

snma.hyper

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Chapter 1

snma.hyper

1.1 Samu Nuojua's Macro Assembler, SNMA v1.97

```
*****
*                *
*      S    N    M    A    V1.97    *
*      ~~~~~~*
*****
```

SNMA is 680x0 conditional macro assembler.

- | | |
|-----------------|----------------------------|
| 1. Introduction | Blablaablaa.... |
| 2. Usage | How to use (start). |
| 3. Features | Expressions, directives... |
| 4. ARexx | ARexx interface |
| 5. Author | Me. |

1.2 1. Introduction

Introduction to Samu Nuojua's Macro Assembler, SNMA

SNMA is a 680x0/6888x macro assembler. SNMA requires OS 2.0+. If you have used another assembler, snma should not throw big surprises in your face (I hope). (Look at things to note)

- 1.1 Copyright and other boring stuff
- 1.2 What you need
- 1.3 How to Install
- 1.4 Good & Bad things
- 1.5 History

1.6 Bug reports

1.7 Misc.

1.8 Thanks

1.3 1.1 Copyright ©

SNMA stands for Samu Nuojuua's Macro Assembler.

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## 1.4 1.2 What you need

What you need to use SNMA to produce stand alone programs.

- AmigaOS 2.04 or higher (V37)
- Text editor (to write/edit programs)
- The following libraries:
  - V. Where note
  - ~~ ~~~~~ ~~~~
- dos.library 37 in rom
- intuition.library 36 in rom
- utility.library 36 in rom
- icon.library any \* in rom WB support
- mathieeedoubbas.library any \* libs: fp support
- mathieeedoubtrans.library any \* libs: fp support
- rexxsyslib.library 36 \* libs: ARexx support

Libraries marked with a \* are not necessarily required. The math libraries are needed for single and double floating point conversions. A 6888x or 680x0 with FPU is needed for the extended

floating point conversions. Rexxsyslib is required for the ARexx support and icon.library for the WB support (if snma is started with the icon).

Although snma can now produce executables, you may still need a linker to link object modules together (i.e. when your sources consist of several modules). There are many choices for the linker and snma should work with the ones which can deal with standard hunks. I have used DLink (from the freely distributable DICE, not the registered or commercial versions - I don't know if they differ anyway) which works just fine and is free.

Recommended:

- Hard Disk
- Manuals, manuals...
- Debugger
- Time (8')
- Development tools (Includes and so on)

```
*****
* Remember, this isn't pascal, this is REAL programming.          *
* - 68000 Assembly language, techniques for building programs *
*****
```

(Good book (a bit old, however) by D.Krantz and J.Stanley).

## 1.5 1.3 Installing SNMA

There are couple of files to be copied. Installer? Well, as soon as I have some time to spare.

SNMA The main file. Copy it somewhere in your search path if you are using snma from the shell. If you are using snma in its ARexx mode, it needs to be started only once so it is not necessary that this file be in the search path in this case. Also, snma now has an icon so that it can be started directly from the WB.

SNMA.guide Documents in AmigaGuide format. Copy this one to anywhere you like.

examples/ Very simple example files.

arexx/ ARexx macros. Copy to your ARexx: directory, whichever ones you are going to use.

See also examples/alias.txt file.

(User friendlies at the best 8' | )

## 1.6 1.4 Good & Bad

My personal view on this assembler.  
(Things are not listed in any particular order)

Good:

- It's free.
- Most common directives are supported.
- Macros are supported.
- All 680x0, 6888x, 68851 and 68030 PMMU instructions are supported
- Does normal optimizations, including forward branches.
- It's coded in assembler. (See below, Bad things).
- Enforcer was in duty all the time I coded, checked, debugged...
- Supports all data types of 680x0 6888x family (I think).  
(FFP conversions are not supported).
- ARexx interface.
- Global symbol table

Bad:

- 68040/68060 instructions (those few) are not yet supported.
- All source files must fit into memory at the same time.
- It's coded in assembler. Messy code sometimes - my fault, my problem. (Moral: Assembly language is a two edged sword).
- Some sort of beginner's help would be good (sources...).
- Only output format is Amiga object code.
- No GUI, but I'm not so sure this would even be useful.
- It's driving me crazy, sometimes.

## 1.7 1.5 History of SNMA

History is now contained in a separate text file entitled "History".

## 1.8 1.6 Bug reports

Bug reports are WELCOME.

Please, state the following facts:

- 1) Your system configuration (Model, CPU, MEM, OS, ...) and the version of SNMA.
- 2) What you did - Source code which caused the bug - If I can't make the bug reappear, it is an awful task to find out what went wrong. If at all possible try to isolate the bug. Usually, only a tiny section of source code is required to show it. Or, if the bug is not directly related to the source code, describe it clearly (in any case).

If you find something is implemented badly, missing or could use a little polishing, along with other similar things, suggestions are welcome.

---

Where to report, see `author` .

```
-----
--* fixed bug better bug *--
-----
```

## 1.9 1.7 Misc., general things

Some words from the inner workings of SNMA  
 ~~~~~

SNMA is not a traditional two pass assembler although its operations can be divided into two stages. Source files are read and parsed only once. SNMA creates its own internal structures in this first pass. In the second pass, `snma` solves all undefined symbols, optimizes code, recalculates the changed values (like pc-relative stuff) and writes object code (and other requested files).

Listing file creation is sloooow. (I suspect the buffered IO, but I cannot make sure because I don't have 3.1 where `SetVBuf()` actually does something).

Memory usage by `snma` isn't the most economical since all source files must fit into memory. (Not to mention the way I implemented all the other stuff). Strip the comments from the include files you use because that will reduce memory usage.

As a memory usage example:

```
One source code module:      size 25625 bytes, 1061 lines
                             (7432 lines with includes)
```

SNMA uses 99403 bytes to store source files and 225356 bytes for all the other stuff making a total of 324759 bytes.

The way I have implemented macros costs memory since `snma` needs the produced macro lines to be in memory during the second pass where expressions with relative and undefined symbols are re-calculated and possible errors shown. (SNMA won't read the source twice).

I know the actual `snma` file is quite large also. Well, I can't help that a lot, without a complete re-design and re-write which is not in my top ten list of how to spend the next years of my life.

The development of SNMA
 ~~~~~

I started the development of `snma` somewhere in the first half of 1993. I have written SNMA entirely in assembler - first I wrote most of it with a68k and then minor parts with `snma` itself. Now I'm using `snma` only - it is good enough for that.

SNMA operates pretty stable on my system (A2000, GVP A3001 28Mhz

---

68030/882, 4M fast 1Mchip, OS2.04). I'm developing it in my free time and have spent long nights staring at my old 1081 and wondering what the \*\*\*\* is wrong with everything.

## 1.10 1.8 Thanks

Thanks  
~~~~~

First, to the following people:

Eric Augustine for helping me with this guide.
Laura Mahoney for sending me source code.

and all the other people who have sent in bug reports.

I really must thank all you who have made so much wonderful 'Freely Distributable' software for the Amiga.

Also, thanks to the following people for the software I use while developing SNMA:

- Charlie Gibbs, A68k
- Matt Dillon, DME and DLink
- Aaron Digulla, XDME
- Steffan Becker, ToolManager
- Jorrit Tyberghein, PowerVisor.

1.11 2. How to use

SNMA can be started from the Shell or from the WorkBench.

- 2.1 Shell startup
- 2.2 Workbench startup
- 2.3 Starting arexx host

1.12 2.1 Startup from shell

SNMA can be started from the shell like a 'traditional' assembler. It parses its arguments using AmigaDOS 2.0 templates. Some of the options can be specified also in the 'old way', i.e. with '-'. These 'old way' arguments override the template arguments.

Command Line template:

```
SNMA  
SOURCEFILE/A O=OBJ/K O=OBJ/K I=INCLUDE/K H=HEADER/K E=EQUATE/K
```

L=LISTING/K Q=QUICKOPT P=PCOPT A=ADDRESSOPT B=BASEFORCE S=SYMBOL
 LB=LONGBRA AREXX/S PORTNAME/K QUIET/S PAGELEN/K/N LNM=LSTNOMAC/S
 LOD=LISTONLYDATA/S EXEOBJ/S SR=SHORTRELOC32 KEEPOBJ/S MOVEM/T
 EC=ERRCOLOR/K/N DEBUG/S OL=OPTLEVEL/K/N TD=TYPESDIR/T
 CS=CASESEN/T

Where:

SOURCEFILE is the name of the source file. It is a first argument and must always be there.

