '00001' N=18
            '00002' FR=880;FG(N,FR,100,1)
            '00003' >RM(1,A,100)
        .EJECT

4. DESCRIPTION OF LT AND DEVICE TERMS

LT   LOCAL TIME

LT TERM IS OF FORM

LT(SEC,MS)

SEC   TIME IN SECONDS FOR LOCAL TIME.
MS   TIME IN MILLISECOND FOR LOCAL TIME

IF ONLY ONE PARAMETER IS GIVEN MILLISECONDS IS ASSUMED.

EXAMPLES

LT(1,1000)   'LOCAL TIME 1 SEC. 1000 MS= 2 SEC.'
LT(2,)   'LOCAL TIME 2 SEC.'
LT(500)   'LOCAL TIME 500 MS'

FG   FREQUENCY GENERATORS

FG-TERM IS OF FORM

FG(NR,FREQ,INTENS,WAVEF) WHERE
NR   FREQUENCY GENERATOR NUMBER (1-24)
FREQ   FREQUENCY (1-15999)
INTENS   AMPLITUDE IN DB (0-120)
WAVEF   WAVEFORM (0-7)

MORE THAN ONE 'FG' MAY BE GIVEN VALUES IN THE SAME
FG TERM. WRITE:

FG(NR1>NR2,FREQ,INTENS,WAVEF) WHERE

NR1,NR2 FREQUENCY GEN. NR (1-24)
NR1 .LE. NR2
ALL PARAMETERS EXCEPT SOUND GENERATOR NUMBER MAY BE

OMITTED IF THE SOUND GENERATOR NR HAS BEEN USED
EARLIER IN THE PIECE.
AN OMITTED PARAMETER WILL GET THE VALUE USED AT THE
LATEST CALL FOR THAT GENERATOR

       EXAMPLE

       FG(1,440,80,2)
       FG(2,550,80,3)
       FG(1,,90,2)   HERE SOUND GENERATOR ONE WILL
                    STILL HAVE FREQUENCY 440 HERTZ

NR, FREQ AND WAVEF MUST BE INTEGERS WHILE INTENS
COULD BE INTEGER OR FRACTIONAL

       EXAMPLE

       FG(1,440,80,2)
       FG(2,550,80.5,3)

THE NUMBER OF DECIMALS IN INTENS MAY NOT EXCEED 5.
THE FRACTIONAL PART WILL BE CONVERTED TO THE
NEAREST QUARTER DECIBEL VALUE

       NOTE

ALL SOUND GENERATORS' INTENSITY WILL BE SET TO ZERO
EVERY TIME A 'NEXT' COMMAND IS ISSUED.
THIS COULD BE OVERRIDED BY USING THE 'DITTO' TERM

NG   NOISE GENERATOR

NG-TERM IS OF FORM

NG(NR,INTENS,COL1,COL2) WHERE

NR   NUMBER OF NOISE GENERATOR (ONLY 1 IS POSSIBLE AT PRESENT)
INTENS   AMPLITUDE IN DB (0-120)
COL1,COL2   NOISE COLOUR (WHITE OR PINK)

BOTH PARAMETERS MAY BE OMITTED IF THE NG-TERM IS USED
EARLIER IN THE PIECE
IF THE COLOUR IS OMITTED THE NOISE COLOUR WILL REMAIN
THE SAME AS BEFORE AND IF THE INTENSITY IS OMITTED
ONLY THE NOISE COLOUR WILL BE AFFECTED
IF BOTH PARAMETERS ARE OMITTED THE TERM WILL CAUSE
NO OPERATION IF IT IS NOT PRECEEDED OR SUCCEDED
BY '>' OR '#'

COL1,COL2 MUST TAKE VALUE WHITE OR PINK
INTENS MAY BE INTEGER OR REAL

       EXAMPLE

NG(1,100,WHITE,PINK)
NG(1,,PINK)

THE NUMBER OF DECIMALS IN THE INTENSITY MAY NOT EXCEED 5.

THE FRACTIONAL PART WILL BE CONVERTED TO THE NEAREST
QUARTER DECIBEL VALUE

            NOTE
IF THE NOISE GENERATOR SHOULD BE SET TO BOTH WHITE
AND PINK NOISE THIS MUST BE DONE WITH THE EX-TERM
THE USE OF NG-TERM WITH COLOUR WHITE WILL ALWAYS
CLEAR THE COLOUR PINK AND VICE VERSA

FF   FILTER UNITS

FF-TERM IS OF FORM

FF(FNR,FCH,INTENS) WHERE
FNR   FILTER NUMBER (1-2)
FCH   FILTER CHANNEL (1-28)
INTENS   AMPLITUDE IN DB (0-120)

MORE THAN ONE FILTER CHANNEL MAY BE GIVEN VALUES IN THE SAME
'FF' TERM. WRITE:

FF(FNR,FCH1>FCH2,INTENS)   WHERE

FCH1,FCH2   FILTER CHANNEL NR (1-28)
FCH1 .LE. FCH2

ALL PARAMETERS MAY BE OMITTED IF THE FILTER TERM
HAS BEEN USED EARLIER IN THE PIECE
IF THE FILTER NUMBER IS OMITTED FNR WILL TAKE
THE SAME VALUE AS IN THE LAST FF-TERM
IF THE CHANNEL NUMBER IS OMITTED FCH WILL TAKE
THE SAME VALUE AS IN THE LAST FF-TERM (REGARDLESS OF
FILTER NUMBER)
IF THE INTENSITY IN OMITTED THE TERM WILL CAUSE
NO OPERATION ON THE FILTER BUT COULD CAUSE A CONNECTION
OR DISCONNECTION IF IT IS PRECEEDED OR SUCCEEDED
BY '>' OR '#'

FNR AND FCH MUST BE INTEGERS WHILE INTENS
COULD BE INTEGER OR REAL

        EXAMPLE

        FF(1,13,80)
        FF(1,14,80.5)

THE NUMBER OF DECIMALS IN INTENS MAY NOT EXCEED 5.
THE FRACTIONAL PART WILL BE CONVERTED TO THE
NEAREST QUARTER DECIBEL VALUE

REV   REVERBERATION UNITS

REV-TERM IS OF FORM

REV(RU,RTIM,INTENS) WHERE
RU   REVERBERATION UNIT (1-2)
RTIM   REVERBERATION TIME (1-15) APPROX. RTIM*0.35 SEC.
INTENS   AMPLITUDE IN DB (0-120)

ALL PARAMETERS MAY BE OMITTED IF THE REVERBERATION TERM
HAS BEEN USED EARLIER IN THE PIECE
IF THE REVERBERATION UNIT IS OMITTED RU WILL TAKE
THE SAME VALUE AS IN THE LAST REV-TERM
IF THE REVERBERATION TIME IS OMITTED RTIM WILL TAKE
THE SAME VALUE AS IN THE LAST REV-TERM (REGARDLESS OF
REVERBERATION UNIT)
IF THE INTENSITY IS OMITTED THE TERM WILL CAUSE NO
OPERATION ON THE REVERBERATION UNIT BUT COULD CAUSE A
CONNECTION OR DISCONNECTION IF THE TERM IS PRECEDED
OR SUCCEEDED BY '>' OR '#'

RU AND RTIM MUST BE INTEGERS WHILE INTENS COULD BE
INTEGER OR REAL

        EXAMPLE

        REV(1,10,80)
        REV(2,,70.5)

RM   RING MODULATORS

RM-TERM IS OF FORM

RM(NR,ENTRY,INTENS) WHERE
NR   RING MODULATOR UNIT NUMBER (1-3)
ENTRY   ENTRY (A OR B)
INTENS   AMPLITUDE IN DB (0-120)

ALL PARAMETERS MAY BE OMITTED IF THE RINGMODULATOR TERM
HAS BEEN USED EARLIER IN THE PIECE
IF THE RING MODULATOR NUMBER IS OMITTED NR WILL
TAKE THE SAME VALUE AS IN THE LAST RM-TERM
IF THE RING MODULATOR ENTRY IS OMITTED ENTRY WILL
TAKE THE SAME VALUE AS IN THE LAST RM-TERM
(REGARDLESS OF RINGMODULATOR UNIT)
IF THE INTENSITY IS OMITTED THE TERM WILL CAUSE NO
OPERATION ON THE RINGMODULATOR UNIT IN QUESTION
BUT COULD CAUSE A CONNECTION OR DISCONNECTION IF IT IS
PRECEDED OR SUCCEEDED BY '>' OR '#'

NR MUST BE INTEGER
ENTRY MUST TAKE VALUE 'A' OR 'B'
INTENS MAY BE INTEGER OR REAL

        EXAMPLE

        RM(1,A,80)
        RM(2,B,75.750)

THE NUMBER OF DECIMALS IN THE INTENSITY MAY NOT EXCEED 5
THE FRACTIONAL PART WILL BE CONVERTED TO THE NEAREST
QUARTER OF DECIBEL

AM   AMPLITUDE MODULATORS

AM-TERM IS OF FORM

AM(NR,ENTRY,INTENS) WHERE

```
NR        AMPLITUDE MODULATOR NUMBER (1-2)
ENTRY     ENTRY (A OR B)
INTENS    AMPLITUDE IN DB (0-120)
```

ALL PARAMETERS MAY BE OMITTED IF THE AMPLITUDE MODULATOR TERM
HAS BEEN USED EARLIER IN THE PIECE
IF THE AMPLITUDE MODULATOR NUMBER IS OMITTED NR WILL
TAKE THE SAME VALUE AS IN THE LAST AM-TERM
IF THE AMPLITUDE MODULATOR ENTRY IS OMITTED ENTRY
WILL TAKE THE SAME VALUE AS IN THE LAST AM-TERM
(REGARDLESS OF AMPLITUDE MODULATOR NUMBER)
IF THE INTENSITY IS OMITTED THE TERM WILL CAUSE NO
OPERATION ON THE RINGMODULATOR IN QUESTION
BUT COULD CAUSE A CONNECTION OR DISCONNECTION IF THE
TERM IS PRECEDED OR SUCCEEDED BY '>' OR '#'

NR MUST BE INTEGER
ENTRY MUST TAKE VALUE 'A' OR 'B'
INTENS MAY BE INTEGER OR REAL

        EXAMPLE

        AM(1,A,80)
        AM(2,B,70.25)

THE NUMBER OF DECIMALS IN THE INTENSITY MAY NOT EXCEED 5
THE FRACTIONAL PART OF THE INTENSITY WILL BE CONVERTED
TO THE NEAREST QUARTER DECIBEL.

AMP   AMPLIFIERS

AMP TERM IS OF FORM

AMP(NR,INTENS) WHERE
NR   AMPLIFIER NUMBER (1 OR 2)
INTENS   AMPLITUDE IN DB (0-120)

EXAMPLE

AMP(1,100)
AMP(2,80.5)

CD   CHANNEL DISTRIBUTORS

CD TERM IS OF FORM

CD(NR,CHNR,INTENS) WHERE
NR   'CD' NUMBER (AT PRESENT ONLY 1 IS POSSIBLE)
CHNR   CHANNEL NR (1-4)
INTENS   AMPLITUDE IN DB (0-120)

EXAMPLE

CD(1,3,100)

OLD   THE 'OLD' SYMBOL

OLD, OLD+VALUE, OLD-VALUE MAY BE USED INSTEAD OF NORMAL
FREQUENCY OR AMPLITUDE VALUES. THE VALUE OF 'OLD' IS SET

BY THE CODEGENERATING PROGRAM TO THE LAST VALUE OF THE REFERRED
PARAMETER.

