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April 1st, 2010
Renesas Electronics Corporation

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Renesas MCU

Perl Script to Convert S-Record Data to a C Structure

Introduction

Application note REG05B0021-0100 – Utility to Convert S-Record Data to a C Structure – provides and describes a Win32 command line utility, ‘motice_cl’, to perform the described conversion. Such a utility is useful when writing flash programming routines when code must be executed from RAM but stored in flash memory until required. Although ‘motice_cl’ performs the conversion process well there are situations when it is desirable to have the output file formatted differently or when software is being developed on a different operating system such as Linux. In such situations it is either not easy or possible to use ‘motice_cl’.

For these reasons a perl (portable extraction and report language) script has been produced to perform the same function as ‘motice_cl’. However, as the script by its very nature is provided as a source file its functionality can easily be modified if different output formatting etc is desired. In addition so long as there is an implementation of perl available the script can be run on a multitude of operating systems.

The script is included in the appendix of this apps note and has been tested on WindowsXP® using ActivePerl by ActiveState (http://www.activestate.com) and under Cygwin (http://www.cygwin.com) and also on Linux. Of course the output of this script should be fully tested before being used in a production environment.

As with ‘motice_cl’ calling of this perl script can be integrated into HEW as a build phase when developing on a Windows® platform.

It is expected that the reader has a basic understanding of perl when reading this application note. Further information on perl can be obtained from the links above, Googling perl or visiting http://www.perl.org.

Contents

Using the Script

It is expected that apps note REG05B0021-0100 is read first before using the perl script provided here. This apps note describes why a conversion from an s-record file to a C structure might be useful and also how to integrate a command line utility into HEW as a build phase.

The text of the perl script can be copied from appendix A of this apps note and pasted into a file which will be called 'motice.pl' for the purpose of this apps note. The script is called using the command line shown below.

```
perl motice.pl source destination structname
```

Source:	Specifies the name and path of the s-record file to be processed.
Destination:	Specifies the name and path of the C file to be produced.
Structname:	Specifies the name of the C structure to be generated.

The C file output by 'motice.pl' contains the following structure definition.

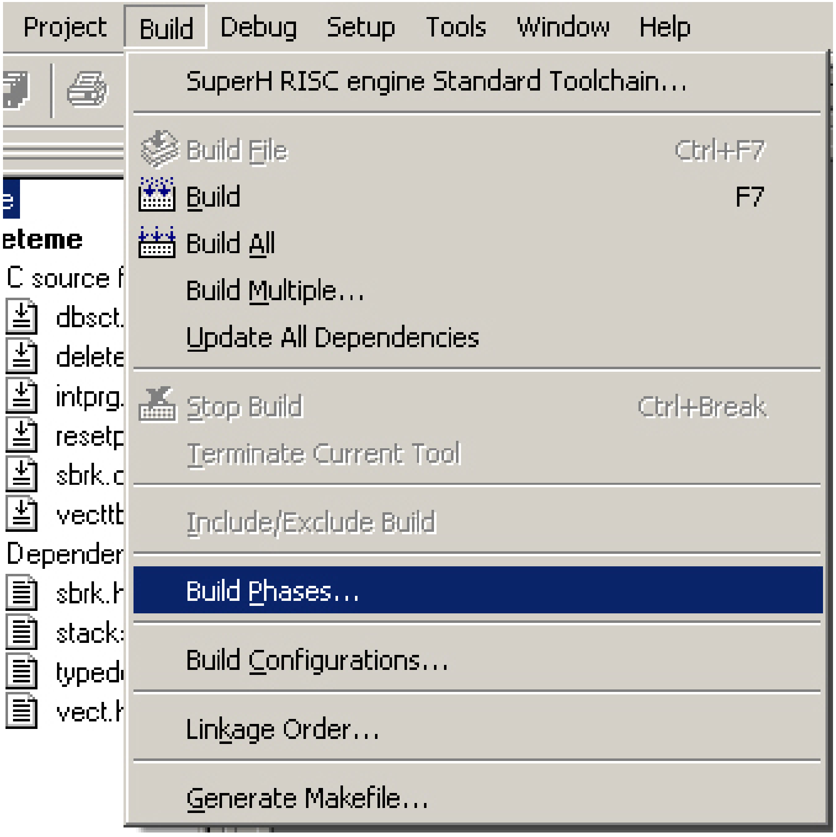
```
struct rom_data {
        unsigned long start_address;
        unsigned long data_length;
        unsigned char data[4708];
};
```

The name of the structure is dependent on the 'structname' command line parameter and the size of the 'data' array is dependent on the amount of data in the processed s-record. Further information can be found in apps note REG05B0021-0100.