OBJ defines the name of the object file.
 O alias: -o<name>

INCLUDE defines a list of directories where the INCLUDE
 I directive searches for include files.
 alias: -i<namelist>

HEADER defines one file to be included before any lines from
 H the source file are assembled. Only one is allowed.
 alias: -h[<name>]

EQUATE defines the equate file name to be created. An empty
 E string is allowed in which case SNMA creates the name
 from the source file name. Currently the equate file
 is generated at the end of assembly. Symbols are taken
 from the hash table, so they are in mixed order. You
 can use the AmigaDOS SORT command if you like some sort
 of order.
 alias: -e[<name>]

LISTING Listing file to be created. Minimal formatting may be
 L done by using the PAGELEN option.
 alias: -l[<name>]

QUICKOPT Quick optimizing flag, default: on
 Q

PCOPT pc-relative optimizing, default: off
 P

ADDRESSOPT effective address optimizing default: on
 A

BASEFORCE Auto-force (Bd,An)->(displ6,An) default: on
 B

SYMBOL Write symbol data hunk default: off
 S

LONGBRA Long branches (wo/size field) default: off
 LB

AREXX flag to start AREXX command host SNMA. Overrides
 other directives.

QUIET Disables informational output.

PAGELEN Defines pagelen used in listing file. If null, snma does not create pages (useful if you want to do your own formatting).
Default: NULL.

LSTNOMAC Don't include macro expansions in the listing file.
LNM Default: off.

LSTONLYDATA Only list the lines which actually define some data.
LOD Default: off.

EXEOBJ Produces an executable, instead of an object module.
SNMAOPT e+ causes same effect.
Default: off.

SHORTRELOC32 write HUNK_RELOC32SHORT instead of HUNK_RELOC32 when-
SR ever possible. Has effect only when EXEOBJ is also specified. Note that the actual hunk written is NOT HUNK_RELOC32SHORT (1020) due to a 2.0 bug, but it is HUNK_DRELOC32 (1015). Since that hunk cannot be in an executable it doesn't matter. Executables which have this hunk, work only in OS 2.0 or later.
Default: off.

KEEPPOBJ Don't delete object file if there are errors in source file.
Default: off.

MOVEM Optimize movem (to move or remove) if possible.
Default: on.

ERRCOLOR ANSI color code for the error highlightning.
EC Default: none.

DEBUG Include LINE DEBUG hunks to all sections. See also debug directive and snmaopt d.
Default: off.

OPTLEVEL Number of maximum optimizing passes. One optimization OL may make more optimization possible. You can define the maximum number of levels snma will take. SNMA will stop optimizing when there is nothing more to optimize.
Default: 1.

TYPESDIR Toggle some directives which override some types.i macros.
TD Default: off.

CASESEN Toggle to use case-sensetine (ON) or -insesensitive (OFF) CS symbols.
Default: on.

See Options .

SNMA does not check the stack. I haven't had problems with a stack

size of 4000 bytes. You can overflow the stack with very nested includes. One level takes about 100 bytes, so "very" means something like 40 levels. Actually, a little less. If you worry about that, use a bigger stack.

Examples

1.13 2.1.1 template: old flags

Many applications use the '-' as an option start character. (like: a68k file.asm -l -iinclude:).

If you wanted to just flag that you needed some file to be generated and wanted snma to create the file name from the source name, you had to pass an empty string (like LISTING ""). I have to admit that this isn't a very elegant method and when trying to pass options to ARexx macros I had many problems with the quotes. So, to allow easier use, a couple of '-' flags are also allowed on the commandline. In template they show as OLDFLAGS/M template. In the template explanation they are referred to as 'alias:'.

To use style old flags, just specify -<flag> in the commandline.

For example: ->snma source.asm -l -e

Request listing and equate file.

1.14 2.1.2 Command Line Examples

```
prompt> SNMA mycode.asm obj mycode.o include myinc:
```

Mycode.asm is a source file, mycode.o is an object file and include files are searched for in the current directory and then from myinc: directory.

```
prompt> SNMA mycode.asm Q on A off B off S on I work:,work2:inc
```

mycode.asm is a source file. Flags are set on and off. Include files are searched for in the current directory, work: and work2:inc.

```
prompt> SNMA mycode.asm EQUATE myequ
```

produces the equate file named myequ.equ and mycode.o object code.

```
prompt> SNMA mycode.asm E ""
```

produces the equate file named mycode.equ and mycode.o object code.

```
prompt> SNMA arexx
```

Starts SNMA ARexx command host.

```
prompt> SNMA mycode.s -e -l -iinclude:
```

mycode.s is source code, -e and -l flags snma to produce equate and listing file, and -iinclude: tells snma to search include files from the include: directory.

1.15 2.2 Workbench support

SNMA may be started from the Workbench, too. Its behaviour is controlled with ToolTypes. SNMA can assemble file(s) or start AREXX SNMA. You can disable a ToolType by removing it or setting it to parenthesis "()".

Tooltypes:

~~~~~

AREXX flag to start snma in AREXX mode.

PORTNAME=<name> AREXX port name. If omitted, snma uses the default name (SNMA).

WINDOW=<file> Specify output file. If omitted, snma will use its default output (CON:...). If the AREXX flag is set too, no default output is created, if omitted. See AREXX/SET

The default tooltypes are set so that AREXX snma will be started. You can have several SNMAs running at the same time (although it is not very useful). If you click several times on the snma icon many SNMAs will be launched, each with a different portname. See AREXX

To stop SNMA you have to send a QUIT command to it. Here's how you do that from the shell:

```
->rx "address SNMA QUIT"
```

where "SNMA" is the name of the AREXX port.

How do you stop snma from the WB? For example, use a tool like ToolManager and create the "SNMA OFF" command which is just like the above shell command.

If you want to assemble files using the icons, I suggest you use something like ToolManager, which makes your life a lot easier.

I added the WB support mainly because it may be helpful to start SNMA in AREXX mode from an icon.

If you start SNMA from the WB and pass it arguments (ie: you have selected other icons as well), SNMA will try to open WINDOW=<file>, if omitted it will open its default output window. Then the passed file(s) is(are) assembled just like in shell mode. SNMA won't

check any of the tooltypes or arguments and it does not check if there's already an snma ARExx port where the assembly could be directed. (I highly doubt that anyone will use this method, but it was rather easy to implement so there it is).

## 1.16 2.3 Starting the ARExx SNMA host

SNMA can be started as an ARExx host and I suggest it be used that way.

Startup from:

- Shell use AREXX template
- WB use AREXX tooltype

See ARExx section (4.).

## 1.17 3. Features of SNMA

This section covers all features of SNMA, relating to the actual assembly process.

3.1 Source code format

3.2 Symbols

3.3 Expressions

3.4 Addressing modes

3.5 Directives

3.6 Data types

3.7 Things to note

3.8 Errors

## 1.18 3.1 Source code format

The format of the source code is 'standard'.

One line can be 256 bytes long (after macro expansion, too).

One source code line may have the following components:

---

<Label> <opcode> <operands> <comment>

<Label> Labels must start from the first column.  
It may end with a colon (':').

Legal label characters are 'A-Z', 'a-z', '0-9', '\_', '.', or codes 127-255 (like äöåÐ). I decided to handle all the characters in the range 127 to 255 as symbol characters.

First character must be: 'A-Z', 'a-z', codes 127-255, '\_', '.' After that digits (0-9) are legal too.

Local labels are supported. You have three alternatives to define a local label:

- 1) add a '.' in front of it. For example: .local
- 2) add a '\' in front of it. For example: \local
- 3) add a '\$' to the end of it. For example: local\$

Local labels may also start with a digit (actual label portion). (1\$, .1, ...)

<opcode> Opcode field is separated from the label field by at least one space. An Opcode can be:

- 1) MC680x0 operation code (instruction).
- 2) Assembler directive .
- 3) Macro invocation.

<operands> Operand field is separated from the opcode field by at least one space. The Operand field may contain 0 to 9 operands depending on what is in the opcode field. Operands are separated by a comma (,). There can now be 99 macro operands.

<comment> Anything after the operand field is ignored and treated as a comment. Those MC680x0 instructions which don't have operands ignore anything after the opcode field. Anything after a ";" character is treated as a comment. If the character in the first column is a "\*", the entire line is considered a comment or if the opcode is a \* it is ignored.

## 1.19 3.2 Symbols in SNMA

Symbols in SNMA have different meaning, depending on where they are used.

Absolute, relative, register and register list symbols are case-sensitive by default, but you can change this behaviour with "snmaopt c-" or with CASESEN=OFF commandline toggle.

### Absolute symbols

~~~~~

Absolute symbols are defined with the EQU or SET directive. Symbols may be local symbols in the same way as labels. See the label definition. Absolute symbols refer to numerical values.

