Note!

Before using this information and the product it supports, be sure to read the general information under “Notices” on page vii.

First Edition (November 1996)

This edition applies to Version 3, Release 7, Modification Level 0, of IBM Application System/400 ILE C/400 (Program 5716-CX2) and Visual Age for C++ for AS/400 (Program 5716-CX5) and to all subsequent releases and modifications until otherwise indicated in new editions. Make sure you are using the proper edition for the level of the product.

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Programming Interface Information

This book is intended to help you write Integrated Language Environment (ILE) C/400 programs using the ILE C/400 compiler or ILE C++ programs using the Visual Age for C++ for AS/400 compiler. It primarily documents general-use programming interfaces and associated guidance information provided by the compilers.

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About This Book

This book contains reference information on Machine Interface (MI) instructions.

Use this book as a reference when you write Integrated Language Environment (ILE) C and C++ applications. This book is intended to be used in conjunction with the Machine Interface Functional Reference, SC41-4810.

This book does not describe how to program in the C programming language, nor does it explain the concepts of ILE.

For information about other AS/400 publications, see either of the following:

- The *Publications Reference* book, SC41-4003, in the AS/400 Softcopy Library.
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For a list of related publications, see “Bibliography” on page 273.

Who Should Use This Book

This book is intended for programmers who are familiar with the ILE C/400 programming language and who plan to use the MI function interface in their ILE C or C++ applications. You also need knowledge of ILE as explained in *ILE Concepts*, SC41-4606

A Note About Examples

The examples in this book are written in a simple style. These examples do not demonstrate all of the possible uses of C language constructs. Some examples are only code fragments and do not compile without additional code.

For ILE C users, all complete runnable examples for the machine interface instructions can be found in library QCLE, in source file QACSRC. The example names are the same as the function name or instruction name. For example, the source code for the example illustrating the use of the `cpybla` function in this book, can be found in library QCLE, file QACSRC, member CPYBLA.

The QSYSINC library must be installed.

Machine Interface Library Functions

This book describes a set of Machine Interface (MI) library functions that provide system-level programming capabilities. The syntax, parameter descriptions, notes on usage, return values and exceptions are presented where applicable for each function. The information presented here is intended to provide you with an indication of what each function can do and highlight any differences in behavior between the function and the MI instruction. You will need to refer to the *Machine Interface Functional Reference*, SC41-4810 for a complete description of each MI instruction.

The **Machine Interface** (MI) is the machine instruction set that allows you to access low level machine procedures.

Most of the MI instructions can be accessed through two interfaces: the builtin interface and the function interface. Some of the functions in the MI library do not have a builtin interface, and some of the builtins do not have a function interface.

The **builtin** interface is a builtin routine that directly accesses the low level machine procedure. You cannot take the address of a routine through its builtin interface, and there is no stack frame associated with a call to a routine through its builtin interface. Performance may be improved if you use the builtin interface but the machine procedures do not use a consistent parameter passing mechanism nor do they make use of return values and null terminated strings like C library functions do.

Although builtin versions are mentioned in the discussion of the function, the syntax is not provided. You will need to refer to the *Machine Interface Functional Reference* where the syntax of all the MI builtins are provided.

The **function** interface provides an easier, more consistent way for passing parameters and using the function calling conventions. If the parameter lists of the function interface and the builtin interface to a machine procedure are identical, the function interface is available as a macro that maps directly to the builtin. If a parameter for an MI function is a string which specifies the name of an AS/400 object, the string must not have any preceding blanks.

See Table 1 on page 255 for a summary of all the ILE C/C++ MI function prototypes. For each function, the prototype for the associated builtin is also provided if it is identical to that of the function. The table also contains the prototypes for builtins which do not have a function interface.

The MI header files allow you to access declarations for both the builtin and function interface to an MI instruction.

Not all the MI instructions described in the *Machine Interface Functional Reference* can be accessed through the functions declared in the MI header files. Many MI instructions are simply not accessible in ILE since the operation they perform can be done just as easily using standard C language constructs. For some of these instructions an equivalent C function is supplied to perform the same operation as the MI instruction. These cases are noted in the function description.

Access to the Machine Interface

You use the AS/400 pointer types with the type definitions and function declarations that make up the MI library to access the MI. The header file <pointer.h> contains the type definitions (typedefs) of the AS/400 pointer types.

Examples

This example shows you how to use the MI builtin _MATS to materialize the attributes of a user space object.

```
#include <pointer.h>
#include <QSYSINC/MIH/RSLVSP>
#include <QSYSINC/MIH/MATS>
#include <QSYSINC/H/QUSCRTUS>

#define CREATION_SIZE  65536

int main(void)

{
   _SPC_Template_T space_t;
   _SYSPTR         ptr_to_space;
   int             error_code = 0;

   QUSCRTUS("MYSPACE   QTEMP     ",
            "MYSPACE   ",
            CREATION_SIZE,
            "\0",
            "*ALL      ",
            "MYSPACE example for Programmer's Reference        ",
            "*YES      ",
            &error_code);

   ptr_to_space = rslvsp(_Usrspc, "MYSPACE", "QTEMP", _AUTH_OBJ_MGMT);

   space_t.TmpSize = sizeof(_SPC_Template_T);

   _MATS(&space_t, &ptr_to_space);
}
```

In this example, the space is created using the Create User Space (QUSCRTUS) API. On the call to _MATS, the argument *space_t* contains the address of the structure into which the space attributes are materialized. This structure is defined in the <QSYSINC/MIH/MATS> header file. The argument *ptr_to_space* contains the address of the system pointer to the space object whose attributes are materialized. This pointer was obtained by using the `rslvsp` function to resolve to the space object. The type definition for _SYSPTR is included in the <pointer.h> header file.