EXAMPLE

```
LT(10)FG(1,OLD-10,OLD+10)
LT(5)  FG(1,900,80,5)
```

IN THIS CASE THE OLD VALUE WILL BE 900 FOR THE
FREQUENCY AND 80 FOR THE AMPLITUDE AT LOCAL TIME 10 SEC.

CONNECT   CONNECTIONS AND DISCONNECTIONS

TO MAKE A (DIS-)CONNECTION BETWEEN TO DEVICES IN THE STUDIO
WRITE THE DELIMITER > (#) BETWEEN THE CORRESPONDING DEVICE TERMS.

EXAMPLE

```
FG(1,200)>CHA(1,100)
FG3#CHA(2)
```

THERE ARE SOME SPECIAL SYMBOLS FOR CONNECTION POINTS
FG3,FG6 ETC (SEE APP. 1). THESE MAY BE USED INSTEAD OF DEVICE TERMS
TO MAKE CONNECTIONS

EXAMPLE

```
FG3>FG6>FG9>FG12
FG(20)>FS
```

DEVICE CHAINS

A DEVICE CHAIN CONTAINS DEVICE TERMS WITH THE DELIMITER & BETWEEN
EACH TERM.

EXAMPLES

```
FG(1)&FG(7>10)&FF(1,1>7,100)
CHA(1)&CHA(2,100)&CHA(4,80)
```

A DEVICE CHAIN MAY BE CONNECTED TO ANOTHER DEVICE CHAIN OR TERM.

EXAMPLE

```
FG(1,1000,100,1)&FG(4,800,80,2)&FG(10)>CHA(1,100)&CHA(2,100)
THIS IS EQUIVALENT TO WRITING:
FG(1,1000,100,1)>CHA(1,100)
FG(1)>CHA(2)
FG(4,800,80,2)>CHA(1)
FG(4)>CHA(2,100)
```

.EJECT
5. DESCRIPTION OF ENVELOPE AND GLISSANDI TERMS.

ENV   ENVELOPE DESCRIPTION

ENV-TERM IS OF FORM
ENV(AMP1,AMP2,T,TYPE,STEP)   WHERE

AMP1   START INTENSITY IN DB   (0-120)

```
AMP2     END INTENSITY IN DB        (0-128)
T        TIME IN MILLISECONDS
TYPE     ENVELOPETYPE               (-9 - 9)
STEP     STEP IN MILLISECONDS
IF 'STEP' IS OMITTED THE ENV STEP WILL BE THAT IN PREVIOUS
'ESTEP' TERM. (SEE BELOW)
```

THE INTENSITY OF THE ASSOCIATED AMPLIFIER WILL
BE VARIED FROM AMP1 DB TO AMP2 DB IN T MILLISECONDS.
THE WAY THE INTENSITY IS VARIED IS CONTROLLED BY TYPE
WHICH SPECIFIES ONE OUT OF 19 POSSIBLE WAYS.

```
TYPE=0 LINEAR VARIATION
-9 < TYPE < 0    CONCAVE VARIATION
 0 < TYPE < 9    CONVEX VARIATION
THE EXACT SHAPE OF THE VARIATION IS FOUND IN APPENDIX 5.
```

EXAMPLES

```
ENV(50,100,500,5,10)
ENV(80,100,100,1)
```

D   TIME OF DURATION

THE D TERM IS OF FORM

D(TIME) WHERE

TIME   TIME IN MILLISECONDS

D(TIME) IS EQUIVALENT TO: ENV(OLD,OLD,TIME)>Z

Z   Z TERM
IS OF FORM

Z

Z IS EQUIVALENT TO: ENV(OLD,0,10,0,10)

ESTEP   STEP OF VARIATION
ESTEP-TERM IS OF FORM

ESTEP(T)

T   TIME IN MILLISECONDS.
IF ESTEP NOT SPECIFIED BY USER,ESTEP WILL BE SET TO 1.
THE FUNCTION OF ESTEP IS BEST EXPLAINED BY EXAMPLES

EXAMPLES

```
ESTEP(2)
ESTEP(35)
```

ENVELOPE ON SOUNDGENERATOR 1 WITH START INTENSITY 90 DB,
END INTENSITY 100 DB,TIME 20 MILLISECONDS AND
TYPE 0 (LINEAR ENVELOPE).
A)   ESTEP=1 (IF NOT SPECIFIED WILL BE ESTEP=1)

THE INTENSITY OF SOUNDGENERATOR 1 WILL BE CHANGED
IN STEPS OF 1/2 DB,EACH STEP WILL REMAIN UNCHANGED
FOR 1 (ESTEP) MILLISECOND AND THERE WILL BE 20
STEPS GENERATED.

B)   ESTEP=2
THE INTENSITY OF SOUNDGENERATOR 1 WILL BE CHANGED
IN STEPS OF 1 DB, EACH STEP WILL REMAIN UNCHANGED
FOR 2 (ESTEP) MILLISECONDS AND THERE WILL BE 10
STEPS GENERATED.

THE VALUE OF ESTEP ALSO AFFECTS ALL OTHER TIMES IN THE
ENVELOPE SPECIFICATION IN THAT THE TIMES MUST ALL
BE EQUAL TO OR GREATER THAN ESTEP AND THAT THE NUMBER OF
INTENSITY CHANGES GENERATED BY AN ENV-TERM ,T/ESTEP,
IS CALCULATED IN INTEGER ARITHMETIC.
THE NUMBER OF INTENSITY CHANGES GENERATED BY ONE ENV-TERM
(T/ESTEP) MUST BE GREATER THAN 0.
THE ESTEP-TERM MAY BE WRITTEN AT ANY PLACE IN THE
ENVELOPE-SPECIFICATION ,IF OMITTED ESTEP IS SET TO 1.

ENVELOPE-CHAIN

AN ENVELOPE CHAIN CONSISTS OF ENV,T AND Z TERMS OPTIONALLY
SEPARATED BY THE DELIMITER >. THE CHAIN IS TERMINATED
BY A NONE ENVELOPE TERM OR A ;

EXAMPLES

ENV(50,100,100,1)>ENV(100,80,100)>T(1000)
ENV(100,80,10,1,1)>ENV(80,100,1000,2,10)>Z

AN ENVELOPE CHAIN CAN BE CONNECTED TO A SINGLE DEVICE
OR A GROUP OF DEVICES BY CONNECTING THE ENV-CHAIN TO
A DEVICE TERM RESP. A DEVICE CHAIN.

EXAMPLE

FG(1,440)>ENV(50,100,10000)>ENV(100,30,100)
FG(1>3)&FG(7)>ENV(50,100,1000,1)>Z

IT IS POSSIBLE TO CONNECT A TERM OR DEVICE CHAIN TO BOTH
AN ENV- CHAIN AND ANOTHER DEVICE CHAIN.

EXAMPLE

FG(1)&FG(4)>ENV(30,80,1000)>ENV(80,90,1000)>CHA(1,100)&CHA(2,100)

NOTE THAT THE DELIMITER > HAS THE MEANING: "CONNECT THE DEVICE
(OR DEVICE CHAIN)" IF IT IS WRITTEN BEFORE A DEVICE TERM.
THE > BEFORE THE ENV TERMS MAY BE OMITTED.

GLIS   GLISSANDO DESCRIPTION

THE GLIS TERM IS OF FORM

GLIS(FREQ1,FREQ2,TIME,TYPE,STEP)   WHERE

FREQ1   START FREQUENCY IN HZ (1-15999)
FREQ2   END FREQUENCY IN HZ (1-15999)
TIME   TIME OF DURATION IN MS.

```
TYPE    GLISSANDO TYPE    (-9 TO +9)
STEP    GLISSANDO STEP
(SEE DESCRIPTION OF STEP IN ENV TERM)
```

GSTEP   STEP OF VARIATION IN GLIS TERMS

GSTEP TERM IS OF FORM

GSTEP(T)   WHERE

```
T       TIME OF STEP IN MS.
(SEE DESCRIPTION OF ESTEP)
```

GLISSANDO CHAIN

THE GLISSANDO CHAIN IS CONSTRUCTED IN THE SAME WAY AS THE ENVELOPE CHAIN.

EXAMPLE

GLIS(8Ø,8ØØ,IØØØ,I,IØ)>GLIS(8ØØ,IØØØ,IØØ,2)>GLIS(IØØØ,8ØØ,IØØ)

ENV AND GLIS TERMS CAN BE MIXED IN THE SAME CHAIN SO THAT A ENV AND GLIS CHAIN CAN SIMULTANEOUSLY BE CONNECTED TO ONE OR MORE DEVICES.

EXAMPLE

```
FG(I>3)&FG(7>9,,.2)>GLIS(22Ø,44Ø,2ØØ,2)ENV(5Ø,IØØ,5ØØ)
GLIS(44Ø,88Ø,IØØØ)ENV(IØØ,9Ø,I2ØØ,I,IØ)
```

```
FG(I2)&CHA(I)>ENV(5Ø,IØØ,IØØØ)>GLIS(IØØ,IØØØ,IØØØ)
```
IN THE LAST EXAMPLE THE GLIS TERM WILL HAVE NO EFFECT ON THE CHA TERM.

FG(I>24)>RM(I,A,IØØ);

IN THIS CASE ONLY CERTAIN FG:S CAN BE CONNECTED TO RM(I,A). THE ERROR PRINTOUT WILL BE "ILLEGAL (DIS-)CONNECTION", BUT THE LEGAL CONNECTIONS ARE MADE BY THE PROGRAM.

```
FG(I)&FG(4,44Ø)>FF(I)&CHA(2)
FG(7,22Ø,IØØ,I)>CHA(4,IØØ)
```

THE ERROR IN THE FIRST LINE WILL NOT BE DETECTED BY THE PROGRAM UNTIL THE FIRST SYMBOL ON THE SECOND LINE IS READ. THE SYMBOL IS NOT A & AND HENCE DEVICE CHAIN NO 2 ON THE FIRST LINE IS ENDED AND THE PROGRAM STARTS TO CONNECT THE TWO DEVICE CHAINS. ERRORS ARE DETECTED AND AS USUAL A SCAN IS MADE WHICH IN THIS CASE STOPS AT THE). ERROR PRINTOUT:

```
FG(          )
Ø2    Ø5I    ILLEGAL (DIS-)CONNECTION
```

IT WOULD HAVE BEEN BETTER TO END THE FIRST LINE WITH A; WHICH SIGNALS END OF DEVICE CHAIN AND THE ERROR PRINTOUT WOULD HAVE COME AFTER THE FIRST LINE.