Example

SNMA pre-defines some symbols with the SET directive.

Relative Symbols

~~~~~

Relative symbols are labels, or equates which have relative symbols in the expression which defines it. The only exception to this is expression Relative-Relative which results in an absolute type. See expressions for restrictions on relative symbols.

"\*" is a special symbol and is the value of the program counter(PC).

For example:

```
data    ds.b    100      ; define space 100 bytes
size    equ     *-data   ; size gets value of 100 (abs type)
```

### Register Equates

~~~~~

Register equates are defined with the equr directive.

"Register symbol" refers to the register (Dn or An).

Register lists

~~~~~

Register lists are only allowed in movem and fmovem instructions. They are defined with reg directive.

"Register list" refers to the list of registers.

### Macro symbols

~~~~~

Macros are defined with the macro and endm directives.

"Macro symbol" refers to the defined macro.

Names of macros are always case-insensitive.

1.20 Pre-defined symbols

SNMA pre-defines the following symbols with SET.

symbol name	value
~~~~~	~~~~~
SNMA	0
snma	0
NARG	0 (actually number of args in macro call)
M68000	1
M68010	2
M68020	4
M68030	8
M68040	16
M68881	512
M68882	512
M68851	2048
F040	1024

M68xxx symbols are meant to be used with the `cpu` directive.

See also `register names` .

## 1.21 Register names

SNMA uses the following register names:

D0-D7 A0-A7 SP CCR SR SFC DFC CACR USP VBR CAAR MSP ISP FP0-FP7  
 FPCR FPSR FPIAR TT0 TT1 TC DRP SRP CRP CAL VAL SCC AC MMUSR PSR  
 PCSR BAD0-BAD7 BAC0-BAC7

Registers from the CCR in the above list are special registers. If the name of special register is the only component of an address mode (like `'lea CAL,a0'`) snma considers it to be a special register. If the name of a special register is one of the components of an address more (like `'lea (CAL,pc),a0'`) it is treated as a normal symbol. However, to avoid any confusion, I strongly suggest that you use these names only when referring to the special registers.

## 1.22 3.3 Expressions in SNMA

Expressions can be used almost anywhere where numerical components are needed. The only exception being floating point numbers which don't allow expressions. Expressions use 32 bit integer math.

Expressions may have: 1) symbols, 2) constants, 3) operators, 4) parenthesis.

1) Symbols must be absolute or relative symbols.

2) Constants are numbers. They can be decimal, hexadecimal (\$), octal

(@) or in binary (%) form.

3) operators (in the order of precedence)

- Unary minus
- ~ bitwise NOT (one's complement)
- << left shift
- >> right shift
- & bitwise AND
- ! or | bitwise OR
- * multiply
- / divide
- // modulo
- + add
- subtract

boolean operators (TRUE <> 0, false = 0)

- =, == equal to
- !=, <> not equal to
- < less than
- <=, <= less than or equal to
- > greater than
- >=, >= greater than or equal to

4) Parenthesis are (). They may be nested.

For example:  $3*((12-6)/(2+2))$

Expressions are either absolute or relative, depending on the types of symbols and operators. Relative symbols are allowed only to add and sub(tract) operands. When an expression is evaluated, it is divided into the sub-expressions to the stage

<number operand number>

where number can be a symbol. This sub-expression gets its own sub-type. Confused? See below.

For example:  $(Rel2-Rel1)/4$  is a legal expression, because the type of  $Rel2-Rel1$  is absolute although they are both relative symbols. See the table below.

Following table shows types of expressions.

A = Absolute , R = Relative, - = not allowed

Operator	operands			
~~~~~	~~~~~			
	A op A	A op R	R op A	R op R
+	A	R	R	-
-	A	-	R	A
*, /, //, &, !, <<, >>			A	- - -

1.23 Local symbol example

The following example demonstrates local and global symbols.

```
; start-----
num equ 123    ; define global symbol
start:
.num equ 10    ; define local symbol
  move.l #.num,d0 ; move 10 to d0
  move.l #num,d1 ; move 123 to d1
new:
.num equ 23    ; define local symbol
  move.l #.num,d0 ; move 23 to d0
  move.l #num,d1 ; move 123 to d1
  rts
  end
; end-----
```

1.24 3.4 Address modes

SNMA supports all the addressing modes of the 680x0.

SNMA supports Motorola's new addressing mode format as well as the old format. I don't have any of the Motorola's manuals, but I have seen enough 'new format' sources. The change is more cosmetic, I think. (Aku(a0) in the new format is (Aku,a0)).

Forcing the size

~~~~~

In some places, you can force a value to be either word or long word. This is generally used to force something to word size, but it can be used to force something to long as well. Forcing is implemented by adding the .w (for word) suffix or the .l (for long word) suffix to the symbol. For example, 'move.l (4.w),a0'.

Note1: The above addressing mode is optimized when using simple 'move.l (4),a0'. 'move.l (4.l),a0' will not allow optimizing due to the forcing suffix.

Note2: SNMA won't complain about the mode (4).w, but it does ignore the forcing suffix. The above mode is discouraged anyway if you take a look at the new Motorola addressing mode syntax. At least in SNMA.

Currently you can't force to byte like "num.b(a0,d0.w)" but you can do it by disabling 020+ code generation by using mc68000 directive. This is a little ugly, I know. Maybe I'll add a ".b" suffix in some day.

Base displacement modes (including Memory Indirect)

~~~~~

You can force Base Displacement and Outer Displacement to be a long word or word with the .l (long) or .w (word) suffix.

For example: ([BD.w,A0,d1.w],OD.l) where BD and OD are symbols.

SNMA will optimize addressing modes to the best possible. If certain components are omitted a change to a quicker mode can be made. When you force some value with a .l or .w, the value must be within range and even if the actual value could be optimized it is not because it is forced.

Example:

```
jsr (BD.w,a6)
  BD equ 0
```

```
; Although BD is null, generated addressing mode will be displ6(An)
; because we forced BD to be word.
```

```
tst.l (BD,a0)
  BD equ 0
```

```
; This will generate addressing mode (An)
; end of example
```

The same applies to Outer Displacement, except that addressing mode is always Memory Indirect if there is OD.

Don't worry if the above is confusing. You don't usually have to force anything since SNMA optimizes to the best mode for you. If you want some value to be an exactly specified size (when importing a value, for example) forcing can be a handy feature.

No Address Register in addressing mode

~~~~~

When an address register is not part of address generation you have two ways to exclude it. First, just don't set it (like (d2.l) ). Then you can always use a Zero Suppressed address register using the name ZAn (n does not matter) instead of An. For example,

```
(10,d3.l)      =      (10,za0,d3.l)
(d1.l)         =      (za0,d1.l)
(10,a2.w)      =      (10,za0,a2.w)  index register is An
```

You may wonder what the <---> is this Zero suppress stuff. The book I used as a reference manual mentioned it and I being a fool, didn't realize until now (a long time passed) that the index register has (err.. may have - that .l or .w - it is good practise to use them) suffix information which says, "HEY ! I'm the index register".

Oh well...

Immediate values

~~~~~

SNMA checks immediate values so that they are in range, depending on the size of the instruction. Immediate values can also be longer than 32 bits if the instruction is some fpu/mmu instruction. FPU instructions allow real mode definition of a number like $-11.13232e-2$. The sizes of FP values are not checked.

