Creating Libraries

Question
I want to store C source files in a library for use with RTI or ConfigurationDesk. How can I create such a library?

Relevant Products
Real-Time Interface (RTI) and ConfigurationDesk; differences between Real-Time Interface (RTI) and ConfigurationDesk are explicitly marked.

Solution

Note
The generated libraries can be exchanged between systems using the same MATLAB® and dSPACE Releases. Compatibility issues might occur if a library is copied to a system using a different MATLAB or dSPACE Release, especially if RTLib functions are used in the C code.

If the source files include function calls generated with Simulink Coder™, the model’s timer task mode must be taken into account. Use libraries only in the timer task mode they were created for. For example, do not use a library created for single timer task mode in a model built in multiple timer task mode.

Method 1
This method can be used for dSPACE Release 2015-B and later and requires no additional tools or components.

As of dSPACE Release 2015-B, each platform-related RTLib contains a general-purpose makefile, DsBuildLibrary.mk, for creating a compatible compiler library.

<table>
<thead>
<tr>
<th>Platform</th>
<th>Location of General-Purpose Makefile</th>
<th>Target Identifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS1005</td>
<td>%DSPACE_ROOT%\DS1005\RTLib\DsBuildLibrary.mk</td>
<td>DS1005</td>
</tr>
<tr>
<td>DS1006</td>
<td>%DSPACE_ROOT%\DS1006\RTLib\DsBuildLibrary.mk</td>
<td>DS1006</td>
</tr>
<tr>
<td>DS1007</td>
<td>%DSPACE_ROOT%\DS1007\DsBuildLibrary.mk</td>
<td>DS1107</td>
</tr>
<tr>
<td>DS1103</td>
<td>%DSPACE_ROOT%\DS1103\DsBuildLibrary.mk</td>
<td>DS1103</td>
</tr>
<tr>
<td>DS1104</td>
<td>%DSPACE_ROOT%\DS1104\RTLib\DsBuildLibrary.mk</td>
<td>DS1104</td>
</tr>
<tr>
<td>DS1202</td>
<td>%DSPACE_ROOT%\DS1202\DsBuildLibrary.mk</td>
<td>DS1202</td>
</tr>
</tbody>
</table>
To create libraries from C source files:

1. Copy a DsBuildLibrary.mk file instance to the folder containing the source files.

2. Open a Command Prompt for dSPACE RCP and HIL <release number> and go to the related folder.

   **Note**

   As of dSPACE Release 2014-A, environment variables and other settings, such as enhancements to the search path, are no longer set. Use the Command Prompt for dSPACE RCP and HIL <release number> for the archiving tools. A shortcut to the command prompt is integrated in the Windows Start menu. The required paths and environment variables are then set automatically.

3. Enter the following command:
   
   ```
   dsmake -f DsBuildLibrary.mk output_filename=<library filename> source_files="<blank separated list of files>" target=<target identifier>
   ```

   **Example:**

   ```
   dsmake -f DsBuildLibrary.mk output_filename=mylib source_files="source1.c source2.c source3.c source4.cpp" target=DS1401
   → Creates the libmylib.lib library in the active folder for the MicroAutoBox. The output file name mylib is added to the fixed part lib.
   ```

   ```
   dsmake -f DsBuildLibrary.mk source_files="source1.c source2.c source3.c source4.cpp" target=DSx86_32
   → Creates a library named lib.a (the fixed part of the name) in the active folder for the SCALEXIO system.
   ```

   You can use additional command line parameters:

   ```
   custom_c_options=<Additional custom C compiler options>
   custom_cpp_options=<Additional custom C++ compiler options>
   custom_obj_files=<Additional custom object files>
   ```

   Alternatively, you can manually adapt the DsBuildLibrary.mk makefile to shorten or omit the parameter list.
Method 2

This method is based on the MATLAB/Simulink environment. The instructions assume that a related model exists.

To create libraries from C source files

1. Open the model’s Configuration Parameters dialog and specify the source files on the Code Generation – Custom Code page in ‘Include list of additional’.
   Select ‘Source files’.
   Enter the required folders (space-separated list).
   Example: source1.c source2.c source3.c

2. Build the model. The object files are generated into the build directory.

   RTI: <modelname>_rti<XXX>

   ConfigurationDesk: <ConfigurationDesk Application>\Build\<application process name>\Compile\<name of the model>.
   It is possible that ConfigurationDesk itself creates a library file during the build process, which can be used instead. Therefore, check the output of the build process for the message “Making library <library name>”.