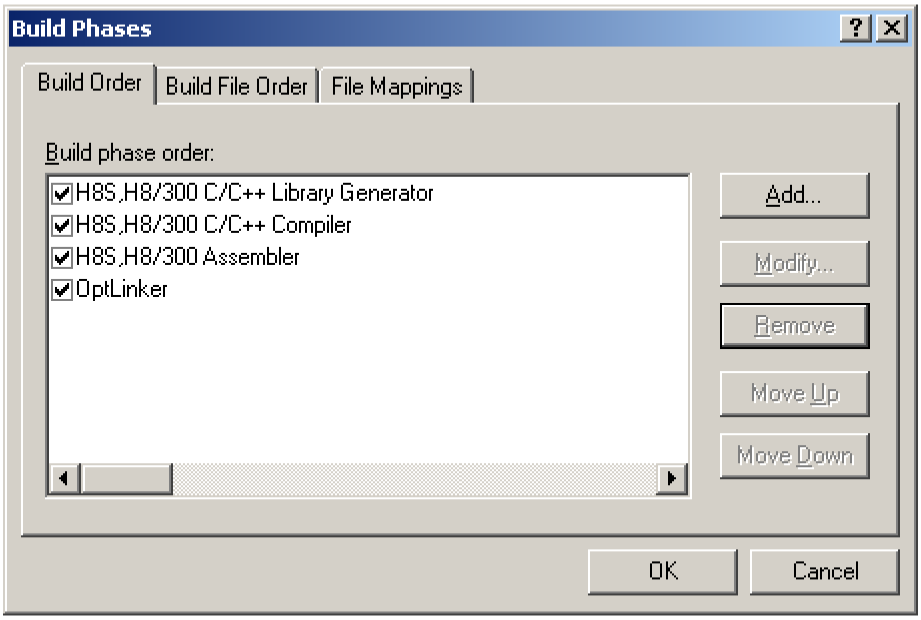
HEW Integration

HEW (High-Performance Embedded Workshop) is the Renesas IDE integrating the compiler toolchains and debuggers in a single application. One of the features of HEW is the ability to produce custom build phases. This lends itself well to this script as a separate build phase can run to call the utility each time an application is built. The following screenshots show the process of setting up the build phase.