Optimizing Address modes

~~~~~

Address modes are optimized very well in SNMA. Forward optimizing is also included. See the SNMAOPT directive and above for more information. I suggest that you keep addressing mode optimizing on, especially when the 68020+ mode is on because of the way SNMA works. You will definitely get the worst addressing mode if the symbols are not defined when the line is assembled first time.

## 1.25 3.5 Directives

The following directives are supported:

|         |                                  |
|---------|----------------------------------|
| CLRFO   | Reset _FO                        |
| CNOP    | Conditional NOP                  |
| CNUL    | Conditional NULL                 |
| CPU     | Define CPU ID type               |
| DC      | Define Constant                  |
| DCB     | Define Constant Block            |
| DEBUG   | Write line debug hunk            |
| DS      | Define Space                     |
| DX      | Define BSS space                 |
| ELSEIF  | Conditional assembly toggle      |
| END     | End of source file               |
| ENDC    | End conditional assembly         |
| ENDIF   | Alias for endc                   |
| EDNM    | End macro definition             |
| ENDR    | End repeat block                 |
| EQU     | Define symbol value              |
| EQUR    | Define register equate           |
| EVEN    | Ensure PC is even                |
| FAIL    | User error                       |
| FO      | Frame offset                     |
| IDNT    | Set program unit name            |
| IFC     | Assemble if strings equal        |
| IFcc    | Assemble if condition true       |
| IFD     | Assemble if symbol defined       |
| IFNC    | Assemble if strings not equal    |
| IFND    | Assemble if symbol undefined     |
| INCBIN  | Include Binary                   |
| INCDIR  | Include directory list           |
| INCLUDE | Include source file              |
| LIST    | Turn on listing file generation  |
| MACRO   | Start macro definition           |
| MC680x0 | CPU mode                         |
| MEXIT   | Exit from macro                  |
| NOLIST  | Turn off listing file generation |

|           |                               |
|-----------|-------------------------------|
| OPT       | Changed to SNMAOPT            |
| REG       | Define register list          |
| REPT      | Start repeat block            |
| RS        | Define structure offset       |
| RSRESET   | Reset <code>_RS</code>        |
| RSSET     | Set <code>_RS</code>          |
| SECTION   | Start new section             |
| SET       | Define SET value              |
| SETFO     | Set <code>_FO</code>          |
| SNMAOPT   | Define options                |
| SMALLDATA | Enable small data for section |
| XDEF      | Export symbol                 |
| XREF      | Import symbol                 |
| types.i   | types.i macros as directives  |

## 1.26 3.5.1 types.i directives

SNMA has most of the `exec/types.i` macros defined as directives. Although this doesn't save very much assembling time it reduces memory usage because `snma` doesn't need to create macro lines.

You can enable/disable this feature with `'snmaopt T'` flag or with a `'typesdir'` toggle in a startup template. By default this feature is disabled.

As you can see, you probably need to include `types.i` because there is only structure definition stuff at the moment. (This does not take into consideration what kind of modifications people have made to the their `types.i` file)

Currently , the following `exec/types.i` macros are supported:

```

aptr   <name>[,how many]   (32 bits)
byte   <name>[,how many]   (8 bits)
bool   <name>[,how many]   (16 bits)
cptr   <name>[,how many]   (32 bits)
double <name>[,how many]   (64 bits)
float  <name>[,how many]   (32 bits)
fptr   <name>[,how many]   (32 bits)
label  <name>
long   <name>[,how many]   (32 bits)
rptr   <name>[,how many]   (16 bits)
struct <name>,<how many>
structure <name>[,offset] (offset=0 if omitted)
short  <name>[,how many]   (16 bits)
ushort <name>[,how many]   (16 bits)
ubyte  <name>[,how many]   (8 bits)
ulong  <name>[,how many]   (32 bits)
ushort <name>[,how many]   (16 bits)
word   <name>[,how many]   (16 bits)

```

[,how many] field is extension to the `exec/types.i` macros.  
 'Structure' doesn't require initial offset (basic macro does).

Notice that there are no data type checks so most of these directives do same thing (the ones which have same size).

Example:

```
structure MyDataStruct
  aptr      ptr      ;ptr      = 0
  byte     col1     ;col1     = 4
  byte     col2     ;col2     = 5
  word     mask     ;mask     = 6
  aptr     planes,8 ;planes= 8
  long     count    ;count    = 8+8*4 = 40
  label    sizeof   ;sizeof= 44
```

## 1.27 CLRFO directive

CLRFO

Resets the `_FO` variable to 0.  
See also `FO` and `SETFO`.

## 1.28 CNOP directive

Conditional NOP. This directive is used to align data arbitrarily.

CNOP `offset,alignment`

Offset is a value which is added to the alignment.  
Alignment is an alignment boundary value.

`cnop 0,4` aligns `pc` to the long word boundary.

`cnop 2,8` align `pc` to the 8 byte boundary plus two bytes.

## 1.29 CNUL directive

CNUL `offset,alignment`

Conditional NULL. Same as `CNOP` but, unlike the `NOP` directive, it pads with null word.

## 1.30 CPU directive

---

CPU <expression>

Defines what kind of instructions are legal. This is also used for FPU and MMU instructions.

Expressions are simple numerical values which are set to the internal SNMA variable (CPU command is only way to set it, it is not a symbol). See Pre-defined symbols .

M68000  
 M68010  
 M68020  
 M68040  
 M68851 MMU  
 M68881 FPU  
 M68882 FPU same as M68881  
 F040 MC68040 floating point only  
 M030 68030 MMU

Examples:

CPU M68000 enables 68000 instructions  
 CPU M68000!M68010!M68020 enables instructions of those cpu's.  
 CPU M68020!M68030!M68881 enables FPU instruction also.

This directive can be used so that if code is desired to be run on M68000 machines you can check that there are no other instructions than those which the MC68000 recognizes. All combinations are possible. CPU -1 enables all instructions to be assembled. SNMA performs "CPU -1" in the beginning of the assembly.

See also MC680x0 directives.

## 1.31 DC directive

Define Constant

DC.n <expression> or <single value>

n is size of data.

See Data types .

dc.b 2+1 reserves one byte and sets 3 to its value.  
 dc.l 12 reserves long word and sets 12 to its value  
 dc.s \$FEEBD00D reserves long word and sets it to \$FEEBD00D  
 dc.d +12.9292e-2 reserves two long words and sets its value what that number is in double format (binary).

Expressions are only valid as integers. Expressions that are floating point numbers are not allowed.

If `n` is not defined the default size is `word`.

### 1.32 DCB directive

Define Constant Block

```
dcb.n <abs expression>, <value>
```

Reserves space for the given data type (`n`). All entries are set to a single value which is given as the second argument. See `Data types`.

### 1.33 DEBUG directive

DEBUG

Writes `LINE` debug hunk(s) to to the output file. Only affects the section where this directive is specified. If `DEBUG` commandline switch is used, `LINE` debug hunk is written to the all sections. "`SNMAOPT D`" can be used to switch `snma` to write the full path of the source name, which may be required with some debuggers.

This feature allows source level debugging to be used with debuggers which support that.

### 1.34 DS directive

Define Space

```
DS.n <abs expression>
```

Defines storage for the given data type (`n`).

```
ds.b 12 reserves space for 12 bytes
ds.l 3 reserves space for 3 longs (12 bytes)
ds.x 4*4 reserves space for 16 extended type fp number.
      (192 bytes)
```

`<abs expression>` must be evaluated and it cannot contain relative symbols (or undefined by far).

All reserved space is set to null.  
See `Data types`.

## 1.35 DX directive

DX.<size> defines BSS space to be allocated after code or data hunk. This directive only takes affect when producing an executable with snma. DX is like DS except that the size is reserved only from the hunk header. When the AmigaOS loads the executable it allocates memory as is specified in the size field of the hunk header. This size can be larger than the actual hunk size. Before 2.0 this memory range was not cleared and it must be done (if desired) by startup code. After 2.0 AmigaOS clears this area.

By using this method you can reduce the size of the executable and make more effecient BSS data references using combined DATA/BSS base register.

## 1.36 ELSEIF directive

ELSEIF toggles conditional assembly. If assembly was off it toggles it on and vice versa.

Warning! This one does NOT WORK as it should, when conditional assembly nests. (I should fix that...).

## 1.37 End Directive

End directive ends assembly. It is not required to be at the end of the source file. When the source file ends it also ends assembly. Anything after the END directive is not assembled.

## 1.38 ENDC directive

ENDC (alias ENDIF)

Toggles off conditional assembly if nest counts match.

## 1.39 ENDM directive

ENDM

Ends current macro definition.

---

## 1.40 ENDR directive

ENDR

Ends current repeat block.  
See REPT .

## 1.41 EQU directive

EQUate.

```
symbol EQU <expression>
```

Sets the value of the symbol to <expression>. Symbol and <expression> are both required. = is equivalent to equ.

See Expressions .

Floating point numbers are supported by specifying a size field to the EQU.

See Data types .

Only floating point data types are supported in equ if the n suffix is present. (You can't 'equ.b 5').

When a symbol is used as part of an fpu instruction simple type checking is done, but only between floating point types. The following code will cause an ERROR:

```
NUM    equ.d    +11.234343
    fmove.s #NUM,fp0
```

To fix this, change NUM to single or fmove to double.

```
NUM    equ.d    +11.234343
    fmove.d #NUM,fp0    declared type same as used type !
```

The following code will not cause an error, because fmove uses the long type which is not floating point type (okay, it would be good to check anyway).