.EJECT

EMS1B MAN
6.   EMS1 COMMANDS

CONTENTS:

6.1 ABBREVIATIONS

TEMP = FILE FOR STORING THE SORT-RECORDS OF THE TEMPORARILY STUDIED
       SOUND OBJECT

TEXT = FILE FOR STORING THE TEXT OF DITTO

ACC = FILE FOR STORING THE SORT-RECORDS OF THE CURRENT BLOCK
       (ACCUMULATED SOUND OBJECTS)

TACC = OUTPUT MEDIUM FOR STORING THE TEXT OF DITTO

AUX = AUXILIARY FILE FOR STORING A TEMPORARY MERGE OF TEMP AND ACC

MT   = DIGITAL MAGNETIC TAPE

6.2 BASIC SORT RECORD FILE OPERATIONS

OPERATION   DESCRIPTION
(NOT COMMAND)

CLEAR   THE FILE IS CLEARED, I. E. THE FILE POINTER IS RESET
                   TO THE BEGINNING OF THE FILE AND THE OLD POINTER IS
                   SAVED FOR USE IN KEEP

KEEP   THE FILE POINTER IS RESTORED TO THE VALUE IT HAD
                   BEFORE THE LAST CLEAR OPERATION ON THAT FILE

SORT   THE RECORDS IN THE FILE ARE SORTED ACCORDING TO TIME
                   AND RECORD TYPE

MERGE   TWO SORTED FILES ARE MERGED INTO ONE FILE

RECORD   THE SORT-RECORDS ARE TRANSLATED TO EMS1-RECORDS AND
                   RECORDED ON MT STARTING FROM THE CURRENT MT BLOCK
                   POINTER (*)

PLAY   AT LEAST ONE MT BLOCK IS PLAYED IN THE STUDIO (*)

                   (*) THE MT BLOCK POINTER IS LEFT IN THE NEW POSITION

6.3 SORT RECORD FILE COMMANDS

GLOBAL TIME IS COUNTED FROM THE START OF THE FIRST BLOCK.
BLOCK TIME IS COUNTED FROM THE START OF THE CURRENT BLOCK.
LOCAL TIME IS COUNTED FROM THE START OF THE CURRENT OBJECT (IN TEMP).

THE FORMAT FOR ALL THE TIME ENTRIES IS   <SEC> [,<MS>].

THE LAST ENVELOPE (OR GLISSANDO) IN THE SORTED TEMP AND ACC STOPS
AT THE BLOCK TIMES <END> AND THE GLOBAL TIME <BLOCKEND> RESPECTIVELY.

<TERM-REST> IS AN ESTIMATE OF THE NUMBER OF TERMS THAT MAY BE
ADDED TO THE CURRENT BLOCK.

COMMAND	OPERATIONS
CLEAR	1. TEMP IS CLEARED 2. TEXT IS CLEARED
CLEAR (MIX)	1. ACC IS CLEARED 2. TACC IS ERASED (ONLY IF FILE,SEE BELOW)
CLEAR (ALL) = CLEAR & CLEAR (MIX)	
KEEP	1. TEMP IS KEPT 2. TEXT IS KEPT
KEEP (MIX)	ACC IS KEPT
KEEP (ALL) = KEEP & KEEP (MIX)	
MIX [(<START>)]	1. TEMP IS SORTED 2. TEMP AND ACC ARE MERGED INTO ACC (VIA AUX) ALL ENTRIES FROM TEMP ARE SORTED ACCORDING TO THE BLOCK TIME <START>+<LOCAL TIME>. IF <START> IS NOT GIVEN, <START>=0 IS ASSUMED. 3. TEMP IS CLEARED 4. TEXT IS ACCUMULATED TO TACC 5. TEXT IS CLEARED
OP	APPEND OBJECT. EQUIVALENT TO MIX (<END OF PRECEDING OBJECT>)
END	1. ACC IS RECORDED AS A BLOCK STARTING FROM THE END OF THE PRECEDING BLOCK (<BLOCKEND>). 2. ACC AND TEMP ARE CLEARED 3. TEXT IS CLEARED 4. IF TACC IS A FILE: THE FILE <LABEL> SRC IS CLOSED. WARNING IF 56 BLOCKS ARE WRITTEN.
PLAY	1. TEMP IS SORTED 2. TEMP IS RECORDED 3. TEMP IS PLAYED
PLAY (MIX)	1. ACC IS RECORDED 2. ACC IS PLAYED

```
PLAY ( <LABEL1> [ ,<LABEL2> ] )
                              1.  THE BLOCK <LABEL1> IS PLAYED.
                          [ 2.  THE BLOCKS TO AND INCLUSIVE THE BLOCK
                                <LABEL2> ARE PLAYED.                    ]

PLAY ( ALL )                      ALL THE RECORDED BLOCKS ARE PLAYED
                                  INCLUSIVE THE CURRENT BLOCK

TRY [ ( <START> ) ]           1.  TEMP IS SORTED
                              2.  TEMP AND ACC ARE MERGED INTO AUX
                                  ALL ENTRIES FROM TEMP ARE SORTED ACCORDING
                                  TO THE BLOCK TIME <START>+<LOCAL TIME>.
                                  IF <START> IS NOT GIVEN, <START>=0 IS ASSUMED.
                              3.  AUX IS RECORDED
                              4.  AUX IS PLAYED

TRAPP                             TRY TO APPEND AN OBJECT.EQUIVALENT TO
                                  TRY ( <END OF PRECEDING OBJECT> ).
```

WHEN THE COMMANDS MIX,APP,TRAPP OR TRY ARE GIVEN, THE MESSAGE

'<OBJECT NUMBER>,<START>,<END>,<TERM-REST>'

IS TRANSMITTED TO UNITS 3 AND 4, WHERE <OBJECT NUMBER> IS
THE OBJECT NUMBER WITHIN THE BLOCK IN ORDER OF APPEARANCE AND
<START> AND <END> ARE BLOCK TIMES.

WHEN THE COMMANDS END OR PLAY (MIX) ARE GIVEN, THE MESSAGE

'<LABEL>,<BLOCKSTART>,<BLOCKEND>,<TERM-REST>'

IS TRANSMITTED TO UNITS 3 AND 4, WHERE <BLOCKSTART> AND <BLOCKEND>
ARE GLOBAL TIMES.

6.4 TEXT RECORD FILE COMMANDS

THE METASYMBOL <STRING> DENOTES A STRING VARIABLE. N DENOTES
AN INTEGER. IF <EXT> IS NOT GIVEN BELOW, THE EXTENSION
'SRC' IS ASSUMED.

```
COMMAND                           OPERATIONS

TOP ( <FNAME> [ ,<EXT> ] )        SET LINE POINTER IN FILE <FNAME> <EXT>
                                  TO THE FIRST LINE OF THE FILE. USE IN
                                  AND SKIP TERMS TO GET LINES FROM THE FILE.

IN [ ( N ) ]                      READ N LINES FROM THE FILE WHOSE NAME
                                  WAS GIVEN IN THE PREVIOUS TOP TERM. THE
                                  LINE POINTER IS MOVED N LINES FORWARD IN
                                  THE FILE. IF N IS NOT GIVEN, N=1 IS ASSUMED

SKIP [ ( N ) ]                    MOVE THE LINE POINTER N LINES FORWARD IN THE
                                  FILE WHOSE NAME WAS GIVEN IN THE PREVIOUS
                                  TOP TERM. IF N IS NOT GIVEN, N=1 IS ASSUMED

LOOK [ ( N ) ]                    READ N LINES FROM THE FILE WHOSE NAME WAS
```

GIVEN IN THE PREVIOUS TOP TERM AND DISPLAY
THEM ON UNIT 4 WITH LINE NUMBERS. THE LINE
POINTER IS NOT MOVED. IF N IS NOT GIVEN,
N=1 IS ASSUMED.

CALL (<FNAME> [,<EXT>])   ADD THE CONTENTS OF THE FILE <FNAME> <EXT>
                               TO THE CURRENT EMS1-TEXT IN TEXT
                               (EQUIVALENT TO 'TOP(<FNAME>)IN(100000)')

SAVE (<FNAME> [,<EXT>])   SAVE THE CURRENT TEXT IN A NEW FILE <FNAME> <EXT>.

REPL (<FNAME> [,<EXT>])   REPLACE THE CONTENTS OF THE OLD FILE
                               <FNAME> <EXT> WITH THE CURRENT TEXT.

ERASE (<FNAME> [,<EXT>])   ERASE THE FILE <FNAME> <EXT>.

6.5 OTHER COMMANDS

COMMAND   OPERATIONS

PUT (<LABEL>)   STORE THE BLOCK NAME <LABEL> ON MT FOR LATER
                               USE WITH THE PLAY COMMAND.
                               IF TACC IS A FILE: OPEN <LABEL> SRC.

DELETE (<S1>,<S2>,..,<SN>)   DELETE SYMBOLS <S1>,<S2>,...,<SN>. THE
                               SYMBOLS MAY BE VARIABLES OR MACROS.

EXIT   EXIT AND RESTART THE PROGRAM

LIST   LIST EXPANDED MACROS

MESS (<TEXT>)   <TEXT> WILL BE WRITTEN ON UNIT 4.
                               EMS1 SWITCHES TO ERROR MODE

MEX   EXIT OUT OF MACRO TO LEVEL 0.

NLIST   NO LISTING OF MACRO EXPANSIONS

STOTIM (<TIME CONSTANT>)   THE TIME SCALE IS CHANGED TO 1000/<TIME
                               CONSTANT> OF THE MUSIC TIME SCALE.

WRITE (<S1>,<S2>,..,<SN>)   <S1>,<S2>,..,<SN> ARE DEFINED OR UNDEFINED
                               SYMBOLS. THE VALUES OF THESE SYMBOLS WILL
                               BE WRITTEN ON UNITS 3 AND 4. EXAMPLES OF
                               PRINTOUTS(<S1>='MIN',<S2>='LIMIT',
                               <S3>='M7'):

                               'MIN   =   15 TYPE: 01'
                               'LIMIT   NOT DEFINED '
                               'M7   *MACRO* '

6.6 TEMPORARY COMMANDS

THE TEMPORARY COMMANDS

      CALL,IN,LOOK,PLAY,SAVE,SKIP,TOP,TRY,TRAPP

ARE EXECUTED BUT NEVER STORED IN THE TEMPORARY TEXT FILE 'TEXT' AND
IN THE ACCUMULATED TEXT MEDIUM 'TACC' .

CALL,ERASE,IN,LOOK,REPL,SAVE,SKIP AND TOP ARE IGNORED WHEN READ FROM
A SECONDARY INPUT FILE.

        .EJECT

7. PSEUDOOPERATIONS

        PSEUDOOPERATIONS ARE SYMBOLS WHICH CONTROL THE COMPILATION OF
        THE INPUT TEXT.
        A CONDITIONAL EXPRESSION IS WRITTEN :

        -CONDITIONAL SYMBOL-(-SYMBOL TO BE TESTED-) - TEXT - <
        THE TEXT MAY CONTINUE ON MORE THAN ONE LINE. THE < IS ENDMARK OF
        THE CONDITIONAL. IF THE CONDITION IS NOT SATISFIED THE TEXT AFTER
        THE CONDITIONAL IS TREATED LIKE A COMMENT UNTIL THE ENDMARK.
        THE CONDITIONALS IMPLEMENTED IN THE SYSTEM ARE:

        CONDITIONAL SYMBOL   CONDITION TO BE TESTED

            IFUND   IF UNDEFINED
            IFDEF   IF DEFINED
            IFPOS   IF POSITIVE (.GT.0)
            IFZER   IF ZERO   (.EQ.0)
            IFNEG   IF NEGATIVE (.LT.0)

        EX. INPUT TEXT: IFUND(NR)NR=0;< NR=NR+1
        THIS MEANS THAT IF THE SYMBOL 'NR' IS UNDEFINED 'NR' WILL BE
        ASSIGNED THE VALUE 0 AND AFTER THAT 1 IS ADDED TO 'NR'.
        IF 'NR' IS DEFINED BEFORE THE TEXT: NR=0; WILL NOT BE COMPILED
        I.E. 'NR' WILL KEEP ITS PREVIOUS VALUE. AFTER THAT 1 IS ADDED
        TO 'NR'.