1. Select 'Build Phases' from the 'Options' menu.



2. Click the add button.



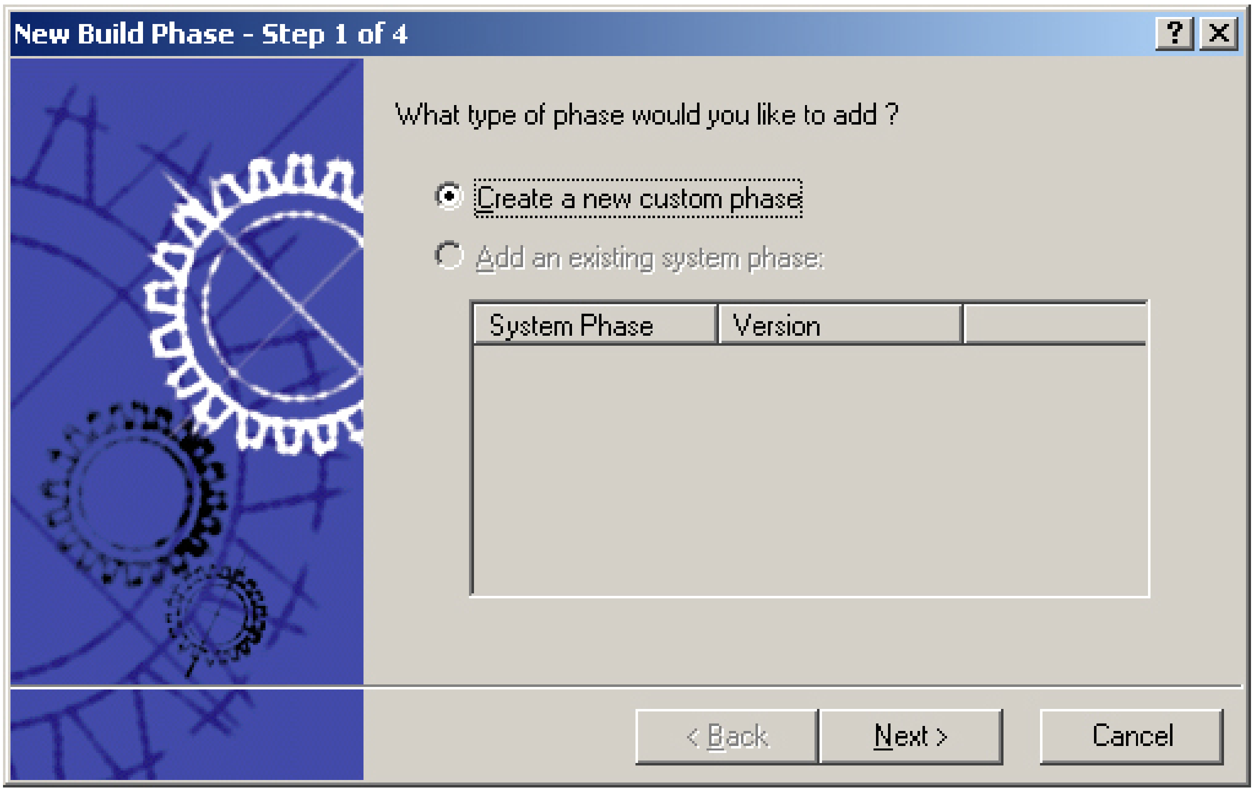
Build Phases

Build Order | Build File Order | File Mappings

Build phase order:

☑ H8S,H8/300 C/C++ Library Generator
☑ H8S,H8/300 C/C++ Compiler
☑ H8S,H8/300 Assembler
☑ OptLinker

3. Create a custom build phase by clicking next.



New Build Phase - Step 1 of 4

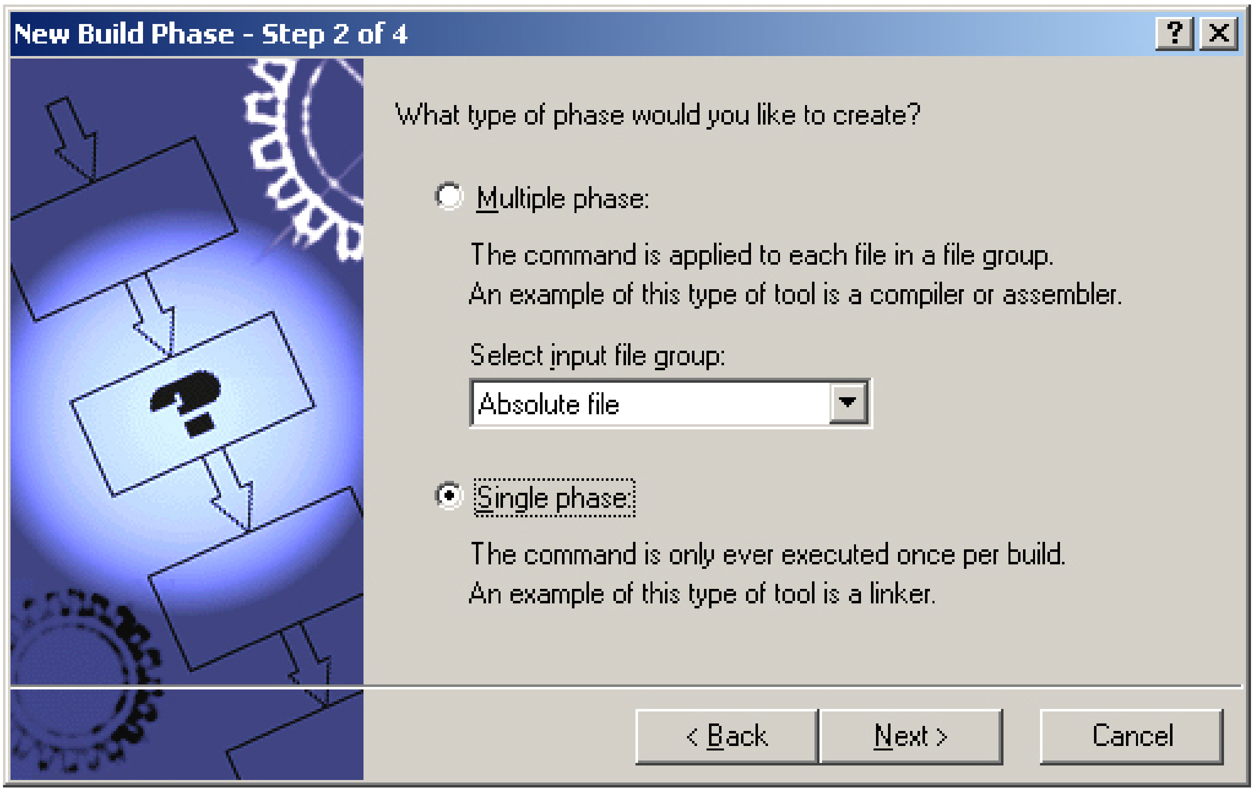
What type of phase would you like to add ?