```
NUM    equ.d    12.23232
    fmove.l #NUM,fp0
```

## 1.42 EQUR directive

EQUR means register equate.

It allows registers to be addressed as symbols.

Register equates must be defined before use.

Example:

```
count  equr  d0
      move.l #0,count      ; means move.l #0,d0
```

### 1.43 EVEN directive

EVEN aligns PC to be divisible by two if it is not already. It does the same thing as `cnop 0,2` See `CNOP`.

### 1.44 FAIL directive

FAIL flags the assembler to stop assembling. It is used to flag user errors. It may be used if a macro call won't get enough parameters for example.

### 1.45 FO directive

Label `FO.<size> <absexpression>`

Define frame offset. Useful with the `link` instruction. This is something like `RS` but decreases the counter `_FO` and then assigns the value to the symbol (label).

Sizes other than byte are aligned to the word boundary.  
See also `CLRFO` and `SETFO`.

It's good practise to keep your stack long word aligned. `FO` doesn't ensure it (how about some `FOLONG` directive?).

Little example:

```
clrFO      ; reset _FO (0)
longl fo.l 1 ;--4
bytel fo.b 1 ;--5
wordl fo.w 1 ;--8

link #_FO,a5      ; _FO = -8

      ;-- set all local variables to 0.

clr.l longl(a5)
clr.b bytel(a5)
clr.w wordl(a5)

unlk a5
rts
```

The stack looks something like the following after `link`:

```

a5
  offset
  ~~~~~~
SP-> -8 [] word word1
 -6 [] byte pad byte
 -5 [] byte byte1
 -4 [] long long1
a5 -> 0 [] long old a5

```

## 1.46 IDNT directive

```
IDNT <name>
```

Sets the name of the program unit to <name>.

## 1.47 IFC directive

```
IFC 'string1','string2'
```

If string1 = string2 DO assemble.

See also IFNC .

## 1.48 IFcc directives

```
IFcc <expression>
```

IFcc is a conditional assembly control directive. cc is the condition. The expression is tested against the value of zero.

```

directive means
(condition)
~~~~~
IFEQ <expression>  EEqual
IFNE <expression>  NEqual
IFGT <expression>  Greater Than
IFGE <expression>  Greater or Equal
IFLT <expression>  Lower Than
IFLE <expression>  Lower or Equal

IF <expression>   If true (not equal)
IFT <expression>  If true (not equal)
IFF <expression>  if false (equal)
IFNT <expression> if not true - false (equal)

```

If the condition is true, assembly is continued. If the condition is false assembly is turned off. The ENDC directive ends conditional assembly.

## 1.49 IFD directive

IFD <symbol>

Conditional assembly trigger.

IF symbol is defined, do assembly, else don't.

See also IFND .

## 1.50 IFNC directive

IFNC 'string1','string2'

If string1 <> string2 DO assembly.

See also IFC .

## 1.51 IFND directive

IFND <symbol>

Conditional assembly trigger.

IF symbol is not defined, do assembly, else don't.

See also IFD .

## 1.52 INCBIN directive

INCBIN <file>

Incbin directive includes the named file into the code in its binary form. No assembling is done on the file. If you had a file named bin and it contained following data in hex form (4 bytes long file):

```
0BAD BEEF
```

Now..

```
IncBin bin
```

would do same as

```
dc.l $0BADBEEF.
```

If the length of the file is not even, an extra null byte is added to the end of the data when it is set to the produced code. This makes sure that the program counter stays aligned. This is just the same as the Incbin without this feature (in SNMA this feature is always on):

---

```
incbin <file>
even
```

Thus, above 'even' is done automatically (always) by 'incbin' and is unnecessary in SNMA.

### 1.53 INCDIR directive

```
INCDIR <mydir1>[,mydir2,mydir3...]
```

INCDIR adds directories to the directory list where the INCLUDE files are retrieved from.

INCBIN uses this list, too.

### 1.54 INCLUDE directive

```
INCLUDE <file>
```

Startsx to assemble <file>. After it has been assembled, snma continues assembling after the INCLUDE directive.

Include files are looked for first in the current directory, and then in in the directory list which can be defined in command line or with the INCDIR directive. If an include file is not found during assembly the assembly is terminated immediately (fatal error).

When snma is in ARexx mode it can have global include tables. If <file> is already in the global table it is skipped (not even loaded into memory). See ADDGB .

### 1.55 LIST directive

LIST turns on listing file generation. You can disable portions (like includes) of a listing file to be generated with the LIST and NOLIST directives. These do not nest.

### 1.56 MACRO directive

```
<Symbol> MACRO
```

Starts macro definition. Code inside a macro definition is not assembled until the macro is called. The NARG symbol is set to the number of arguments passed to the macro, when the macro is called. Macro names are case-insensitive.

---

The Macro call may have up to 99 parameters. A produced macro line must fit into 256 bytes, however. If a parameter is enclosed between "<" and ">", it can contain any characters (including commas, spaces, tabs) except the ">" (which always ends the parameter started with "<") and LF (\$a).

Backslash ("\") has special meaning in macro definition. If character after it is:

- 1) 01-99 insert argument number <number>
- 2) 0[0] insert size field of macro call
- 3) @<label> produces unique label (like local labels).
- 4) \*<function()> executes special function

Argument number (1) may be defined with one or two digits. If you want to produce something like <argument><number> with arguments below 10 you must set the leading 0, otherwise it is not required.

```

;-----
  simple examples:

BURGER macro
  dc.b "\011"
endm

BURGER HAM      ; produces dc.b "HAM1"

Do macro
  move.\0 \1,\2
endm

Do.b d0,d1      ; produces move.b d0,d1
;-----

```

Special functions (4) insert the resulting string into the macro. If there is an error the actual function call is inserted. These 'functions' do not nest, BUT you can define macro arguments in the argument of a function (like \\*valof(\1)).

The parenthesis are always required because there must be some way to tell when the 'function' ends.

\\*VALOF(expression) inserts the numerical value of expression. This expression is only solved during pass1. If expression has relative components, optimization may change it but the change is NOT reflected here. Also, symbols in the expression must already be defined.

```

\*DATE(format)                inserts the current date string of the system.
  Format char      format type
  ~~~~~
 d DOS (dd-mmm-yy)
 i INT (yy-mmm-dd)
 u USA (mm-dd-yy)
 c CND (dd-mm-yy)

```

DATE() uses dos/datestamp.

```

*TIME() inserts current system time
 TIME() uses dos/datestamp.

```

```

*VAR(name) inserts local or global (ENV:) dos variable
 using dos/GetVar().

```

```

*STRLEN(string) inserts length of string
*UPPER(string) converts string to uppercase
*LOWER(string) converts string to lowercase

```

```

DATE macro
 dc.b 'Assembling Date: *DATE(d)',0
 endm

```

## 1.57 mc680x0 directives

The following directives are shortcuts to the cpu directive.

```

mc68000
mc68010
mc68020
mc68030
mc68040
mc68881
mc68882

```

These do the same as CPU with a single argument, which is one of the types of cpu. MC68881 (mc68882) enables also 68020 (68030). Using the CPU directive, you can control arbitrarily the value of CPUID.

mc68040 is bit useless now because I still don't know the 68040 specific instructions.

## 1.58 MEXIT directive

```

MEXIT

```

Exit from macro definition.

---

When macro is called it may be useful to exit from macro expansion before actual macro ends.

Used usually in conditional macros.

## 1.59 NOLIST directive

NOLIST directive turns off listing file generation.  
See also LIST directive.

## 1.60 SNMAOPT directive

SNMAOPT flag[,flag,flag...]

where flags are:

Q Quick optimizing. Move->moveq, add->addq, sub->subq whenever possible.  
Default: On

P Absolute long addressing -> program counter relative whenever possible.  
Default: Off

A Effective address optimizing. 0(An)->(An), BD and OD optimizing if 0 or word. (BD,An)->displ6(An) if possible. Optimizes address modes as quick as they can be.  
Default: On

B Auto-force (BD,An) -> displ6(An). You can override by disabling this flag or using .l suffix in the symbol. (BD.l,An) makes the addressing mode always long irrespective of the B flag. This feature is present because routines in the run-time libraries can all be called by the (displ6,An) mode. Displacement can be an xref'd symbol which is solved during link time. Because symbol is xref'd it must be treated as 32 bit because in theory it can be this way. All library calls however can use (displ6,An) mode. In using this option you needn't add the .w suffix to all calls.  
Default: On

S With this flag symbol hunks are written to the object file. This is handy when using symbolic debuggers.  
Default: Off

L Long branches. Enable long branches if there is no size field in Bcc instructions.  
Default: Off

---

- E Produce executable (instead of producing object code).  
Source file cannot have xref statements. Sorry, no  
DATA+BSS coagulation yet.  
Default: Off
- R RELOC32SHORT to executables, implemented as 1015.  
Default: Off
- J 'jsr <ea>, rts' pair to the jmp <ea> if rts is not  
referenced. See Opt j example.  
Default: Off
- M Movem to move if only one reg.  
Default: On
- D Write the full path of the source file to the line  
debug hunks. See also DEBUG.  
Default: Off.
- T SNMA has some exec/types.i macros defined as directives.