 .1 NESTED CONDITIONALS

        THE TEXT CORRESPONDING TO A CONDITIONAL MAY CONTAIN CONDITIONALS.
        THE INNER CONDITIONALS WILL HAVE THE SAME ENDMARK AS THE OUTERMOST.

        EX. IFDEF(IND)FG(1,220,80,1)>CHA(1,100)IFZER(FR)FR=1000;<
        POSSIBLE INTERPRETATIONS OF THIS LINE, DEPENDING ON
        THE PREVIOUS ASSIGNMENTS OF 'IND' AND 'FR' ARE:

        'IND' DEFINED, 'FR' ZERO: FG(1,220,80,1)>CHA(1,100)FR=1000;
        'IND' DEFINED, 'FR' NONZERO: FG(1,220,80,1)>CHA(1,100)
        'IND' DEFINED, 'FR' UNDEFINED: IFZER(FR)
                                    24 001   SYMBOL NOT DEFINED
        'IND' UNDEFINED, 'FR' IRRELEVANT: NO RESULTING OUTPUT

        .EJECT
8.MACRO

        FREQUENTLY CERTAIN SECTIONS OF TEXT WILL BE REPEATED SEVERAL TIMES
        IN THE INPUT, USUALLY WITH ONLY SOME MINOR MODIFICATIONS.
        IN ORDER TO AVOID REPEATING THE TEXT STRING MORE THAN ONCE, IT MAY
        BE ASSIGNED TO A SYMBOL AS IN CHAPTER 2.6 SUBSEQUENTLY, ANY OCCURRENCE

OF THIS MACRO SYMBOL FOLLOWED BY ANY OTHER DELIMITER THAN
'=' WILL CAUSE THE SYMBOL TO BE REPLACED BY THE TEXT STRING.

THE NUMERICAL VALUES OF VARIABLES INSIDE THE MACRO WILL BE SUBSTITUTED
AFTER THE DEFINING STRING HAS BEEN COPIED INTO THE TEXT IN PLACE
OF THE MACRO SYMBOL. IT IS NOT NECESSARY TO HAVE VARIABLES OCCURRING
INSIDE A MACRO DEFINED WHEN THE TEXT STRING IS ASSIGNED TO THE MACRO
SYMBOL. BY GIVING DIFFERENT VALUES TO SUCH VARIABLES EACH TIME BEFORE
THE MACRO IS CALLED FOR IN THE INPUT TEXT, DIFFERENT PARAMETERS WILL
APPEAR INSIDE THE CORRESPONDING TEXTSTRINGS. ALTERNATIVELY,
THE MACRO DEFINITION ITSELF MAY BE USED TO CHANGE VARIABLES FROM
THEIR INITIAL VALUES.

HOW TO DEFINE A MACRO IS DISCUSSED EARLIER IN CHAPTER 2.6
THE VARIABLES IN A MACRO MAY BE CHANGED OUTSIDE THE MACRO.

EX. SET THE FIRST 3 SOUNDGENERATORS TO FREQUENCIES 100,200,300
INTENSITIES TO 100,90,80 AND WAVEFORMS TO 2,4,6

```
SETFG="FG(NR,FR,NI,VA)NR=NR+1;FR=FR+100;NI=NI-10;VA=VA+2;"
NR=1;FR=100;NI=100;VA=2
SETSG;SETSG;SETSG
```
THE RESULT FROM THE LAST LINE IS THE SAME AS WRITING:
FG(1,100,100,2) FG(2,200,90,4) FG(3,300,80,6)
BECAUSE THE VARIABLES 'NR','FR','NI','VA' ARE CHANGED INSIDE
THE MACRO EACH TIME THE MACRO IS CALLED, I.E. BY WRITING 'SETSG'.
THE SAME RESULT IS OBTAINED FROM THE FOLLOWING TEXT:
```
SETSG="IFUND(NR)NR=1;FR=100;NI=100;VA=2;<FG(NR,FR,NI,VA)
NR=NR+1;FR=FR+100;NI=NI-10;VA=VA+2;"
SETSG;SETSG;SETSG
```

8.1 NESTING OF MACROS

A MACROTEXT MAY CONTAIN CALLS TO OTHER MACROS. MACROS CALLED FOR
IN THE INPUT TEXT ARE CALLED FIRST LEVEL MACROS, MACROS CALLED IN A
FIRST LEVEL MACRO IS CALLED A SECOND LEVEL MACRO, A MACRO CALLED
IN A SECOND LEVEL MACRO IS CALLED A THIRD LEVEL MACRO ETC.
THE MAXIMUM AMOUNT OF LEVELS MAY BE 100 AT PRESENT.
EX. WE WANT TO PUT AN ENVELOPE ON OUTPUT CHANNEL 1 WHICH GOES FROM
OLD-5 TO OLD+5 IN 500 MS AND THEN FROM OLD+5 TO OLD-5
IN ANOTHER 500 MS. WE WANT THIS REPEATED 10 TIMES.

```
EA1="ENV(OLD-5,OLD+5,500,3)>ENV(OLD+5,OLD-5,500,3)"
EA5="EA1>EA1>EA1>EA1>EA1"
EA10="EA5>EA5"
EAMP(CH1)>EA10
```

8.2   RECURSIVE CALLS

A MACRO MAY CONTAIN A CALL FOR ITSELF BUT IT IS NESCESSARY TO USE
CONDITIONALS TO STOP THE RECURSION OTHERWISE IT WOULD BE AN INFINITE
PROCESS.

EX. THE SAME RESULT AS IN PARAGRAPH 8.0 COULD BE OBTAINED IN THE
FOLLOWING WAY:
```
SETSG="IFUND(NR)NR=1;FR=100;NI=100;VA=2;<TEST=4-NR;IFPOS(TEST)
SG(NR,FR,NI,VA)NR=NR+1;FR=FR;100;NI=NI-10;VA=VA+2;SETSG;<"
```

8.3 MACRO EXPANSION

IF IN THE LIST MODE THE WHOLE MACRO TEXT IS TRANSFERRED TO THE
OUTPUT TEXT.
EX.
INPUT TEXT

```
MAC1="ENV(0,100,500)"
MAC2="MAC1>MAC1>"
MAC3="MAC2>MAC1>ENV(100,0,500)"
MAC3
```

OUTPUT TEXT

```
'00101' MAC1="ENV(0,100,500)"
'00102' MAC2="MAC1>MAC1>"
'00103' MAC3="MAC2>MAC1>ENV(100,0,500)"
'00104'     '---MACRO---:  MAC3'
'00105'        '---MACRO---:  MAC2'
'00106'           '---MACRO---:  MAC1'
'00107' ENV(0,100,500)
'00108' >
'00109'           '---MACRO---:  MAC1'
'00110' ENV(0,100,500)
'00111' >
'00112' >
'00113'        '---MACRO---:  MAC1'
'00114' ENV(0,100,500)
'00115' >ENV(100,0,500)
```

A LATER CORRECTIVE RUN, USING THIS OUTPUT TEXT AS INPUT,
CAN BE USED TO CORRECT THE RESULT OF THE MACRO EXPANSION.
AFTER THE 'NOLIST' COMMAND, THE EXPANSION OF MACROS IN
THE OUTPUT TEXT IS SUPPRESSED, AND CORRECTIONS CAN THEN
ONLY BE MADE AT THE MACRO LEVEL.
.EJECT

9. OPERATING PROCEDURES

IF THE COMPUTER IS RUNNING AND THE MONITOR SYSTEM LOADED
START AT STEP 6 ELSE DO THE FOLLOWING

1   TURN ON THE POWER SWITCHES ON THE COMPUTER AND
    THE CONSOLE TELETYPE

2   PLACE THE PAPER TAPE MARKED 'DECDISK BOOTSTRAP' IN THE
    PAPER TAPE READER

3   SET THE ADDRESS SWITCHES (THE UPPER SWITCH ROW WITH
    15 SWITCHES) TO '77637' (111 111 110 011 111)

4   PRESS STOP AND RESET

5   PRESS READIN

THE MONITOR WILL NOW BE LOADED AND STARTED.
IT WILL IDENTIFY ITSELF BY PRINTING

KM15 VXX   (XX IS VERSION NUMBER)

$

ON THE CONSOLE TELETYPE

6   COPY THE EMS1-TAPE TO DISK IN THE FOLLOWING WAY

MOUNT THE EMS1 DECTAPE ON A DECTAPE TRANSPORT AND
SELECT NUMBER 1 ON THAT TRANSPORT (BE CAREFULLY SO THAT
NO OTHER TRANSPORT IS READY AT THE SAME TIME WITH THE
SAME NUMBER)

CALL THE SYSTEM PROGRAM PIP

```
$PIP              ($ TYPED BY MONITOR, PIP BY USER)

PIP VXX           (PIP IS LOADED AND READY TO USE)
>C DK5 & DT1 (H)

                  (> TYPED BY PIP, THE REST OF THE LINE BY USER)
>^C               (PIP DONE KILL PIP)
                  (^C MEANS HOLD DOWN CNTRL KEY WHILE
                  STRIKING C)
```

7   ASSIGN THE UNITS USED BY EMS1 PACKAGE TO THE MEDIA
YOU WANT TO USE IN THIS PARTICULAR RUN.
THE UNITS USED ARE THE FOLLOWING

UNIT	USE	RECOMMENDATION
-14	SORT DISK	DK4
-15	SORT DISK	DK5
-10	SORT DISK	DK6
-12	ERROR MESSAGES	TT OR TV
-4	EXECUTE FILE	DK1
1	STANDARD SYMBOL INPUT AND INTERMEDIATE STORAGE	DK1
2	TEXT INPUT	DT1
3	TEXT OUTPUT "TEXT" (MUST BE FILEOR.)	DT2
4	INPUT OF CORRECTIONS (NONFILEOR.)	TT OR TV
5	TEXT OUTPUT "TACC"	DT3
6	SAVE TEXT	DT1
7	ACCUMULATED EMS CODE	MT0
10	ACCUMULATED EMS CODE	MT0

EXAMPLE

```
$A DK4 -14/DK5 -15/DK6 -10/DT1 3/DT2 5/DT3 2,6/MT1 7,10
$A DK7 -4,1/TT 4,-12
```

8   LOAD AND START THE EMS1 PACKAGE BY TYPING
AFTER THE MONITORS '$' SIGN

E EMS1

WHEN EMS1 IS LOADED AND STARTED IT TYPES

EMS1 VXX   (XX VERSION NUMBER)

ON THE UNIT ASSIGNED TO 4
IF UNIT 2 FILEORIENTED IT TYPES:

NAME OF INPUT FILE?

ANSWER WITH FILENAME, EXT OF MAIN TEXT INPUT FILE OR WITH A
CARRIAGE RETURN IF NO MAIN FILE EXISTS. IN THE LATTER CASE
MAIN TEXT INPUT IS UNIT 4 BUT SECONDARY TEXT INPUT IS STILL UNIT 2.
ANSWER WITH ALT. MODE IF END OF RUN. EMS1 RETURNS TO MONITOR.

IF UNIT 2 FILEOR. OR NOT THE NEXT QUESTION IS:

INTERACTIVE MODE. YES OR NO?