● Create a new custom phase

○ Add an existing system phase:

System Phase	Version	

4. Create a single build phase. This means that the phase will only execute once per build. The 'motice.pl' script is only required to run once when it processes the s-record file output from the linker.



What type of phase would you like to create?

○ Multiple phase:

The command is applied to each file in a file group.
An example of this type of tool is a compiler or assembler.

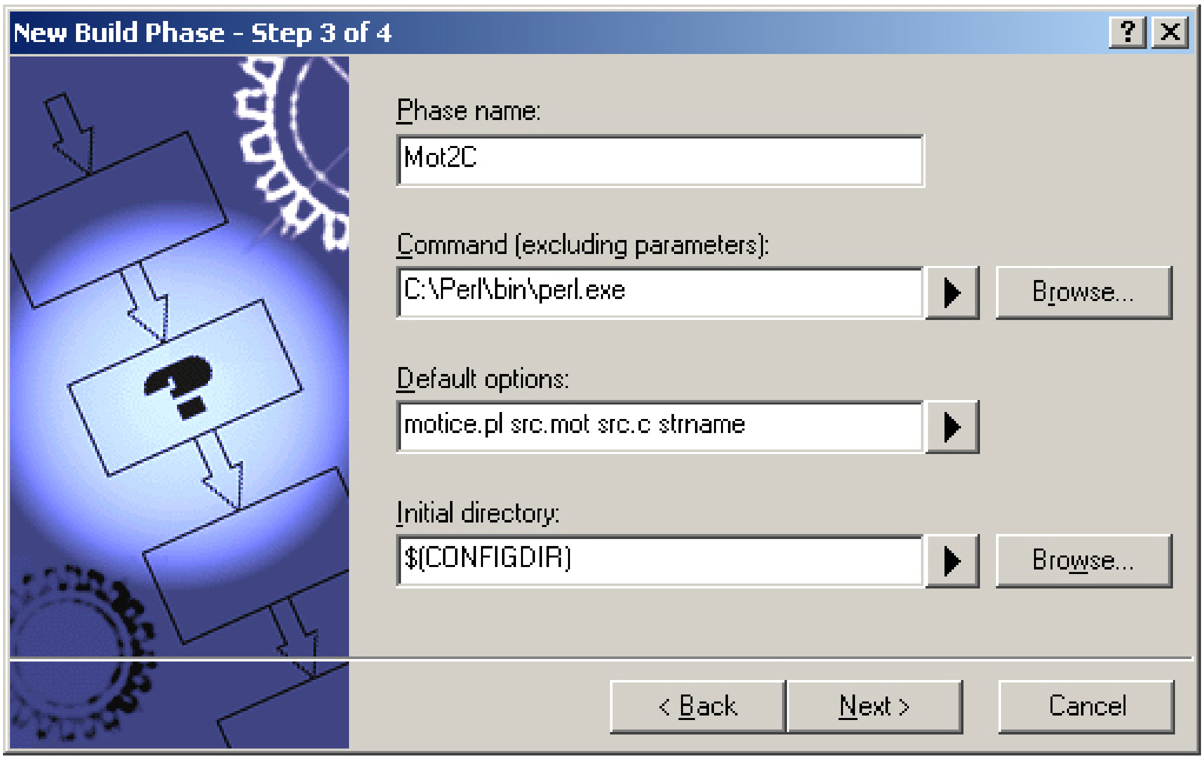
Select input file group: Absolute file

● Single phase:

The command is only ever executed once per build.
An example of this type of tool is a linker.