Flags are case-insensitive.

Example:

```
OPT S,P+,b-
```

Write symbol hunks, Optimize Absolute long -> pc-relative,  
Disable Auto-forcing of (BD,An).

## 1.61 OPT J example

```
Little example:
...
jsr SubRoutine
rts
 Can be converted to
...
jmp SubRoutine
 because SubRoutine (usually) ends to rts.
```

Be careful with this one - if you pass parameters via  
stack or do something else that depends on a return  
address being in stack, DO NOT USE this.

If you have enabled this optimizing, you can locally disable it  
by setting a label to the rts or by using snmaopt directive.

## 1.62 REG directive

Symbol REG <reg-list>

REG directive specifies the register list used by the movem instruction. List may contain a symbolic register name defined by equr. Symbolic register lists must be defined before use. Symbols defined by the REG directive can be used only with the movem instruction. <reg-list> may be omitted. If <reg-list> is empty, the movem instruction, which uses empty list, is not generated.

example:

```
list reg d0-d3/a0-a2/a5
movem.l list,-(sp) push registers onto stack
nop
movem.l (sp)+,list pop registers from stack
```

## 1.63 REPT directive

REPT <num>

Starts repeat block. <num> specifies how many times repeat block is repeated.

Example

```
rept 100 ; clear 400 bytes
clr.l (a0)+
endr
```

See ENDR .

Don't define things inside a repeat block, use include or something similar.

## 1.64 RS directive

Label RS.<size> <absexpression>

RS directive can be used to define structure offsets. Label is always required (for obvious reasons). Size field is one of the allowed. See data types . Expression must be absolute and defined before use.

Simple example:

```
rsreset ; reset _RS

num1 rs.l 1 ; num1 = 0
double rs.d 1 ; double = 4
```

```
byte rs.b 3 ; byte = 12 (3 bytes)
word rs.w 1 ; word = 16 (auto-align to word boundary)
```

## 1.65 RSRESET directive

RSRESET

Reset the value of `_RS` symbol to 0. Equivalent to `RSSET 0`.  
See also `RS` .

## 1.66 RSSET directive

RSSET <absexpression>

Set `_RS` value. `_RS` can be set also with the `SET` directive,  
but DO NOT 'equ' it. See also `RS` .

## 1.67 SECTION directive

SECTION <name>[,<type>[,<mem type>]]

Start a new section. Name of the section is set to <name>.

The Type of section is one of the following:

```
CODE CODE_C CODE_F
DATA DATA_C DATA_F
BSS BSS_C BSS_F
```

`_C` extension specifies mem type (C=CHIP, F=FAST).

<mem type> specifies the type of the memory where the hunk  
should be loaded. It can be specified with <type> field by  
extension or with separate third argument which is CHIP or  
FAST.

## 1.68 SET directive

<Symbol> SET <number>

With `SET` you can define a symbol whose value can be changed  
arbitrarily later on. You can 'equ' set symbols but then they  
become absolute symbols which cannot be changed again.

---

## 1.69 SETFO directive

SETFO <absexpression>

Sets `_FO` variable to the <absexpression>.  
See also `FO` .

## 1.70 SMALLDATA directive

SMALLDATA [`<An>`]

Enables small data model for the current section. If the section has any base relative address modes which have `An` as a base register, snma handles them as being references to data area - ie. using `HUNK_DREL` or `EXT_DREF` hunks.

If register `An` is omitted , the default is `a4`.

To use small data model, you need linker `a` which can deal with `HUNK_DREL` and `EXT_DREF` hunks. Please refer to your linker documentation for more information on how to use the small data model. There are certain rules as to how to name sections which define data and so on.

## 1.71 XDEF directive

XDEF <symbol>[,<symbol>[,<symbol>...]]

Define external symbol. Defines a symbol value to be visible to other modules. (Export)

## 1.72 XREF directive

XREF <symbol>[,<symbol>[,<symbol>...]]

External reference to symbol. Defines a label to be imported from other modules.

## 1.73 3.6 Data types

Supported data types.

All data types are NOT supported by ALL instructions.

Directives which support:

DC.n  
DCB.n

---

DS.n  
 EQU.n (all integers are 32 bit values and they are defined  
 without a suffix).  
 RS.n

n is one of these.                    size  
 ~~~~~~                                ~~~~  
 b = byte                            ( 1 byte )  
 w = word                            ( 2 bytes)  
 l = long word                        ( 4 bytes)  
 s = single precision floating point number    ( 4 bytes)  
 d = double precision floating point number    ( 8 bytes)  
 x = extended precision floating point number (12 bytes)  
 p = packed floating point number            (12 bytes)  
 Used K-factor is 17 with packed type.

## 1.74 3.7 Things to Note

Things to note when using SNMA.

- 3.7.1 Instructions
- 3.7.2 Expressions
- 3.7.3 Include files
- 3.7.4 Directives
- 3.7.5 Misc.

## 1.75 3.7.1 Notes about instructions

Bcc (bsr, bra, beq,...) instructions  
 ~~~~~~

- If there is no size field (like bra or bsr) SNMA attempts to optimize the branch to the shortest possible. If the size field is given (like bsr.w) SNMA does not try to optimize the instruction. When generating jump tables, I wanted branches to be 'forced' to word size without altering the snmaopt directive (I don't remember those option chars even myself 8).

If the size field is omitted:

- LONGRA flag tells SNMA whether to use long or word size. LONGBRA=on enables long branches in these cases and LONGBRA=off disables longs, forcing SNMA to use word size branches.
- If the value is an external reference, SNMA won't optimize

it. Instead, depending the on `LONGBRA` flag (and the CPU mode) it may be set to `long` or `word`.

- Currently, if you `Bcc` to another module and SNMA ends up at a long branch, things go wrong. I have to dig out what is in those new hunks - about which my old Bantam book knows nothing at all. Until then be warned... (a change to `jsr` could be made but I'm searching for a more elegant method, like `RELRELOC32`) SNMA should really warn if this happens.

## 1.76 Bcc instruction

Bcc instruction. (Also `bsr`).

```
bhs = bcc
blo = bcs
```

```
Sizes: .s .b (byte)
 .w (word)
 .l (long)
```

## 1.77 3.7.2 Notes about the expressions

The Check of the data sizes  
 ~~~~~

SNMA checks that specified data fits where it is set. For example if you have the instruction `"move.w #100000,d0"` SNMA tells you that value won't fit as word. Positive number range is unsigned and negative signed (All internal math is 32 bit).

Remember that when using the NOT (`~`) operation all 32 bits are affected, not just parts of it.

Range checking can be annoying if you are using NOTs with bit masks and sizes other than long word. (Hint: you can mask values with AND) Checking of the ranges by SNMA reveals some bugs (value too big to fit in a byte) which were not noticed when using a68k, so I think it is a useful feature.

## 1.78 3.7.3 Notes about the include files

SNMA assembles V37 includes just fine.

The V40 includes which I got from `NativeDeveloperKit3.1` have very few problems with SNMA.

Oops... about `devices/conunit...` `<>` is a macro argument enclosure (or something like that) and is now supported by

snma.

NOTE: I haven't tried all the possible macros, so I don't claim all macros will work as intended. If you have some problems, a bug report is welcome.

StripC tool which is in the NDK3.1 won't handle the file exec/macros.i, BTW.

## 1.79 3.7.4 Notes about the directives

The OPT directive is changed to "SNMAOPT" to avoid any confusion with other assemblers which may have implemented the OPT directive differently.

The CPU directive works a little differently than the MACHINE directive found in some assemblers. So, to avoid any confusion I implemented a CPU directive.

## 1.80 3.7.5 Misc. notes

Alignement problems

~~~~~

SNMA does not produce mis-aligned code. One thing to mention:

```
;-----
s dc.b 'arg' line 1
sl = *-s line 2
 dc.w 0 line 3
;-----
```

The value of 'sl' will be 4 instead of the intended 3. SNMA 'adjusts' dc.b in this case with one null byte. To prevent this (so that 'sl' will get the right value), add EVEN or CNOP between line2 and line3. (It's good practice to have EVEN or CNOP 0,4 after 'DC.B's anyway).