ANSWER 'NO' IF NO ERROR CORRECTIONS ARE TO BE MADE. ERROR PRINTOUTS
WILL BE AS USUAL.
ANSWER YES IF CORRECTIONS ARE TO BE MADE FROM UNIT 4 IF AN ERROR
IS DETECTED BY THE SYSTEM.

THE PROGRAM IS NOW READY TO USE.
.EJECT
APPENDIX 1

PERMANENT SYMBOLS

DEVICE SYMBOLS

FG
NG
FF
REV
RM
AM
AMP
CD

ENVELOPE AND GLISSANDI TERMS

ENV
D
Z
ESTEP
GLIS
GSTEP

COMMANDS

PART
PLAY
TRY
TRAPP
APP
MIX
END
STDTIM

CLEAR
KEEP
CALL
TOP
IN
SKIP
SAVE
ERASE
REPL
DELETE
WRITE
MESS
MEX
LOOK
EXIT

CONDITIONALS

IFDEF
IFUND
IFPOS
IFZER
IFNEG

AUXILIARY SYMBOLS

LIST
NOLIST
OLD

ARGUMENTS TO CLEAR AND KEEP COMMANDS

MIX
ALL

ARGUMENTS TO PM AND AM TERMS

A
B

ARGUMENTS TO NG TERM

WHITE
PINK

SPECIAL CONNECTION POINTS

FG3   FREQ. GENERATORS GROUP 1-3
FG6   FREQ. GENERATORS GROUP 4-6
FG9   FREQ. GENERATORS GROUP 7-9
FG12   FREQ. GENERATORS GROUP 10-12
FG15   FREQ. GENERATORS GROUP 13-15
FG18   FREQ. GENERATORS GROUP 16-18
FG21   FREQ. GENERATOR GROUP 19-21
FG24   FREQ. GENERATOR GROUP 22-24
FS   FREQUENCY SHIFTER

.EJECT
APPENDIX 2.   LEGAL STUDIO CONNECTIONS.

```
          FROM      TO

          FG(1)     CHA(1)
          FG(2)     CHA(2)
          FG(3)     CHA(3)
          FG3       CHA(4)
                    CD(1)
                    FG6

          FG(4)     CHA(1)
          FG(5)     CHA(2)
          FG(6)     CHA(3)
          FG6       CHA(4)
                    CD(1)
                    FG9
                    RM(1,A)
                    RM(1,B)
                    RM(2,B)
                    REV(1)
                    REV(2)
                    AM(1,B)
                    FF(1)
                    FF(2)

          FG(7)     CHA(1)
          FG(8)     CHA(2)
          FG(9)     CHA(3)
          FG9       CHA(4)
                    CD(1)
                    FG12

          FG(10)    CHA(1)
          FG(11)    CHA(2)
          FG(12)    CHA(3)
          FG12      CHA(4)
                    CD(1)
                    FG15
                    RM(1,A)
                    RM(1,B)
                    RM(2,B)
                    REV(1)
                    REV(2)
                    AM(1,B)
                    FF(1)
                    FF(2)

          FG(13)    CHA(1)
          FG(14)    CHA(2)
          FG(15)    CHA(3)
          FG15      CHA(4)
                    CD(1)
                    FG18
.EJECT
          FROM      TO

          FG(16)    CHA(1)
          FG(17)    CHA(2)
          FG(18)    CHA(3)
```

```
        FG18      CHA(4)
                  CD(1)
                  FG21
                  RM(1,B)
                  RM(2,B)
                  REV(1)
                  REV(2)
                  AM(1,B)
                  AM(2,B)
                  FF(1)
                  FF(2)

        FG(19)    CHA(1)
        FG21      CHA(2)
                  CHA(3)
                  CHA(4)
                  CD(1)
                  FG24

        FG(20)    FG21
                  FS

        FG(21)    FG21
                  RM(1,A)

        FG24      CHA(1)
                  CHA(2)
                  CHA(3)
                  CHA(4)
                  CD(1)
                  RM(1,B)
                  RM(2,B)
                  REV(1)
                  REV(2)
                  AM(1,B)
                  AM(2,B)
                  FF(1)
                  FF(2)

        FG(22)    FG24
                  RM(2,A)

        FG(23)    FG24
                  AM(1,A)

        FG(24)    FG24
                  AM(2,A)
.EJECT
        FROM      TO

        NG(1)     CHA(1)
                  CHA(2)
                  CHA(3)
                  CHA(4)
                  CD(1)
                  RM(2,B)
                  REV(1)
                  AM(2,B)
                  FF(1)
```

```
                        FF(2)

            FF(1)    CHA(2)
                     CHA(3)
                     CHA(4)
                     CD(1)
                     RM(1,A)
                     RM(1,B)
                     RM(2,B)
                     REV(1)
                     REV(2)
                     AM(1,A)
                     AM(2,B)
                     FF(2)
                     AMP(1)=REV(3)
                     AMP(2)=REV(4)

            FF(2)    CHA(1)
                     CHA(2)
                     CHA(3)
                     CHA(4)
                     CD(1)
                     RM(2,B)
                     REV(1)
                     REV(2)
                     AM(1,B)
                     AM(2,A)
                     AMP(1)=REV(3)
                     AMP(2)=REV(4)

            REV(1)   CHA(1)
                     CHA(2)
                     CHA(3)
                     CHA(4)
                     CD(1)
                     AM(1,B)
                     AM(2,B)
                     AMP(1)
                     AMP(2)
.EJECT
            FROM     TO

            REV(2)   CHA(1)
                     CHA(2)
                     CHA(3)
                     CHA(4)
                     CD(1)
                     AM(1,B)
                     AM(2,B)
                     AMP(1)
                     AMP(2)

            RM(1)    CHA(1)
                     CHA(2)
                     CHA(3)
                     CHA(4)
                     CD(1)
                     REV(2)
                     AM(1,A)
```

```
                AM(2,B)
                FF(1)
                FF(2)
                AMP(1)
                AMP(2)

RM(2)    CHA(1)
         CHA(2)
         CHA(3)
         CHA(4)
         CD(1)
         REV(2)
         AM(1,B)
         AM(2,A)
         FF(1)
         FF(2)
         AMP(1)
         AMP(2)

RM(3)    CHA(1)
         CHA(2)
         CHA(3)
         CHA(4)
         CD(1)
         REV(2)
         AM(2,B)
         FF(1)
         FF(2)
         AMP(1)
         AMP(2)

AM(1)    CHA(1)
         CHA(2)
         CHA(3)
         CHA(4)
         CD(1)
.EJECT
FROM     TO

AM(2)    CHA(1)
         CHA(2)
         CHA(3)
         CHA(4)
         CD(1)

AMP(1)   RM(1,B)
         RM(2,B)
         REV(2)
         AM(1,B)
         AM(2,B)
         FF(1)
         FF(2)

AMP(2)   RM(1,B)
         RM(2,B)
         REV(2)
         AM(1,B)
         AM(2,B)
         FF(1)
```

FF(2)

.EJECT

APPENDIX 3.   THE SORT RECORD

WORD	TYPE OF SORTRECORD	CONTENTS
1	ALL TYPES	LOCAL TIME
2	ALL TYPES	BITS 0-5: LOCAL TIME (CONT)
		BITS 6-17: STUDIO ADDRESS
3	ALL TYPES	BITS 0-11: SOURCE LINE NR
		BITS 12-17: TERM NR
4	CONNECTIONS	=0 IF DISCONNECT, =1 IF CONNECT
4	AMPLIFIERS	AMPLITUDE IN DB*4
4	FG FREQUENCY	FREQUENCY IN HZ
4	FG WAVEFORM	WAVEFORM
4	ENV, GLIS	FROM AMPLITUDE(FREQUENCY)
5	NOT ENV,GLIS	SAME AS WORD 4
5	ENV, GLIS	TO AMPLITUDE(FREQUENCY)
6	NOT ENV,GLIS	BIT 17=1 IF OLD+VALUE
6	ENV, GLIS	BITS 0-15 ENVELOPE TYPE (GLIS TYPE
		BIT 16=1 IF OLD+DATA 2
		BIT 17=1 IF OLD+DATA 1
7	NOT ENV,GLIS	NOT USED
7	ENV, GLIS	ENVELOPE DURATION
8	NOT ENV,GLIS	NOT USED
8	ENV, GLIS	ENVELOPE (GLIS) STEP

.EJECT

APPENDIX 4.   ERROR PRINTOUTS.

02	011	ILLEGAL DELIMITER
02	012	ILLEGAL PARAMETER
02	013	ILLEGAL MNEMONIC
02	014	ILLEGAL NUMBER OF PARAMETERS
02	021	ILLEGAL FREQUENCY GENERATOR NUMBER
02	022	ILLEGAL FREQUENCY GENERATOR FREQUENCY
02	023	ILLEGAL FREQUENCY GENERATOR WAVEFORM
02	024	ILLEGAL FREQUENCY GENERATOR INTENSITY
02	032	ILLEGAL FREQUENCY FILTER CHANNEL
02	033	ILLEGAL FREQUENCY FILTER INTENSITY
02	041	ILLEGAL AMPLIFIER NUMBER
02	042	ILLEGAL AMPLIFIER INTENSITY
02	051	ILLEGAL (DIS-) CONNECTION
02	062	ILLEGAL REVERBATION TIME
02	063	ILLEGAL REVERBATION INTENSITY
02	070	TIME MISSING IN T-TERM
02	071	ILLEGAL TIME
02	081	ILLEGAL NOISE COLOUR
02	082	ILLEGAL NOISE INTENSITY
02	091	ILLEGAL AMPLITUDE MODULATOR NUMBER
02	092	ILLEGAL AMPLITUDE MODULATOR ENTRY
02	093	ILLEGAL AMPLITUDE MODULATOR INTENSITY
02	102	ILLEGAL RING MODULATOR ENTRY
02	103	ILLEGAL RING MODULATOR INTENSITY
02	112	ILLEGAL CHANNEL DISTRIBUTOR INTENSITY
02	121	ILLEGAL DEVICE NUMBER
02	150	ILLEGAL ANALOG TAPE INTENSITY
02	142	ILLEGAL CHANNEL INTENSITY
02	201	ILLEGAL ESTEP VALUE
02	241	ILLEGAL ENV SYNTAX