5. Configure the build phase to call the perl interpreter with the correct command line parameters

Here the phase has been called ‘Mot2c’, the full path for the perl interpreter executable has been entered as have the default parameters for the command including the script itself. The source file will be the s-record output from the HEW project and will usually be found in the debug or release build directories.



New Build Phase - Step 3 of 4

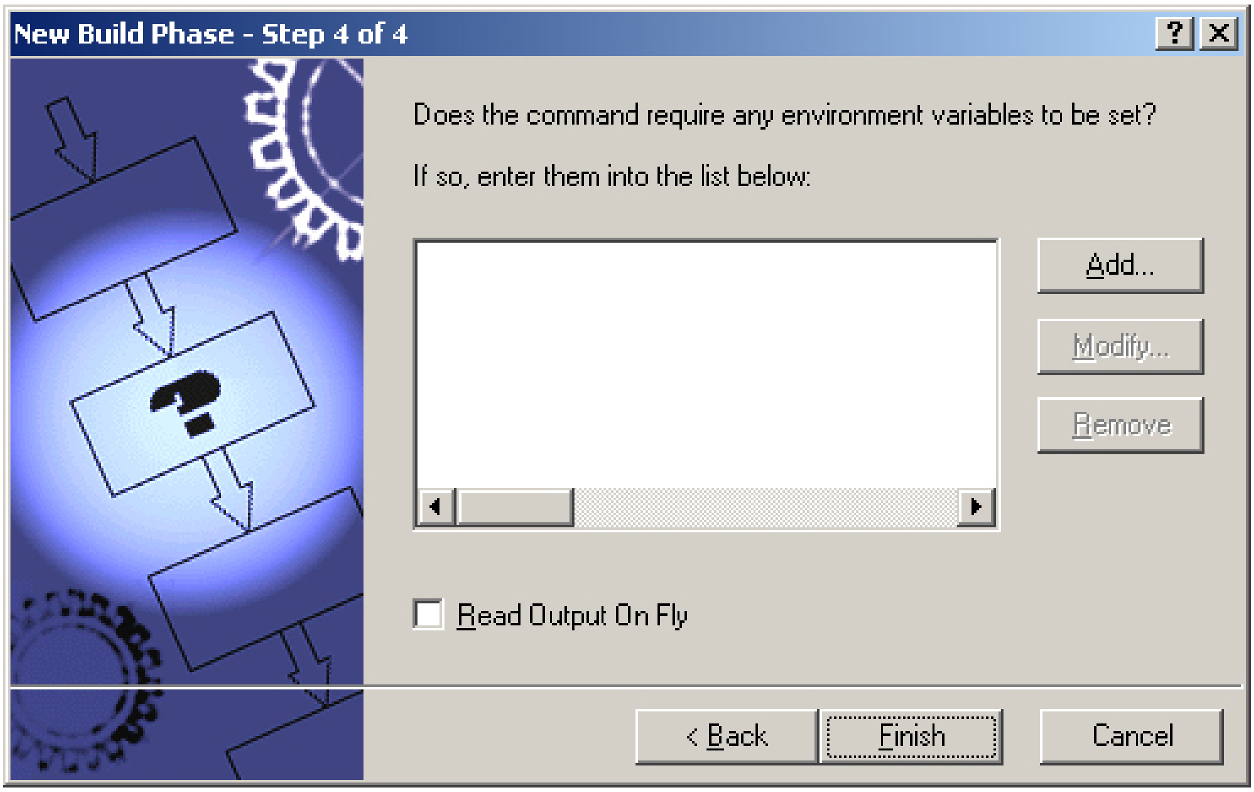
Phase name: Mot2C

Command (excluding parameters): C:\Perl\bin\perl.exe

Default options: motice.pl src.mot src.c strname

Initial directory: $(CONFIGDIR)