One pass assembler

~~~~~

SNMA does not read and parse the source twice. So things like conditional assembly relating to the value of PC are probably going to break under snma. You don't have to declare normal symbols before you use them (with the exception of register equates and lists), snma is smart enough to create its private structures for them, and then solves them in pass2.

## 1.81 3.8 Error messages of SNMA

Error messages in SNMA are quite self explanatory. An error may be a "DEAD END" error which means that assembly cannot continue. An object file is NOT produced if there is even one error. If there is an old object file it is deleted so you don't link it by accident. There are a couple of warnings too. Grammar of the error messages is quite awful, by the way, but I hope you get an idea of what caused the error (I hope you understand this guide, too).

The first character of the possible cause of the error is underscored. This might sometimes be in the wrong spot, so don't wonder if you think the error is somewhere else (it can be). I added this feature later on and there are quite a lot of places I should adjust it so that the error column will be in the right spot always. When I find it is in the wrong place I usually (or sometimes) try to fix the problem, which is not quite a big one.

When the error is in a macro you get two messages in the SHELL interface. The first one tells you where the error is in the macro and the second, where the macro call is which caused the error. The error count is incremented by one, because there is only one error, except in AREXX mode where both are counted.

When an error is found in pass 2 (solving undefined symbols...) you get only one error message when it's in a macro. This needs some work but, you can see where the error is quite easily even now (well, not always...8-( )

If you get an error which says its an internal bug or something similar, a bug report is welcome and appreciated.

You can control the error message mechanism with AREXX/SET command.

## 1.82 4. SNMA, ARexx

The ARexx interface is implemented as a command host. The PORTNAME keyword in the template can be used to change the basename of the ARexx port. Default basename is SNMA.

RexxMaster must be running when using snma in ARexx mode.

SNMA itself cannot execute any ARexx macros, it is a simple command host.

4.1 General

4.2 Commands

4.3 Examples

SNMA's ARexx port is the first one I wrote so it may need

---

little more polishing, but it works the way I want. Totally different question: is that way the right one?... 8^)

## 1.83 4.1 general ARExx stuff

### GENERAL AREXX THINGS

~~~~~

I recommend you use snma as an ARExx host. Calling snma direct from the text editor and using a global symbol table cuts down assembly time. If you have difficulties in writing interface macros for the text editor you use, you can always utilize the ShellAsm.rexx macro. The interface is basically the same as in snma's shell mode. That way you can still use global tables. Also, snma is always in memory so, no load time in this method either.

It is possible to display error messages as in shell mode when snma is in ARExx mode. SNMA writes the messages to the default output if you want (you can always redirect the default output wherever you want, for example to con:). See AREXX/SET

There are lots of possibilities in using snma, be creative! (As always).

## 1.84 4.2 ARExx commands of SNMA

Many commands use RexxVariableInterface to pass information back.

|        |         |                                  |
|--------|---------|----------------------------------|
| 4.2.1  | ASM     | Assemble file                    |
| 4.2.2  | CHDIR   | Change working directory         |
| 4.2.3  | FREE    | Free resources of last assembly  |
| 4.2.4  | GETERR  | Get the errors                   |
| 4.2.5  | INFO    | Get info about the last assembly |
| 4.2.6  | QUIT    | Quit SNMA (ARExx)                |
| 4.2.7  | SET     | SET attributes                   |
| 4.2.8  | ADDGB   | Add global include               |
| 4.2.9  | REMG    | Remove global include            |
| 4.2.10 | SEEG    | See global includes              |
| 4.2.11 | SELFCHK | Check snma's code                |

## 1.85 4.2.1 SNMA,ARExx: ASM command

Command:

~~~~~ ASM SOURCEFILE/A,OBJ=O/K,INCLUDE=I/K,HEADER=H/K,  
LISTING=L/K,EQUATE=E/K

Template:

~~~~~

All the keywords are the same as in SNMA commandline. SNMA ARexx commandline does not have PORTNAME, AREXX or SNMAOPT flags. You can set SNMAOPT flags with the SET command.

Results:

~~~~~

ASM command triggers SNMA to assemble SOURCEFILE. To find out how assembly went, see/use the INFO command.

## 1.86 4.2.2 SNMA, ARexx: CHDIR command

Command: CHDIR DIRNAME/A

~~~~~

Template: DIRNAME is the name of the directory

~~~~~

Function:

~~~~~

Changes the working directory of SNMA. You can set the working directory to be the same directory where your source file is with this command. If you have the include files in the same directory as the program source this becomes quite a helpful command. If DIRNAME does not exist or is a file, SNMA opens a Requester to tell you.

Why is this named CHDIR instead of CD ? To avoid any confusion between this and AmigaDOS CD.

## 1.87 4.2.3 SNMA, ARexx: FREE command

Command: FREE

~~~~~

Template: none

~~~~~

Function:

~~~~~

Frees all resources opened by the ASM command. After you execute this command you will lose all information about the previous assembly, including errors.

"Resources" here means memory. All file handling (opening/closing) is internal to the ASM command.

## 1.88 4.2.4 SNMA, ARexx: GETERR command

Command: GETERR NUMBER/N REMOVE/S WARN/S STEM/K

~~~~~

Template:

~~~~~

NUMBER error/warning number. SNMA keeps track of which error was requested last. If the number is omitted the next error is returned. If GETERR tries to fetch an error which does not exist it returns special values (see below).

REMOVE Toggling removes error from the list. Errors are numbered such that the first one is always number one and if you remove number one, the second one becomes number one and so on.

WARN Toggling causes GETERR to return WARNINGS instead of the ERRORS.

STEM variable specifies variable base name.

Results:

~~~~~

<STEM>.LINENUM  
<STEM>.LINETXT  
<STEM>.FILENAME  
<STEM>.ERRTXT  
<STEM>.COLUMN

<STEM>.LINENUM

The line number of the error. If this is NULL there is no such error as the one requested.

<STEM>.LINETXT

String which holds the source code line where the error is.

<STEM>.FILENAME

Name of the source code file.

<STEM>.ERRTXT

Error description text.

<STEM>.COLUMN

Column number where SNMA thinks the error is. If your source code has TABS in it you may need to change the TAB value with SET command to get the right column.  
Default TAB is 8 (as AmigaDOS uses).

<STEM>.ERRNUM

Which error this was. Handy if you want to know when using GETERR to fetch next error. Number 1 is first.

Function:

---

~~~~~ GetErr is used to fetch errors SNMA found in the source code. Warnings are fetched with GetErr, too.

Errors are stored in a list. The first error is first in the list, second is second and so on. The Warnings are in a separate list.

Exactly how many errors is in the list can be found with the INFO command from the <STEM>.ERRORS field. Warnings are in the <STEM>.WARNINGS field.

GETERR REMOVE changes these values if you call INFO after GETERR REMOVE, but does not change them when you call GETERR.

If you call GETERR with an illegal error number (an error which does not exist) you will get the following results:

```
LINENUM=0
LINETEXT=' '
FILENAME=' '
ERRTXT='No more errors'
ERRIND=0
```

LINENUM=0 is not generated anywhere else because line numbers start at one(1), so it is safe to check this field in an ARexx macro if the error fetching was successful.

If you call GETERR to get the next error and there is no text error (all errors are handled) the situation is same as above.

## 1.89 4.2.5 SNMA, ARexx: INFO command

Command: INFO <STEM>  
~~~~~

Template:  
~~~~~

<STEM> is the stem variable where values are put.

Results:  
~~~~~

|                 |                                  |
|-----------------|----------------------------------|
| <STEM>.STATUS   | ok, warn, error, fail            |
| <STEM>.LINES    | How many lines we assembled      |
| <STEM>.ERRORS   | number of errors                 |
| <STEM>.WARNINGS | number of warnings               |
| <STEM>.CODE     | number of code sections          |
| <STEM>.DATA     | number of data sections          |
| <STEM>.BSS      | number of bss sections           |
| <STEM>.CODESIZE | number of bytes in code sections |
| <STEM>.DATASIZE | number of bytes in date sections |
| <STEM>.BSSSIZE  | number of bytes in bss sections  |

---

<STEM>.FAILSTR        possible failure string  
                       (if STATUS="FAIL")

.STATUS        is one of the following strings:

OK        = assembly went just fine / nothing  
           assembled yet  
 WARN     = last assembly resulted warn  
 ERROR    = last assembly resulted error  
 FAIL     = last assembly resulted failure

if .STATUS is "FAIL" .FAILSTR has the failure  
 description.

.LINES        tells how many lines SNMA assembled. (Include  
 files are also counted for this).

.ERRORS       How many errors, if any. Failures don't count  
 here.

.WARNINGS     How many warnings there were, if any.

.CODE        Number of CODE sections.