02	242	ILLEGAL ENV AMPLITUDE
02	245	ENV OR GLISTIME LESS THAN STEP
02	246	ILLEGAL ENV TIME
02	247	ILLEGAL ENV TYPE
02	251	NO DEVICE TO ENVELOPE GIVEN
02	261	ILLEGAL LOCAL TIME VALUE
02	271	ILLEGAL GSTEP VALUE
02	301	NO DEVICE TO GLISSANDO GIVEN
02	302	ILLEGAL GLIS SYNTAX
02	303	ILLEGAL GLIS TIME
02	304	ILLEGAL GLIS TYPE
02	305	ILLEGAL GLIS FREQUENCY
02	142	ILLEGAL CHANNEL INTENSITY
04	001	SYMBOL WITH MORE THAN 6 CHARACTERS.
04	002	INTEGER WITH MORE THAN 5 FIGURES
04	003	TWO DECIMAL POINTS
04	004	A DECIMAL POINT (.) MUST NOT BE USED AS A DELIMITER.
04	010	IN THE EXPRESSION 'A=B' B IS NOT A DEFINED SYMBOL.
04	020	SYMBOL NOT DEFINED.
04	021	SYMBOL DEFINED BUT NOT POSSIBLE IN THIS PART OF THE TEXT.
04	031	TOP NOT EXECUTED IF READ FROM SECONDARY TEXT INPUT
04	032	UNIT 2 NOT FILEORIENTED
04	033	IN,SKIP,DELETE,LOOK NOT EXECUTED IF READ FROM SEC. TEXT INF
04	034	FILE NOT PRESENT ON UNIT 2
04	035	NO TOP COMMAND EXECUTED OR SECONDARY FILE EMPTY
04	036	PARAMETER NOT INTEGER
04	050	LABEL ERROR
04	064	; / ∧ OR) NOT POSSIBLE AS FIRST ELEMENT OF AN EXPR.
04	074	OVERFLOW. ADD OR SUBTRACT
04	075	OVERFLOW. MULTIPLICATION
04	076	TRY TO DIVIDE BY ZERO
04	100	A '=' IS POSSIBLE ONLY AFTER A SYMBOL OR A '='.
04	101	ATTEMPT TO ASSIGN A FIXED SYMBOL
04	102	SYMBOL TABLE FULL
04	104	A ' " ' FOUND IN A NON-MACRO TEXT.
04	103	A MACRO MUST NOT BE CALLED IN ERROR MODE.
05	001	END OF INPUT FILE WITHOUT AN 'EXIT'
		INPUT FROM UNIT 4.
09	001	NO EXTENSION TO FILENAME
09	002	INPUT FILE FILEORIENTED. FILENAME ?
09	003	OUTPUT FILE FILEORIENTED. FILENAME ?
09	004	FILE NOT FOUND.
09	005	UNIT 1 NOT FILEORIENTED.
09	006	FILE FMNEMO EMS NOT FOUND
09	007	FILE ERROR EMS NOT FOUND.
09	008	NO FILENAME ON FILEORIENTED DEVICE.
99	99	--------- EXIT. END OF THIS RUN.---------
01	001	NOT A PERMANENT SYMBOL
01	002	NOT A COMMAND
01	003	ILLEGAL PARAMETER IN 'PLAY' TERM
01	004	NOTHING TO PLAY
01	005	ILLEGAL PARAMETER IN 'TRY'-TERM
01	006	ILLEGAL PARAMETER IN 'MIX'-TERM
01	007	THE ONLY POSSIBLE PARAMETERS TO 'CLEAR' ARE 'MIX' OR 'ALL
01	009	THE ONLY POSSIBLE PARAMETERS TO 'KEEP' ARE 'MIX' OR 'ALL'
01	010	KEEP WITHOUT MEANING HERE
01	015	SAVE,ERASE,REPL NOT EXECUTED IF READ FROM SEC. TEXT INPUT
01	016	LEFT PARANTHESIS MISSING AFTER SYMBOL
01	017	, AFTER SYMBOL

```
01    018          'END' AFTER PREVIOUS 'PART' MISSING
01    020          PART COMMAND FIRST THING IN A BLOCK!
01    021          'PART' AFTER PREVIOUS 'END' MISSING
01    024          LEFT PARANTHESIS MISSING IN 'STDTIM'-TERM
01    025          ERRONEUS TIMEPARAMETER IN 'STDTIM'-TERM
01    030          FILE ALREDY PRESENT
01    040          ERROR DETECTED IN "MERGE". NOT ENOUGH SPACE ON OUTPUT UNIT
01    041          DURATION OF MIX =0!
01    050          LABEL ERROR
05    002          END OF FILE ON ADDITIONAL INPUT FILE.
99    002          EMS1 V1.1

99    004          NAME OF INPUT FILE?
99    005          UNIT 3 MUST BE FILEORIENTED.
99    006          INTERACTIVE MODE? YES OR NO?
9     007
0     000
  .EJECT
APPENDIX 6.        EXAMPLES OF EMS1 TEXT.


        EXAMPLE NR 1.

'00001'  PART(STORS)
'00002'  G0=196;A0=220;D0=147;H00=123
'00003'  C1=262;D1=294;E1=330;F1=349;H0=247;A0=220;C0=131
'00004'  F0=175;G0=196
'00005'  NOT1=1000;NOT2=500;MAX=80;WF=2;ET1=-1;ET2=-2
'00006'  TON="LT(GT1,GT2)MAX1=MAX+10;T1=TID/10;T2=TID-2*T1;T3=2*T1
'00007'  GT2=GT2+TID;GT3=GT2-1000;IFPOS(GT3)GT2=GT3;GT1=GT1+1;<
'00008'  FR1=FR+10
'00009'  IFDEF(LISTA)WRITE(MAX1,T1,T2,T3,GT,FR1)MESS(???);<
'00010'  FG(NR,,,WF)>ENV(50,MAX1,T1,2)>ENV(MAX1,MAX,T1,ET2)>T(T2)
'00011'  GLIS(FR1,FR,T3)
'00012'  FR1=FR*2;NR1=NR+1;MAX1=MAX-6
'00013'  FG(NR1,FR1,,WF)>ENV(50,MAX,T1)>ENV(MAX,40,T2)
'00014'  FR1=FR1*2;NR1=NR1+1;MAX2=MAX-10
'00015'  FG(NR1,FR1,,WF)>ENV(50,MAX1,T1,ET1)>ENV(MAX1,MAX2,T1)>ENV(MAX2,30,T2)"
'00016'  SILL="TID=NOT1;FR=C1;TON
'00017'  TID=NOT2;FR=D1;TON
'00018'  FR=C1;TON
'00019'  TID=NOT1;FR=H0;TON
'00020'  FR=C1;TON
'00021'  FR=E1;TON
'00022'  TID=NOT2;FR=F1;TON
'00023'  FR=E1;TON
'00024'  TID=NOT1;FR=D1;TON
'00025'  FR=E1;TON
'00026'  FR=C1;TON
'00027'  TID=NOT2;FR=A0;TON
'00028'  FR=F0;TON
'00029'  TID=NOT1;FR=G0;TON
'00030'  FR=C0;TON
'00031'  "
'00032'  FG3>FG6>CHA(1,100)
'00033'  FG9>FG12>CHA(2,100)
'00034'  FG15>FG18>CHA(3,100)
'00035'  FG(21)>FG21>CHA(4,100)
'00036'  FG(20)>FG21
'00037'  FG(24)>FG24>CHA(4,100)
```

```
'ØØØ38'  FG(23)>FG24
'ØØØ39'  FG(22)>FG24
'ØØØ4Ø'  GTI=I;GT2=Ø
'ØØØ4I'  NR=I;SILL;SILL
'ØØØ42'  NR=7;GTI=5;GT2=Ø;SILL;SILL
'ØØØ43'  NR=I3;GTI=9;GT2=Ø;SILL;SILL
'ØØØ44'  NR=I9;GTI=I3;GT2=Ø;SILL;SILL
'ØØØ45'  MIX
'ØØØ46'  END
```

DESCRIPTION OF THE EMSI-TEXT.

'SILL' IS A MACRO FOR A I5 NOTE CANON. FOUR DIFFERENT SOUNDGENERATOR GROUPS EACH
PLAY THIS TUNE. THEY START TO SOUND AFTER RESP. I,5,9,I3 SECONDS. ONE NOTE IS
BUILT BY THE MACRO 'TON'. THIS MACRO CONTAINS A GROUND NOTE FOR SOUNDGENERATOR NR
"NR" AND 3 OVERTONES ON SOUNDGENERATORS "NR+I", "NR+2" AND "NR+3". EACH OF THE
TONES HAS SPECIFIC ENVELOPES TO GIVE THE WHOLE TONE A SPECIFIC CHARACTERISTIC.
THE 'TON' MACRO STARTS WITH A CALCULATION OF DURATION TIMES OF THE ENVELOPES. IF
THE SYMBOL 'LISTA' IS DEFINED THE CALCULATED VALUES OF THE SYMBOLS MAXI, TI, T2,
T3, GTI, AND FRI ARE WRITTEN OUT AND AFTER THAT THE MESSAGE "???" IS WRITTEN TO
THE USER AND THE SYSTEM WAITS IN ERROR MODE. THIS GIVES THE USER AN OPPORTUNITY
TO CHANGE VALUES. BY A "DELETE(LISTA)" THIS MESSAGE WILL NOT BE WRITTEN OUT UNTIL
'LISTA' IS DEFINED AGAIN. THE CONNECTIONS ARE MADE SO THAT SOUNDGEN. I-6 IS
CONNECTED TO CHANNEL I, 7-I2 TO CHANNEL 2, I3-I8 TO CHANNEL 3, AND I9-24 TO CHANNEL
4. THE 'SILL' MACRO "PLAYS" THE CANON ONCE THUS EACH GROUP "PLAYS" THE TUNE TWICE.
THE 'MIX' COMMAND TRANSFERS THE 'TEMP' DISK TO THE 'MIX' DISK. THE 'END' COMMAND
IMPLIES GENERATION OF MT-CODE ON THE MT. THE BLOCK LABEL ON THE MT WILL BE 'STORS'.
THIS LABEL CAN BE USED IN A LATER 'PLAY' COMMAND.

COMMENTS LINE BY LINE

LINE   COMMENT

I   BEGIN A NEW BLOCK WITH LABEL 'STORS' ON MT AND NAME 'STORS SRC' ON THE DT
         FILE ON UNIT 5.
2-4   ASSIGN FREQUENCY VALUES TO THE SYMBOLS GØ,AØ, ETC.
5   NOTI, NOT2 ARE TIME VALUES OF A WHOLE NOTE RESP. A HALF NOTE. MAX IS USED
         IN ENV TERMS ON LINES IØ,I3,I5. WF IS WAVEFORM FOR ALL THE 'FG':S
         ETI,ET2 ARE CURVEFORMS OF THE ENV TERMS ON LINES IØ,I5
6   START OF DEFINITION OF THE 'TON' MACRO. THE TONE STARTS AT GTI SEC. GT2 MS
         LOCAL TIME. MAXI IS MAXIMUM AMPLITUDE OF THE FIRST FG. TI=I/IØ, T2=8/IØ,
         T3=2/IØ OF THE WHOLE TONE TIME 'TID'.
7   ADD THE TONE TIME 'TID' TO GT2. IF GT2 MORE THAN IØØØMS (I SEC.) THEN GT3
         WILL BE POSITIVE AND I IS ADDED TO GTI (I SEC.) AND IØØØ MS(I SEC.), I.E.
         THE SAME AMOUNT IS SUBTRACTED FROM GT2.
8   FRI IS THE FREQUENCY USED IN THE GLIS TERM AT LINE NO II.
9   IF THE VARIABLE 'LISTA' IS DEFINED THE VALUES OF MAXI,TI,T2,T3,GTI,FRI ARE
         WRITTEN OUT. AFTER THAT THE MESSAGE '???' IS WRITTEN OUT AND THE PROGRAM WAITS
         IN ERROR MODE FOR INPUT FROM UNIT 4 (TT OR TV).
         A 'DELETE(LISTA)' WILL MAKE THE VARIABLE LISTA UNDEFINED AND THUS MAKE THAT
         NO MORE OF THE ABOVE PRINTOUTS WILL COME OUT.
IØ   THE FIRST FG GOES FROM 5Ø TO MAXI DB IN TI MS CURVEFORM 2, FROM MAXI TO MAX
         IN TI MS, CURVEFORM ET2 AND STAYS AT MAX DB FOR T2 MS.
II   FIRST FG GOES FROM FRI TO FR HZ IN T2 MS.
I2   FRI IS THE FREQUENCY OF THE FIRST OVERTONE. NRI IS THE NUMBER OF THE SECOND
         FG. MAXI IS USED IN THE ENV TERM ON LINE I5.
I3   THE SECOND FG GOES FROM 5Ø TO MAX DB IN TI MS, CURVEFORM Ø AND FROM MAX TO
         4Ø DB IN T2 MS.
I4   FRI IS THE FREQUENCY OF THE THIRD OVERTONE USED IN THE 'TON' MACRO.