6. No environment variables are required for the utility so leave this blank and hit ‘Finish’.



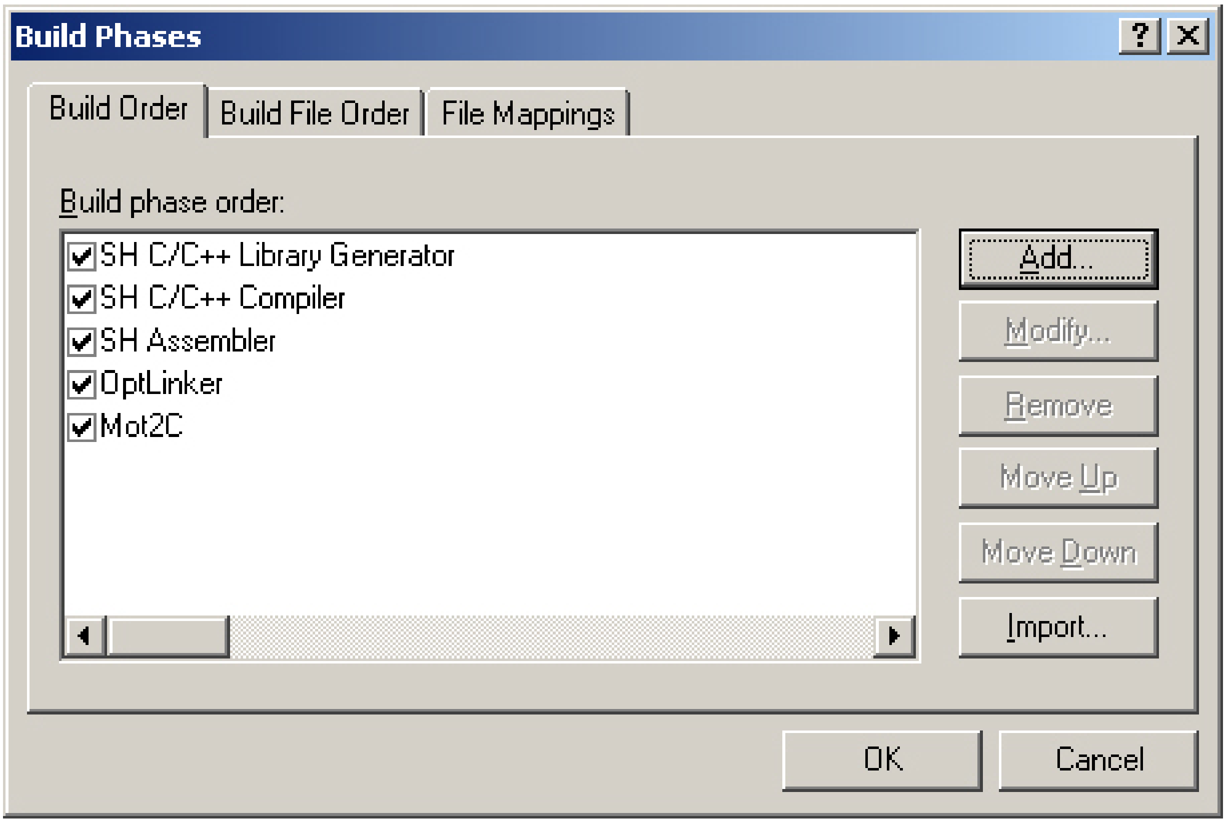
New Build Phase - Step 4 of 4

Does the command require any environment variables to be set?

If so, enter them into the list below:

□ Read Output On Fly

7. The ‘Build Phases’ form should now show the newly created ‘Mot2c’ build phase. Ensure that it is ticked so that the phase is executed. The order the build phases are executed can be changed. This is not necessary here as the ‘Mot2c’ phase must run after the linker otherwise it will have no s-record file to process!



☑SH C/C++ Library Generator
☑SH C/C++ Compiler
☑SH Assembler
☑OptLinker
☑Mot2C

Click ‘OK’. Now when the project is built the ‘Mot2c’ phase will execute and convert the s-record file to a C structure. The HEW output window will show the output from the script.

Summary

The script provided with this apps note provides the same functionality as the utility ‘motice_cl’ described by apps note REG05B0021-0100. As the script is written in the perl language and supplied as source code it is possible for it to be run on different platforms and for its functionality to be modified as required. The script is fully commented and so should be easy to understand and change.