.DATA    and .BSS are equivalent with .CODE

.CODESIZE  
       The number of bytes section(s) take. This is the  
       sum of all CODE sections.

.DATASIZE and .BSSIZE are equivalent with .CODESIZE.

.FAILSTR     Possible failure description. See .STATUS.

## 1.90 4.2.6 SNMA, ARexx: QUIT command

Command:        QUIT  
 ~~~~~  
 Template:      none  
 ~~~~~  
 Function:      Quits SNMA  
 ~~~~~

## 1.91 4.2.7 SNMA, ARexx: SET command

Command:    SET Q=QUICKOPT/T P=PCOPT/T A=ADDRESSOPT/T  
 ~~~~~  
           B=BASEFORCE/T S=SYMBOL/T LB=LongBRA/T  
           TABS/K/N KS=KEEPSOURCE/T OF=OUTFILE/T RE=RXERR/T  
           LNM=LSTNOMAC/T LOD=LSTONLYDATA/T SR=SHORTRELOC32/T  
           KO=KEEPOBJ/T MOVEM/T EC=ERRCOLOR/K/N DEBUG/T  
           OL=OPTLEVEL/K/N TD=TYPESEDIR/T CS=CASESEN/T

## Template:

```
~~~~~ QUICKOPT    Q flag  move-moveq and so on
PCOPT            P flag  absolute long ->pc-relative
ADDRESS         A flag  address mode optimizing
BASEFORCE       B flag  ensure displ6(an) mode
SYMBOL          S flag  write symbol hunk
LONGBRA         L flag  enable long branches (w/o .l
                    suffix)
```

## TABS

Number which specifies your current TAB setting. SNMA needs this value for the GETERR.COLUMN field. If the value is NULL the value is NULL or negative SNMA simply ignores it.  
Default: 8.

## KEEPSOURCE

KS If off snma frees all the source code it allocated in the last assembly and you cannot print the line of the error, but when working from a text editor that is not necessary. When this flag is on, snma frees the source when the text assembly is started (or via FREE command), keeping the source code in memory between the previous assembly and the next one.  
one.  
Default: ON.

## OUTFILE

OF Toggle to enable/disable normal snma output. With this is OFF snma will not write assembly messages to the default output. When ON snma writes to the default output.  
Default: OFF.

## RXERR

RE Enable/disable ARexx errors. Normally, in ARexx mode this flag is kept on. If it is off snma will NOT generate ARexx error structures. INFO and GETERR commands think that there were no errors if this flag is off, even if there are errors.  
Default: ON.

LSTNOMAC no macro expansions to the listing file  
LNM Default: OFF.

LSTONLYDATA only those lines which define data.  
LOD Default: OFF.

SHORTRELOC32 Use short reloc32 whenever possible.  
SR Default: OFF.

KEEPOBJ Do not delete object file when there are errors in the source file.

---

Default: OFF.

MOVEM movem optimizing.  
Default: ON.

ERRCOLOR Error highlighting.  
EC

DEBUG Toggle to enable debu line hunks

OPTLEVEL How many times to run optimizer.  
OL

TYPESDIR Some macros implemented as directives.  
TS

CASESEN Case-sensetive symbols.  
CS Default: ON.

Function:

~~~~~

To change default settings of SNMA. The SNMAOPT directive overrides those flags which can be set with SNMAOPT. Some flags are the same as in the shell template .

The ARexx SET command has nothing to do with the SET directive.

1.92 4.2.8 SNMA, ARexx: ADDGB command

Command: ADDGB
~~~~~ SOURCEFILE/A,OBJ=O/K,INCLUDE=I/K,HEADER=H/K,  
LISTING=L/K,EQUATE=E/K

Template:

~~~~~ Template is same as in the ASM command.

Function:

~~~~~ To add symbols and macros to the global table. A single ADDGB can add any number of include files to the global table.

ADDGB works like ASM with the following exceptions:

- 1) No code is generated
- 2) Second pass is not executed
- 3) Absolute symbols and macros are transfered to the global table at the end of assembly.
- 4) Include files are added to the internal include file list to prevent them from being included again.

Equates, sets, floating point equates and macros are transferred to the global table.

---

The idea of the global table is to lower include file loading and processing time. You need do this process only once after which SNMA will find the symbol (or macro) from the global symbol table if it is there. If you try to INCLUDE a file which has been ADDFB'd the include file will be skipped. If you have includes in your source the include files which are ADDGB'd are not processed.

SNMA locks the files you add to the global table. This prevents you from modifying the (still readable) files, as the change doesn't modify the global table anyway. The REMGB command can be used to remove a file from the global table.

Important! The main sourcefile symbols and macros are NOT transferred to the global table. A file you handle with this command usually contains some INCLUDE directives which SNMA processes. This enables you to process your current sourcefiles with ADDGB.

Errors are reported just like in the ASM command.

If you have includes which produce code and you want that code to be included DO NOT use the ADDGB command to include that file.

The Global table can be used only in ARexx mode.

So, what does all that mean in practice? There is a little example in snma/examples. Look at it.

The current implementation of include file skipping tries to lock the file, even if it is in the global table and if it doesn't succeed it fails. For the hard disk users there is nothing to worry about, but the floppy users may find this frustrating. In theory, you should be able to add the include file to the global table from the floppy and then remove the actual disk where they were loaded, but as snma tries to lock these files it can't find them. Any floppy users out there? It is not a big task to change the include handling to allow the above situation. It is big enough to avoid if nobody really needs it though. (Hint: Invest in a hard disk. Yeah, I know, THAT requires money 8)

## 1.93 4.2.9 SNMA, ARexx: REMGB command

Command: REMGB FILENAME  
~~~~~

Template:
~~~~~ FILENAME           Name of include file you want to remove.

---

This removes only symbols added in the main include file. If this include has included other include files they will not be removed. If the FILENAME has been omitted, the global table is cleared and the symbols freed.

Function:

~~~~~ To remove symbols and macros for one file (or all) that have been included in the global tables. You can see what files are in the global tables with the SEEGB command.

I have the following alias defined in my shell-startup:

```
alias remgb "rx 'address SNMA remgb "[ ]'"
```

Then just typing remgb <name> will remove the file from the global table if present there.

Symbols which have been declared by using the SET directive belong to the first file which defined them. When you remove that file, the symbol is removed from the global table even if some other include file has changed it (i.e. declared by using SET).

1.94 4.2.10 SNMA, ARexx: SEEGB command

Command: SEEGB STEM

Template:

```
~~~~~ STEM      stem variable name.
      STEM.COUNT will hold the number of filenames
      STEM.0      filename 0
      STEM.1      filename 1
      STEM.n      filename n
```

Function:

~~~~~ To get information as to what files are in the global symbol table. If you don't specify a STEM variable this command is a no-op.

## 1.95 4.2.11 SNMA, ARexx: SELFCHK command

Command: SELFCHK

~~~~~

Function:

~~~~~ Calculates a new checksum from the snma's own code and compares it with that calculated in startup. If there's

a difference snma will report it. Programs tend to run away every now and then when developing. Using this command you can make sure snma is still in good health. (Yes, sometimes memory protection would be nice).

## 1.96 4.3 ARexx examples

The ARexx directory of the snma package has many ARexx macros (programs). You may use them as they are or modify them anyway you like.

ShellAsm.rexx is a simple macro to call from the shell and it does basically the same as SNMA in shell mode. This one looks a little better than that found in the V1.70 release.

addgb.rexx adds symbols to the global table. Basically the same as ShellAsm.rexx.

seegb.rexx displays what include files are in the snma global symbol table.

Other macros are for the XDME text editor. Those who have some other text editor (which supports ARexx) may find them helpful as an example in writing their own interface macros.

|               |                                          |
|---------------|------------------------------------------|
| asm.xdme      | assembles file                           |
| GetErr.xdme   | fetches error information                |
| snmainfo.xdme | displays information about last assembly |

These macros need a little more work but they do well for now. The GetErr macro also needs some work with 'user macro' errors.

Feel free to modify these macros anyway you please or write completely new ones. My taste is not necessarily yours.

If you modify these files and distribute them, please change the names and state what they are supposed to do clearly enough.

## 1.97 5. Author

The author lives in Helsinki, Finland.

If you are using snma, by sending mail or a postcard you will motivate him to work even harder with snma. By stating which Amiga model you use the author knows that snma has no problems (has it? It shouldn't) with different Amiga models. By stating where you got the snma package, you will be giving interesting information too. (Paranoid? Who? Me? Why? 8')

---

Send your comments, flames or whatever to

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Well, although snma is freeware, donations are always welcome.

Finally, thanks to Satu for the patience.

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