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☺ TMS9900/99105 Cross-assembler

☺ Rev. 1.0

☺ Derived from the original William C. Colley, III.
☺ M6800 Cross Assembler

☺ by

☺ Alexander Cameron

☺ Written and modified during June 1984.

☺ The Manual Such As It Is.

☺ 1.1 Format of Cross-assembler Commands
 ☺ 1.1.1 Command Strings

☺ The use of the 9900 cross-assembler is

☺ A>a99 filename options

☺ filename
 ☺ The name of the source input file is

☺ options: See next section.

☺ 1.1.2 Options

☺ The source file comes from the currently

☺ a, b, c, d Disk drives.
 ☺ - The currently logged in disk drive.

☺ Lines of input contain no errors unless

☺ Console dev
 ☺ List device.

☺ The hexadecimal output unless called

☺ Options may be together in a single

☺ 1.1.3 Examples

☺ A>a99 barf source -- a:barf.a99
 ☺ list -- none.
 ☺ hex -- none.

```

☺          A>a99 barf sblxha source -- b:barf.a99
☺                               list  -- con:
☺                               hex   -- a:barf.h99

☺          A>a99 barf ly      source -- a:barf.a99
☺                               list  -- lst:
☺                               hex   -- none.

☺          A>b:a99 barf sbh-  source -- b:barf.a99
☺                               list  -- none.

```

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☺ hex -- a:barf.h99

☺ 1.2 Format of TMS9900 Cross-assembler Source Files

☺ Lines of source input are terminated with CR/LF

☺ Lower case letters are converted to upper

- ☺ 1) In opcodes,
- ☺ 2) In checking for keywords such as NOT, and
- ☺ 3) In command strings.

☺ This means that "not" is "NOT" "Not" etc

☺ 1.2.1 Statements

☺ Source files for the TMS9900 Cross-assembler

☺ [label] [opcode] [arguments] [;comments.]

Label<á aróá recognizeΣ b· thei> beginnintá iε ì

Opcode<áá ma·á bśá eithe>á 990::áá instructioε ì

Thśá argument< followint thś opcodeσ wil∞á var· ì

Line<á terminatσ witΦ eithe> β CR/Lf pai> o>á β ì

1.2.2 Symbols

Symbol< ma· bσ op an· length¼á bu| onl·á thσ ì

A-Z a-z ! & . : ? [\] ^ _ `

{ | } ~ 0-9

Notśá tha|á symbol< ma· no| begiε witΦ 0-|á a< ì

¼á specia∞á symbo∞ ñ i< alway< equa∞á tŃá thσ ì

1.2.3 Numeric Constants

Number<á begiεá witΦá 0-9,%«á Ńá leadintá basσ ì

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| | | |
|---|---|-----------------------|
| ☺ | 0ff80h | evaluate to ff80 hex. |
| ☺ | 128 and 128d | evaluate to 80 hex. |
| ☺ | 35o, and 35q | evaluate to 1d hex. |
| ☺ | %0111000 and 0111000b | evaluate to 39 hex. |
| ☺ | 1-á character>á constan[i≤ ß strin[composeΣá ou ì | |

| | | |
|---|------|------------------------|
| ☺ | "ab" | evaluates to 6162 hex. |
| ☺ | " " | evaluates to 0000 hex. |
| ☺ | "' " | evaluates to 0027 hex. |
| ☺ | 'A' | evaluates to 0041 hex. |

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☺ Notóáá tha[á iεá thóá two-character>áá character> ì

☺ 1.2.4 Strings

☺ String<á aróá formeΣ iε thσ samσ wa·á a< ì

☺ 1.3 Expression Evaluation

- ☺ Thóá followintá operator≤á aróá alloweΣáá iε ì

- ☺ Unary Plus, Unary Minus
- ☺ *, /, MOD, SHL, SHR
- ☺ +, -
- ☺ >, >=, <, <=, <>, =
- ☺ (These can also be written as
- ☺ GT, GE, LT, LE, NE, EQ.)
- ☺ NOT (1's complement)
- ☺ AND (Bitwise logical AND)
- ☺ OR, XOR (Bitwise logical OR and Exclusive
- ☺ OR)
- ☺ HIGH, LOW
- ☺ Parenthese≤á aróá useΣ tñ chango thóá ordezá ou ì

☺ All∞ operator≤ excep| +¼á -¼ *¼ /¼ =¼ <>¼ >¼ ì

☺ Tho "HIGH¼ mumbleó i≤ equivalen| tñ "mumblo SH¼ ì

☺ AN- 0ffh".