Appendix A – Perl Script Source

```
#!/usr/bin/perl -w

# perl script to convert the data in a file of s-records into
# a constant C structure

# command line format for the script is
# motice.pl sourcefile destinationfile structname

print( "\nMotice.pl - v0.1 (c) Renesas 2005\n" );
print(   "~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~\n" );

# check we have 3 command line arguments
if( ( $#ARGV + 1 ) != 3 )
{
 # incorrect number of command line arguments, print usage instructions
 print( "\nMotice.pl is a utility which converts the data within a
Motorola\n" );
 print( "S Record file into a C source file with the data in a C
structure.\n" );
 print( "\nperl motice.pl source destination structname\n" );
 print( "\n\tsource\t\tspecifies the s record source file\n" );
 print( "\tdestination\tspecifies the C file to be generated\n" );
 print( "\tstructname\tspecifies the name of the generated C structure\n" );
 die;
}

$total_records = 0;
$address = 0;
$count = 0;
$checksum = 0;
$min_address = 0xFFFFFFFF;
$max_address = 0;
$databytecount = 0;

# attempt to open source file - s-record
open( INFILE, $ARGV[0] ) || die "Cannot open source file: $ARGV[0]\n";
# read each s-record in turn to establish the maximum and minimum addresses of
data in the file
while( $srec = <INFILE> )
```

```
{
 chomp( $srec );
 $ret = process_srec();
 if ( $ret == 0 )
  {
  # pass
  if( $min_address > hex( $address ) )
  {
   $min_address = hex( $address );
  }

  if( $max_address < ( ( hex( $address ) + $databytecount - 1 ) ) )
  {
   $max_address = ( ( hex( $address ) + $databytecount - 1 ) );
   # '-1' is neaded here because if the address is 1000 and the byte count is 1
the
   # maximum address is 1000 (not 1001)
  }
 }
  else
  {
   # fail
   if( $ret == 1 )
   {
    # not an s-record
    close( INFILE );
    my $l = $total_records + 1;
    die( "\nError: Line $l is not a valid s-record\nExiting\n" );
   }
   elsif( $ret == 2 )
   {
    # checksum failure
    close( INFILE );
    die( "\nError: Line $total_records checksum error\nExiting\n" );
   }
   elsif( $ret == 3 )
   {
    # S0, S5, S7, S8 or S9 record
   }
  }
}
```

```
close( INFILE );

# create array with enough space to hold the data
# do this by placing an element at the end of the array
$alldata[ $max_address - $min_address ] = ();
# initialise contents to H'FF
$index=0;
foreach (@alldata)
{
 $alldata[ $index ] = 0xff;
 $index++;
}

# reopen s-record file and copy data contents into the array
open( INFILE, $ARGV[0] ) || die "Cannot open source file: $ARGV[0]\n";
$total_records = 0;
while( $srec = <INFILE> )
{
 chomp( $srec );
 $ret = process_srec();
 if ( $ret == 0 )
 {
  # pass
  # copy data into the array
  $index = 0;
  $srecstr = pack( "H*", $srecdata );           # convert hex values to binary
string
  @srecvals = unpack( "C*", $srecstr );      # convert binary values to unsigned
char bytes
  foreach $sval (@srecvals)
  {
   $alldata[ (hex($address) + $index ) - ($min_address) ] = $sval;
   $index++;
  }
 }
  else
  {
   # fail
   if( $ret == 1 )
   {
    # not an s-record
    # this should not happen as it should have been detected in the first pass
through the file
    close( INFILE );
    my $l = $total_records + 1;
    die( "\nError: Line $l is not a valid s-record\nExiting\n" );
   }
   elsif( $ret == 2 )
   {
    # checksum failure
    # this should not happen as it should have been detected in the first pass
through the file
    close( INFILE );
    die( "\nError: Line $total_records checksum error\nExiting\n" );
   }
   elsif( $ret == 3 )
   {
    # S0, S5, S7, S8 or S9 record
   }
  }
}
close( INFILE );

################