	NR1 IS NUMBER OF THE THIRD FG. MAX2 IS USED IN THE ENV TERM ON LINE 15.
15	THE THIRD FG GOES FROM 50 TO MAX1 DB IN T1 MS, CURVEFORM ET1, FROM MAX1 TO MAX2 DB IN T1 MS AND FROM MAX2 TO 30 DB IN T2 MS.
16	START OF THE DEFINITION OF THE 'SILL' MACRO WHICH CONTAINS THE WHOLE CANON "STORSILL OCH SMA SILL".
16-30	TIME AND FREQUENCY OF THE TONES IN THE CANON ARE GIVEN AT EACH LINE. NOTE THAT THE LOCAL TIME IS ADDED WITH THE TIME VALUE OF THE NOTE EACH TIME THE MACRO 'TON' IS CALLED SO THAT THE TONES WILL COME IN THE RIGHT TIME SEQUENCE.
31	END OF THE 'SILL' MACRO.
32-39	FG:S 1-6 ARE CONNECTED TO CHANNEL 1, FG:S 7-12 TO CHANNEL 2, FG:S 13-18 TO CHANNEL 3 AND FG:S 19-24 TO CHANNEL 4.
40	STARTTIME 1 SEC. AND 0 MS FOR THE FIRST 'SILL' MACRO.
41	FG:S 1-3 PLAYS THE CANON TWICE.
42	FG:S 7-9 PLAYS THE CANON TWICE STARTING AT LOCAL TIME 5 SEC. 0 MS.
43	FG:S 13-15 PLAYS THE CANON TWICE STARTING AT LOCAL TIME 9 SEC. 0 MS.
44	FG:S 19-21 PLAYS THE CANON TWICE STARTING AT LOCAL TIME 13 SEC. 0 MS.
45	TRANSFER THE SORTRECORDS PRODUCED BY THE ABOVE 'SILL' MACROS ON THE 'TEMP' DISK TO THE 'MIX' DISK. ("TRANSFER" HERE ALSO INCLUDES SORT)
	MAKE MT CODE FROM THE MIX DISK. ERASE THE MIX AND TEMP DISKS UNLESS ANY OF THE COMMANDS KEEP, KEPP(MIX), KEEP(ALL) COMES AFTER THE END
.EJECT	COMMAND. THE PROGRAM NOW EXPECTS A NEW PART COMMAND TO START A NEW BLOCK.

EMS1C MAN
        APPENDIX 7   740806

MOVING SOUND IN EMS1

FROM VERSION V4.1 OF EMS1 IT IS POSSIBLE TO CONTROL TWO MOVING
SOUNDS.
A POINT IN THE ROOM AND A DURATION ARE SPECIFIED AND THE SOUND CAN
BE HEARD MOVING FROM THE ORIGINAL POINT TO THE POINT SPECIFIED.
DOPPLER-EFFECT IS AUTOMATICALLY ADDED. THE SOUND CAN BE MADE TO
ACCELERATE OR DECELLERATE DURING THE TIME SPECIFIED. THE DOPPLER-
EFFECT CAN BE INCREASED OR REDUCED. THE AMOUNT OF REVERBERATION
CAN BE SPECIFIED FOR EACH SOUND.
EACH SEGMENT OF THE MOVEMENT CAN BE DESCRIBED IN ONE OF THE FOLLOWING WAYS:
- A STRAIGHT LINE BETWEEN TWO POINTS
- A SPIRAL MOTION
- A CIRCULAR MOVEMENT (A SPECIAL CASE OF SPIRAL WITH CONSTANT RADIUS)
THE NEW FACILITIES ARE ADAPTED TO A NEW WAY OF CONNECTING THE STUDIO,
WHICH IS ALMOST, BUT NOT QUITE, COMPATIBLE WITH THE FORMER WAY.
SOUNDS CONNECTED TO CD(1) ARE HEARD WITHOUT ANY LEVEL SET ON THE
CHANNELS.
THE REVERBERATORS NEED NOT BE CONNECTED TO THE CHANNELS; A FIXED
CONNECTION EXISTS.
AMP(1) AND AMP(2) BEING USED FOR REVERBERATIONS 3 AND 4 CAN NO
LONGER BE USED IN THEIR FORMER FUNCTION. THESE TERMS REMAIN IN EMS1,
BUT AMP(1,88) FOR INSTANCE, MEANS THE SAME AS REV(3,,88) AND
AMP(2,91) THE SAME AS REV(4,,91).
MOVING SOUND NO.1 USES CD(1,1), CD(1,2), CD(1,3), AND CD(1,4)
FOR THE DIRECT SOUND. THE CORRESPONDING REVERBERATING PART OF THE
SOUND IS COMING VIA AMPLIFIERS, WHICH SO FAR CAN BE REACHED ONLY
VIA PROGRAMS, I.E. THEY CANNOT BE REACHED DIRECTLY FROM THE CONSOLE.
MOVING SOUND NO.2 USES CHA(1), CHA(2), CHA(3), AND CHA(4) FOR THE
DIRECT SOUND AND A COUPLE OF AMPLIFIERS (NOT VISIBLE ON THE CONSOLE)
FOR THE REVERBERATION SOUND, LIKE SOUND NO.1. IF IT IS NOT NECESSARY
TO MOVE SOUND NO.2 IT IS POSSIBLE TO HAVE, AS PREVIOUSLY, DIFFERENT
DEVICES CONNECTED TO DIFFERENT CHANNELS GIVING UP TO NINE DIFFERENT
NON-MOVING SOUNDS.
THUS THE DEVICES OF MOVING SOUND NO.1 SHOULD BE CONNECTED TO CD(1).
IF A MOVING SOUND NO.2 IS DESIRED ITS DEVICES SHOULD BE CONNECTED
TO ALL FOUR CHANNELS. THE WAY TO GET MANY NON-MOVING SOUNDS ARE
OTHERWISE:
CONNECTION TO:
        CHA(1)   FOR ONE SOUND   IN FRONT LEFT CORNER
        CHA(1)&CHA(2)   STRAIGHT FORWARD
        CHA(2)   FRONT RIGHT CORNER
        CHA(2)&CHA(3)   STRAIGHT RIGHT
        CHA(3)   REAR RIGHT CORNER
        CHA(3)&CHA(4)   STRAIGHT BACKWARDS
        CHA(4)   REAR LEFT CORNER
        CHA(4)&CHA(1)   STRAIGHT LEFT
        CHA(1)&CHA(2)&CHA(3)&CHA(4)   IN THE MIDDLE
FOR NON-MOVING SOUNDS LEVELS MUST BE SET ON THE CHANNELS AS USUAL.
FOR MOVING SOUNDS THIS IS DONE AUTOMATICALLY. WHEN A MOVING SOUND HAS
REACHED ITS DESTINATION AND STOPPED THE LEVEL REMAINS, AS FOR A USUAL
ENVELOPE.

LATER ON THERE WILL BE EMS1 TERMS FOR CONTROLLING THE REVERBERATION

LEVELS DIRECTLY:
```
        RD(1,1,  )         TO        RD(1,4,  )        FOR SOUND ONE
        RD(2,1,  )         TO        RD(2,4,  )        FOR SOUND TWO
```
RD STANDS FOR REVERBERATION DISTRIBUTOR
CD STANDS FOR CHANNEL DISTRIBUTOR.

LET US STUDY THE NEW EMS1 TERMS WITH THE HELP OF A COMPLETE EXAMPLE:

        PART(ONE)   'AS USUAL'

WE LET FG NO. 1 TO 12 BELONG TO MOVING SOUND NO.1:
        FG3>FG6>FG9>FG12>CD(1);

AND FG13 TO 24 BELONG TO SOUND NO.2:
        FG15>FG18>FG21>FG24>CHA(1)&CHA(2)&CHA(3)&CHA(4);
        FG(20>21)>FG21;
        FG(22>24)>FG24;

SET A REVERBERATION TIME AND A LEVEL FOR THE FOUR REVERBERATORS:
        REV(1,15,90)
        REV(2,15,90)
        REV(3,15,90)
        REV(4,15,90);
REVERBERATION TIME 3 AND 4 MUST SO FAR BE SET MANUALLY ON A CONSOLE
ON THE REVERBERATION DEVICE ITSELF. THE REASON FOR INCLUDING THEM
IN THE REV TERM IS SYMMETRY. THE COMMAND IS NOT OBEYED.
THE LEVEL SET, 90DB, IS A REFERENCE LEVEL APPLYING TO BOTH MOVING
SOUNDS. IT SHALL PREFERABLY NOT BE SET HIGHER THAN 90 DUE TO THE
NOISE. THIS IS COMPENSATED BY SETTING A HIGHER LEVEL ON THE REVERBERA-
TION SOUND IN THE TERMS FOR EACH OF THE MOVING SOUNDS.

THE CONSTRUCTION OF THE NEW SPIRAL REVERBERATORS ALLOW SETTING
REVERBERATION TIME IMMEDIATELY BEFORE THEY ARE TO BE USED.

SPECIFY THAT MOVING SOUND NO.1 SHALL USE FG NO. 1 TO 12, THAT THE
REFERENCE LEVEL FOR THE DIRECT SOUND IS 100 DB AND ALIKE FOR THE
REVERBERATED SOUND

        MOVS(1,1>12,100,100);

THE DOPPLER EFFECT IS THE REASON FOR CONNECTING THE FREQUENCY GENERA-
TORS TO THE MOVING SOUND. EARLIER THEY HAVE BEEN CONNECTED TO CD(1).
THE LEVEL 100 DB ON THE DIRECT SOUND MEANS THAT THE LEVEL SET ON THE
FREQUENCY GENERATORS WILL BE DISTRIBUTED ON THE FOUR
CHANNELS. 100 DB ON THE REVERBERATED SOUND MEANS THAT IT WILL
SOUND 10 DB LESS, AS IT ALSO PASSES THROUGH THE ATTENUATORS,
SET TO 90 DB IN THE REV TERMS.

THE SAME PROCEDURE IS APPLIED FOR SOUND NO.2:
        MOVS(2,13>24,,100,3000);
THE DIRECT LEVEL IS HERE EXCLUDED. THIS MEANS THAT IT REMAINS ON ITS
OLD VALUE, IN THIS CASE 0. ONLY THE REVERBERATED SOUND WILL BE
HEARD.
THE VALUE 3000 IS TO INCREASE THE DOPPLER EFFECT THREE TIMES.
THE VALUE 1000 OR NONE GIVES A NORMAL DOPPLER EFFECT.
THE FREQUENCY GENERATORS ARE GIVEN FREQUENCY, LEVEL, AND WAVESHAPE
AS USUAL.