☺ Tho relationa∞ operator≤ (=¼á >¼ etc. r evaluato ì

☺ Expression≤ááá aróáá terminateΣáá b·áá commas¼ ì

© This group contains the following opcodes:

©

© COC CZC XOR MPY DIV XOP LDCR STCR

© Instruction format: [opcode|format3|format1]

©

Example: XOP @LABEL, 3

© 1.4.6 Group 4 Instructions

© This group contains instructions allowing multiple i

© This following instructions belong to this i

©

T B BLW CL SET IN NE AB SWPB

©

INC INCT DEC DECT X

©

BIND (a TMS99105 instruction)

© Instruction format: [opcode|format1]

©

Example: INC @LABEL(R3)

© 1.4.7 Group 5 Instructions

© This group contains instructions allowing Single-Bit i

© These following instructions belong to this i

©

SBO SBZ TB

© Instruction format: [opcode|format4]

©

Example: SBO 25

© 1.4.8 Group 6 Instructions

© This group covers the Conditional Jump i

© These following instructions belong to this i

©

JEQ JGT JH JHE JL JLE JLT JMP JNC JNE

©

JNO JOC JOP

© Instruction format: [opcode|format2]

☉ Example: JEQ LABEL

☉ 1.4.9 Group 7 Instructions

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☉ This group has Immediate Source Operands

☉ The following instructions belong to this

☉ AI ANDI CI LI ORI
☉ BLSK (a TMS99105 instruction)

☉ Instruction format: [opcode|format5]
☉ [format6]

☉ Example: AI R3,128

☉ 1.4.10 Group 8 Instructions

☉ This group covers the Internal Register Load

☉ The following instructions belong to this

☉ LWPI LIMI

☉ Instruction format: [opcode]
☉ [format6]

☉ Example: LIMI 3

☉ 1.4.11 Group 9 Instructions

☉ This group covers the Internal Register Store

☉ The following instructions belong to this

☉ STST STWP
☉ LS and LW (TMS99105 instructions)

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©1.5.7EVEN

©This statement is used to force the assembler to

©[label] EVEN

©1.5.8 DXOP

©This statement allows the programmer to define

© DXOP PUSH,3 ;assign the name PUSH to
© ;XOP number 3
©
©For example in PUSH is the previous code XOR

è ©

©
©1.5.9 Conditional Assembly

©Block of code to be assembled or not

© IF expression

© (lines of code)

© ENDI

© If the expression evaluates to 0 the code is

- ☺ 1.5.11 SET
- ☺ This statement is used to assign a temporary register.
- ☺ The syntax is:
- ☺ label SET expression
- ☺ 1.6 Error Messages
- ☺ Error messages are flagged with a single letter:
- ☺ A Presently not implemented.
- ☺ B Distance of branch instruction is
- ☺ D Digitally too large for basic word
- ☺ E Expression ill-formed. Loop forward
- ☺ I Instruction imbalance. Loop forward ELS
- ☺ L Invalid label. Label may contain
- ☺ M Label already defined. Label

☺ definitions are not SET statements.

☺ O Invalid opcode « Loofo> i

☺ P Phasint error « Loofo> expression< i

☺ R Register value too large « Register< i

☺ S Syntax error « Check you> syntax i

☺ T Too many arguments « oia thi< i

☺ U Undefined symbol encountered i

☺ V Value out of bounds « Ie i

☺ * This statement generates a thor i

☺ " Quoted imbalance error « Bea> i i

☺ (Parenthesis imbalance error « Coun| i

☺ 1.7 Assembler Abort Conditions

☺ Under certain circumstances thi> assemble> i

☺ assembly «á Iµ yo] don'f ge[thσ erro>á coun[ì

- ☺ 1) Can't open source.
- ☺ Thσá sourcσ filσ doe≤ no[exis[ì
- ☺ 2) Can't open list.
- ☺ Can't open hex.
- ☺ Nŉá director·á entrie≤ lef[á oεá thσ ì
- ☺ 3) Illegal command line.
- ☺ Bone up on command lines.
- ☺ 4) No file info supplied.
- ☺ Bone up on command lines.
- ☺ 5) If stack overflow.
- ☺ I fá directive≤ ma· onl·á bσá nesteΣ ì
- ☺ 6) Disk read error.
- ☺ Sourcσá filσá ha≤ βá baΣá CR fά o> ì
- ☺ 7) Disk write error.
- ☺ Ou[oµ disδ o> director· spacσ oε thσ ì
- ☺ 8) Error closing file.
- ☺ Problefάá closin fάá lis fά o>áá he° ì
- ☺ 9) Symbol Table Overflow.
- ☺ You>á sourcσ prograφ define≤ toŉ man· ì

☺ A>clink a99 -s

☺ *a99asmln

☺ *a99eval

☺ *a99get

☺ *a99put

☺ *a99symb

☺ *a99tbls

☺ And, as if by magic, you've got a99.com!

☺ Notσά tha|ά thσ linkagσ caε al∞ bσ donσ oεά onσ ì

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☺ 1.9 Final Comments

☺ Happ·ά assemblingíá Iμ yoj havσ question≤ o≥ ì

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