# Write C File #
################
# open file to write to
open( OUTFILE, ">$ARGV[1]" ) || die "Cannot open destination file: $ARGV[1]\n";

print OUTFILE ( "//\n" );
print OUTFILE ( "//\tThis file has been generated by 'motice.pl' (v0.1) (c)
Renesas 2005\n" );
print OUTFILE ( "//\n" );
print OUTFILE ( "//\t$ARGV[1]\n" );
my $tad = localtime;                    # get the system date and time
print OUTFILE ( "//\t$tad\n" );
print OUTFILE ( "\n\n" );

print OUTFILE ( "struct rom_data {\n" );
print OUTFILE ( "\tunsigned long start_address;\n");
print OUTFILE ( "\tunsigned long data_length;\n");
print OUTFILE ( sprintf( "\tunsigned char data[%d];\n", ($max_address -
$min_address) + 1 ) );
```

```
# add 1 to max - min address as if min was 0 and max was 2 there would be 3 (0,
1 and 2 ) data bytes
print OUTFILE ( "};\n" );


print OUTFILE ( "\nconst struct rom_data $ARGV[2] = {\n" );
print OUTFILE ( sprintf( "\t0x%08x,\n", $min_address ) );
print OUTFILE ( sprintf( "\t0x%08x,", ($max_address - $min_address) + 1 ) );
# add 1 to max - min address as if min was 0 and max was 2 there would be 3 (0,
1 and 2 ) data bytes


$index = 0;
foreach $sval (@alldata)
{
 if( $index % 16 == 0 )  # 16 bytes of data per line
 {
  print OUTFILE ( "\n\t" ) ;
 }
 print OUTFILE ( sprintf( "0x%02x", $sval ) );
 # only add a comma if the end of the C array has not been reached
 if( $index != ( $max_address - $min_address ) ) { print OUTFILE ( ", " ); }
 $index++;
}


print OUTFILE ( "\n};\n" );
close( OUTFILE );


# print stats to console
print( "\nSource file\t= $ARGV[0]\n" );
print( "Dest file\t= $ARGV[1]\n" );
print( "Struct name\t= $ARGV[2]\n" );
print( sprintf("Start address\t= 0x%x\n",$min_address) );
print( sprintf("End address\t= 0x%x\n",$max_address) );
print( sprintf( "Byte count\t= 0x%x (%d bytes)\n", ($max_address - $min_address)
+ 1, ($max_address - $min_address) + 1 ) );
# add 1 to max - min address as if min was 0 and max was 2 there would be 3 (0,
1 and 2 ) data bytes
print( "$total_records s-record(s) processed" );
#end


################
# sub-routines #
################
```

```
sub process_srec {
  if( $srec =~ /^s[0-9]/i )                     # does string start with "S" or
"s" and a digit 0 to 9
  {
   # looks like an s-record
   # extract type
   $type = hex( substr( $srec, 1, 1 ) );
  }
  else
  {
   # not an s-record record
   return 1;
  }

  #extract length, address, checksum and data from record types S1, S2 and S3
  if( ( $type == 1 ) || ( $type == 2 ) || ( $type == 3 ) )
  {
   $total_records++;
   $count = substr( $srec, 2, 2 );
   $databytecount = ( ( hex( $count ) ) - ( $type + 1 ) - 1 );
   $address = substr( $srec, 4, ( ( $type + 1 ) * 2 ) );
   $checksum = substr( $srec, ( 4 + ( ( ( hex ($count) ) - 1 ) * 2 ) ), 2  );

   # verify the checksum
   # checksum is an 8-bit hex value representing the 1's complement of the sum
of byte values of
   # the count, address and data fields
   $cs = 0;
   for( $i=2; $i<( ( ( hex ( $count ) ) * 2 ) + 2 ); $i+=2 )
   {
    $cs += hex( substr( $srec, $i, 2 ) );
   }
   $cs = $cs % 256;
   $cs = 255 - $cs;

   # check the checksum
   if( $cs == hex( $checksum ) )
   {
    # checksum passed
    # extract the data
    $srecdata = substr( $srec, 4 + ( ( $type + 1 ) * 2 ), 2 * $databytecount );
   }
   else
   {
    # checksum fail
    return 2;
   }
  }
  elsif( ( $type == 0 ) || ( $type == 5 ) || ( $type == 7 ) || ( $type == 8 ) ||
( $type == 9 ) )
  {
   $total_records++;
   return 3;
  }
  else
  {
   # not an s-record - should not get here
   return 1;
  }

  return 0;
} #end of sub process_srec
```

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