FOR EXAMPLE
```
        FG(1,100,70)
        FG(2,200,70)
        FG(3,300,70)
        ETC
        FG(24,2400,70);
```

TO MAKE A SPIRAL MOTION WITH MOVING SOUND NO.1, THE TERM
IS:
```
        MOVSRA(1,20000,3600,30000,-4)
```

A POINT IN THE ROOM IS NOW SPECIFIED AS A RADIUS AND AN ANGLE.
MOVSRA IS SHORT FOR MOVING SOUND RADIUS-ANGLE.
THE RADIUS 1000 INDICATES A DISTANCE FROM THE CENTRE OF THE ROOM
TO ANYONE OF THE LOUDSPEAKERS. THE NUMBER 20000 IS CONSEQUENLY
A DISTANCE 20 TIMES AS FAR. THE SOUND WILL MOVE FROM WHERE IT
WAS BEFORE TO A POINT AT THIS DISTANCE, FURTHER DETER-
MINED BY THE ANGLE.

THE ANGLE IS MEASURED IN DEGREES. THERE ARE 360 DEGREES ON
A REVOLUTION.
THE ANGLE   0   IS STRAIGHT FORWARD
                  90   IS STRAIGHT RIGHT
                  180   IS STRAIGHT BACKWARDS
                  270 OR -90   STRAIGHT LEFT.
EACH POINT IN THE ROOM CAN BE DESCRIBED AS A CERTAIN RADIUS
AND ONE OF MANY POSSIBLE ANGLES WITH 360 DEGREES DIFFERENCE.
A POINT IN THE DIRECTION DIAGONALLY TO THE RIGHT CAN BE
SPECIFIED BY ANY OF THE ANGLES 45,405,765, -315, OR -675 DEGREES.

WHEN STARTING A COMPOSITION THE MOVING SOUNDS ARE AT THE RADIUS
AND ANGLE 0, I.E. IN THE CENTRE.

IN OUR MOVSRA TERM THE NUMBER 3600 IS THE NEW ANGLE.
THE NUMBER 30000 IS THE DURATION IN MS DURING WHICH THE SOUND
SHALL MOVE, I.E. DURING 30 SECONDS. A MOVEMENT FROM 0 TO 3600 DEG-
REES MEANS A MOVEMENT 10 REVOLUTIONS CLOCKWISE. AT THE SAME TIME
THE RADIUS GOES FROM 0 TO 20000 WHICH GIVES AN OUTWARDGOING
SPIRAL MOTION.
THE LAST NUMBER -4 CORRESPONDS TO THE TYPE OF ENVELOPE OR GLISSANDO.
IN THIS CASE IT CAN BE CALLED AN ACCELERANDO TYPE. A NEGATIVE
ACCELERANDO TYPE MEANS THAT THE MOVEMENT IS SLOWER IN THE
BEGINNING AND FASTER AT THE END, I.E. AND ACCELERANDO. A
POSITIVE NUMBER CORRESPONDS IN THE SAME WAY TO A RITARDANDO.
THE DOPPLER EFFECT DEPENDS ON THE INWARD- OR OUTWARDGOING
MOVEMENT, BUT IS NOT AFFECTED BY A CHANGE OF ANGLE ONLY.
AN OUTWARDGOING ACCELERANDO, LIKE IN THIS CASE, MAKES THE
FREQUENCY CONTINUALLY DECREASING.

WHEN THE SOUND HAS REACHED ITS DESTINATION IT CAN BE SUCCEEDED BY A
NEW SEGMENT BY WRITING:
```
        MOVSRA(1,22000,360,3000,4)
```
THIS SEGMENT SUCCEEDS THE OTHER ONE DIRECTLY AS NO SEMI-COLON,
OR ANY OTHER DEVICE TERM WAS INSERTED IN BETWEEN. THE SOUND IS NOW
RETARDING DURING ANOTHER REVOLUTION WITH CURVE-FORM +4.
THE DOPPLER EFFECT IS DECREASING DUE TO RETARDATION.

IN THE FIRST MOVSRA TERM WE WENT 20 UNIT RADII DURING 30 SEC,
IN THE SECOND A TENTH OF THIS, TWO UNIT RADII DURING A TENTH

OF THE DURATION, 3 SEC., AND WITH THE REVERSE CURVE FORM,
+4 INSTEAD OF -4.
THEREFORE THERE IS NO JUMP OF SPEED IN THE JOINT, BUT THE
FREQUENCY HAS ITS LOWEST VALUE THERE AND THEN RISES TO
ALMOST ITS NOMINAL VALUE.

AT A NEW TERM THE OLD RADIUS AND ANGLE ARE COLLECTED. THE ANGLE
IS HOWEVER REDUCED TO A SMALL NUMBER. ELSE THE SECOND TERM
WOULD HAVE MEANT GOING NINE REVOLUTIONS COUNTER-CLOCKWISE,
FROM 3600 TO 360 DEGREES.
REMAINING ANGLES ARE ALWAYS REGARDED AS NUMBERS LARGER THAN -180
AND NOT LARGER THAN +180 DEGREES. A TERMINATION TO THE LEFT MEANS
AN ANGLE OF -90 DEGREES, EVEN IF THE SOUND HAS MOVED CLOCKWISE
FROM 0 TO 270 DEGREES. TO CONTINUE HALF A REVOLUTION CLOCKWISE
SPECIFY THE NEW ANGLE AS +90 DEGREES. TO GO HALF A REVOLUTION
COUNTER-CLOCKWISE SPECIFY IT AS -270 DEGREES.
IT IS ALSO ALLOWED TO SPECIFY NEGATIVE RADII. THIS CORRESPONDS
TO A POINT OPPOSITE THE ANGLE SPECIFIED. TO CROSS THE CENTRE
OF THE ROOM WE CAN LET THE RADIUS PASS FROM A POSITIVE VALUE TO
A NEGATIVE ONE. A REMAINING NEGATIVE RADIUS IS HOWEVER
TRANSLATED TO A POSITIVE AT THE SAME TIME AS THE ANGLE IS
CORRECTED BY 180 DEGREES WHEN USED AS A NEW STARTINGPOINT.

SUPPOSE THAT THE SOUND IS TO BE MOVED ALONG A STRAIGHT LINE
TO A CERTAIN POINT; THE REAR LEFT CORNER ON THE UNIT CIRCLE .
WE THEN USE A COMMAND WHERE POINTS IN THE ROOM ARE
NOT SPECIFIED AS RADII AND ANGLES BUT AS X- AND Y-COORDINATES.
THE X-DIRECTION IS TO THE RIGHT AND THE Y-DIRECTION IS STRAIGHT
FORWARD. 1000 IS STILL THE DISTANCE FROM THE CENTRE TO ANY OF
THE LOUDSPEAKERS. THEREFORE

X =	Y =	CORRESPONDS TO	THE POINT
-707	707	CORRESPONDS TO	LOUD SPEAKER 1
707	707	CORRESPONDS TO	LOUD SPEAKER 2
707	-707	CORRESPONDS TO	LOUD SPEAKER 3
-707	-707	CORRESPONDS TO	LOUD SPEAKER 4

THE COMMAND IS:
>MOVSXY(1,-707,-707,5000,4);

MOVSXY IS IDENTICAL WITH MOVSRA CONCERNING DURATION AND ACCELERANDO.
IT IS ALLOWED TO LET MOVSRA AND MOVSXY SUCCEED EACH OTHER.

WE DO SOMETHING SIMILAR WITH MOVING SOUND NO.2:
MOVSRA(2,20000,-3600,30000,4)>MOVSRA(2,22000,-360,3000,-4)>
MOVSXY(2,707,-707,6000,-2);

THIS PART IN THE EXAMPLE IS ENDED BY:

        LT(40,)FG(1>24)ENV(OLD,20,2000);
        MIX;
        END;

MOVS TERMS CAN BE CONNECTED TO EACH OTHER ALSO FOR DIFFERENT

MOVING SOUNDS. EXAMPLE:

```
PART(TWO)
FG(1>24,,70)
MOVSXY(1,2000,2000,3000)>MOVSXY(2,-2000,2000,2000);
```

IT IS ALLOWED TO CHANGE THE REFERENCE LEVELS OR THE DOPPLER CONSTANT
WHILE A SOUND IS MOVING:

```
        LT(2,)MOVS(1,,,90);
```

THIS REDUCES THE REVERBERATION LEVEL BUT DOES NOT AFFECT WHICH
FREQUENCY GENERATORS ARE CONNECTED, THE DIRECT LEVEL OR THE DOPPLER
CONSTANT.

THE DURATION Ø MEANS A MOMENTARY MOVEMENT WITHOUT DOPPLERSHIFT:

```
        LT(6,)MOVSXY(2,-2000,-2000,0) OR MOVSXY(2,-2000,-2000)
```

AT AN OUTWARDGOING ACCELERANDO FAST ENOUGH TO PASS THE SOUND
BARRIER THE FREQUENCY IS DECREASING TO 0 AND THEN STARTS TO
RIZE AGAIN;

IF A GLISSANDO IS SET ON THE FREQUENCY GENERATORS THE DOPPLER
EFFECT ON IT IS SUPERIMPOSED.

```
        LT(0)FG(12)>GLIS(OLD,1000,4000);
```

IT IS POSSIBLE TO CHANGE FREQUENCY GENERATORS BETWEEN THE MOVING
SOUNDS IF THE CORRESPONDING PHYSICAL RECONNECTION IN THE STUDIO
IS MADE;

```
        LT(4,)MOVS(2,10>12);
        FG9>CD(1);FG12#CD(1);
        FG9#FG12>FG15;
```

THE MOVING SOUND NO.2 HERE GETS THE FREQUENCY GENERATORS 10,
11 AND 12 FROM SOUND NO.1.
TO TAKE AWAY CERTAIN GENERATORS FROM THE MOVING SOUND WRITE:

```
        LT(5,)MOVS(0,1>3);
```

NATURALLY, IT IS POSSIBLE TO CONNECT NOISE TO CD(1) OR THE CHANNELS
AND USE MOVS, MOVSRA, AND MOVSXY AS USUAL, ALTHOUGH THERE IS NO DOPPLER
EFFECT.

IN CORRESPONDANCE WITH ESTEP AND GSTEP THERE IS A TERM TO
SPECIFY HOW OFTEN THE MOVING SOUNDS SHALL UPDATE THE LEVELS AND
THE DOPPLER FACTOR:

```
        MSTEP(20);
```

20 IS THE NORMAL VALUE. AS IN ENV AND GLIS THERE IS ALSO THE
POSSIBILITY TO WRITE IN THE SINGLE TERM A VALUE STATING THE
STEP FOR THIS TERM:

```
MOVSRA(1,1000,0,5000,3,100);MOVSXY(2,-1000,0,5000,,100);
```

THESE TWO SEGMENTS WILL BE UPDATED EACH 100TH MS, INDEPENDANTLY

OF THE ACTUAL MSTEP VALUE.

IT TAKES A RELATIVELY LONG TIME TO CALCULATE THE MOVING SOUND
DUE TO THE MANY FLOATINGNUMBER CALCULATIONS THAT HAVE TO BE
MADE. IF THE TWO MOVING SOUNDS ARE ACTIVE WITH THE STEP 20 MS
THE COMPOSITION WILL TAKE ABOUT SEVEN TIMES REAL TIME TO REALIZE
PROVIDED IT IS SIMPLE IN OTHER RESPECTS, FOR ONE MOVING SOUND OR
FOR A TWICE AS BIG MSTEP IT WILL TAKE ABOUT HALF THAT TIME.
THIS TIME WILL BE CONSIDERABLY SHORTER WHEN EMS1 IS READY TO
BE RUN IN THE DOS-SYSTEM AND LATER ON RSX.
                    JULY -74