   The object file extension depends on the hardware platform and on the timer task mode the model was built with:

<table>
<thead>
<tr>
<th>Platform</th>
<th>Single Timer Task Mode</th>
<th>Multiple Timer Tasks Mode¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS1005</td>
<td>.o50</td>
<td>.m50</td>
</tr>
<tr>
<td>DS1006</td>
<td>.o86</td>
<td>.m86</td>
</tr>
<tr>
<td>DS1007</td>
<td>.o07</td>
<td>.m07</td>
</tr>
<tr>
<td>DS1103</td>
<td>.o04</td>
<td>.m04</td>
</tr>
<tr>
<td>DS1104</td>
<td>.o03</td>
<td>.m03</td>
</tr>
<tr>
<td>DS1202</td>
<td>.o07</td>
<td>.m07</td>
</tr>
<tr>
<td>DS1401</td>
<td>.o03</td>
<td>.m03</td>
</tr>
<tr>
<td>SCALEXIO</td>
<td>.o86</td>
<td>.m86</td>
</tr>
</tbody>
</table>

¹ In the multiple timer task mode, files with the extension *.m<xx> are generated if the respective model consists of at least two timer tasks.
3. Open a **Command Prompt for dSPACE RCP and HIL <release number>** and create the library with the compiler's archiving tool.

**Note**

As of dSPACE Release 2014-A, environment variables and other settings, such as enhancements to the search path, are no longer set. Use the **Command Prompt for dSPACE RCP and HIL <release number>** for the archiving tools. A shortcut to the command prompt is integrated in the Windows Start menu. The required paths and environment variables are then set automatically.

**PowerPC Platforms (DS1005, DS1103, DS1104, MicroAutoBox/DS1401)**

Enter the following command:

```
%%PPC_ROOT%\bin\"libppc -a <OBJECT1> <OBJECT2> ... <LIBRARY_NAME>
```

Example for DS1005:

```
%%PPC_ROOT%\bin\"libppc -a source1.o50 source2.o50 source3.o50
user_library.lib
```

`libppc` might generate warnings. You can ignore the warnings if the generation of the library completes without error messages.

For detailed information on the PowerPC archiving tool, refer to the compiler documentation: *Assembler/Linker/Librarian User's Guide and Reference for the PowerPC Family* by Microtec at `%PPC_ROOT%\Docs (PowerPC Compiler Vs. 3.x)` or `%PPC_ROOT%\doc\compiler (PowerPC Compiler Vs. 2.0).

**DS1006 Platforms**

Enter the following command (up to and including dSPACE Release 2014-A):

```
%%X86_ROOT%\bin\"x86-ar -r <LIBRARY_NAME> <OBJECT1> OBJECT2> ...
```

As of dSPACE Release 2014-B:

```
%%X86_ROOT%\bin\"i686-elf-ar -r <LIBRARY_NAME> <OBJECT1> OBJECT2> ...
```

Example (up to and including dSPACE Release 2014-A):

```
%%X86_ROOT%\bin\"x86-ar -r user_library.lib source1.o86 source2.o86 source3.o86
```

Example (as of dSPACE Release 2014-B):

```
%%X86_ROOT%\bin\"i686-elf-ar -r user_library.lib source1.o86 source2.o86 source3.o86
```

For more information on the x86 archiving tool, refer to documentation of bin utilities at `%X86_ROOT%\Docs\binutils\ar.html.`
**SCALEXIO Platforms**

Enter the following command (up to and including dSPACE Release 2017-A):
```
"%DSPACE_ROOT%\Compiler\QNX650\host\win32\x86\usr\bin\"nto86-ar -r
<LIBRARY_NAME> <OBJECT1> OBJECT2> ...
```

As of dSPACE Release 2017-B
```
"%DSPACE_CONFIG%\Compiler\QNX650\host\win32\x86\usr\bin\nto86"-ar -r
<LIBRARY_NAME> <OBJECT1> OBJECT2> ...
```

Example:
```
"%DSPACE_ROOT%\Compiler\QNX650\host\win32\x86\usr\bin\"nto86-ar -r
user_library.a source1.o86 source2.o86 source3.o86
```

**DS1007/MicroLabBox (DS1202) Platforms**

Enter the following command (up to and including dSPACE Release 2017-A):
```
"%DSPACE_ROOT%\Compiler\QNX650\host\win32\x86\usr\bin\"ntoppc-ar -r
<LIBRARY_NAME> <OBJECT1> OBJECT2> ...
```

As of dSPACE Release 2017-B:
```
"%DSPACE_CONFIG%\Compiler\QNX650_463\host\win32\x86\usr\bin\"ntoppc-ar -r
<LIBRARY_NAME> <OBJECT1> OBJECT2> ...
```

Example:
```
"%DSPACE_ROOT%\Compiler\QNX650_463\host\win32\x86\usr\bin\"ntoppc-ar -r
user_library.lib source1.o07 source2.o07 source3.o07
```


5. To use the new library in a model, refer to FAQ 298.

Since dSPACE Release 2014-B, C++ has been natively supported. The workflow for generating libraries is not limited to C sources files, C++ source files can also be included.

Related FAQs

- **FAQ 298**: Best Practice for Handling S-functions, Libraries and Additional Source Code
FAQ Overview

http://www.dspace.com/go/faq

Support

To request support, please use the form at http://www.dspace.com/go/supportrequest

Updates and Patches

Software updates and patches are available at http://www.dspace.com/go/patches. dSPACE strongly recommends to use the most recent patches for your dSPACE installation.

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