Omitted Operands

If you want to omit an operand (referred to as a "null operand" in the *Machine Interface Functional Reference*) when you use the function interface to access the MI, you must supply a NULL pointer. This only applies to omitted pointer operands. This allows you to use a single interface to access all variations of an MI instruction.

Examples

This example shows how the process control space pointer (the second parameter) may be omitted from the matpratr (Materialize Process Attributes) function interface by passing a NULL pointer on the call to the function.

```
void matpratr (_MPRT_Template_T *mprt_t, _SYSPTR ctrl_space, char options);

matpratr (&mptr_t, NULL, options);
```

This example shows you the builtin interface. There are 2 builtins that provide access to the MATPRATR machine instruction; one in which the process control space pointer is omitted and the other in which it is not. If a NULL is passed for the second argument on the call to matpratr, the semantics are the same as the _MATPRATR1 builtin.

```
void _MATPRATR1 (_MPRT_Template_T *mprt_t, char *options);

void _MATPRATR2 (_MPRT_Template_T *mprt_t, _SYSPTR *ctrl_space, char *options);
```

Exception Handling

Exceptions in the *Machine Interface Functional Reference* are listed as 2-byte hexadecimal numbers as follows:

```
22 Object Access        <---- Group
   01 Object not found  <---- Subtype
   02 Object destroyed
   03 Object suspended
          :
```

To monitor for exceptions around calls to MI library functions and builtins you can follow steps 1 and 2 or steps 1, 3 and 4 :

1. Convert hex to decimal to determine the correct MCH message. For example, hexadecimal 2201 becomes MCH3401.
2. Use the #pragma exception_handler directive
3. Find out what C signal the exception maps to. It could be one of SIGPFE, SIGILL or SIGSEGV.
4. Choose to :
   - Ignore the signal. The exception is handled and placed in the joblog.
   - Accept the default actions. Using the initial state (SIG_DFL), the exception is not handled and percolates.
   - Call a signal handler. The exception is handled and is placed in the joblog.

Example

This example shows you how exceptions from MI library functions can be monitored and handled using a signal handling function. The signal handler my_signal_handler is registered before the rslvsp function signals a 0x2201 exception. When a SIGSEGV signal is raised, the signal handler is called. If an 0x2201 exception occurred, the signal handler calls the QUSRCRTS API to create a space.

```
#include <signal.h>
#include <QSYSINC/MIH/RSLVSP>
#include <QSYSINC/H/QUSCRTUS>
#include <string.h>

#define CREATION_SIZE  65500

void my_signal_handler(int sig) {

   _INTRPT_Hndlr_Parms_T excp_data;
   int                   error_code = 0;

   /* Check the message id for exception 0x2201 */
   _GetExcData(&excp_data);

   if (!memcmp(excp_data.Msg_Id, "MCH3401", 7))
      QUSCRTUS("MYSPACE   QTEMP     ",
               "MYSPACE   ",
               CREATION_SIZE,
               "\0",
               "*ALL      ",
               "MYSPACE example for Programmer's Reference        ",
               "*YES      ",
               &error_code);
}

int main(void) {

   _SYSPTR         ptr_to_space;

   /* Set up signal handler          */
   signal(SIGSEGV, &my_signal_handler);

   /* If space is not there, create it using QUSCRTUS API */
   ptr_to_space = rslvsp(_Usrspc, "MYSPACE", "QTEMP", _AUTH_OBJ_MGMT);

   /* The rest of the program goes here ... */
}
```

Using the Templates declared in the MI Header Files

Some MI instructions require templates that are 16-byte aligned in memory. If a template contains a pointer (of any type), a structure of this type will always be 16-byte aligned. To ensure 16-byte alignment of a template that does not contain a pointer, you can do one of two things:

1. Use malloc to allocate the storage for the template. Storage allocated by malloc is always 16-byte aligned.
2. Declare the template as part of a union whose other member is a pointer. This will force 16-byte alignment since the alignment of a union is always that of its strictest member.

Many templates contain variant portions that require the template user to allocate the correct amount of storage based on information that is usually not known until run time. Consider, for example, the template used for the matobjlk (Materialize Object Locks) function. The typedef for _MOBJL_Template_T is:

```
typedef _Packed struct _MOBJL_Template_T {
   int            Template_Size;        /* size for materialization*/
   int            Bytes_Used;           /* size of data available  */
   char           Lock_Alloc;           /* Lock states allocated   */
   char           Lock_Synch;           /* Lock states Synch Wait  */
   char           Lock_Asynch;          /* Lock states Asynch Wait */
   char           reserved1;
   short          Num_Descripts;        /* # of Lock Descriptors   */
   char           reserved2[2];
   _LOCK_Descript_T Locks[1];           /* Lock state descriptor(s)*/
   /* Lock state desciptor is repeated for each lock currently     */
   /* allocated or waited for. This number is given in the         */
   /* Num_Descripts field.                                         */
}  _MOBJL_Template_T;
```

The number of lock state descriptors is variable depending upon the number of locks currently allocated (or waited for) on the object specified. One way to handle the variant portion is to first materialize the information to obtain the number of lock state descriptors. This is given by the Num_Descripts field. It is then known exactly how much storage you need to allocate in order to materialize all the lock state descriptors. If the number of lock state descriptors happens to be three, then the following section of code would allocate the storage needed to materialize all lock state descriptors.

```
/* Allocate storage for template - disregard variant portion */
mobjl = (_MOBJL_Template_T *)malloc(sizeof(_MOBJL_Template_T));

/* Set all fields in the template to zero.                   */
memset(mobjl, '\0', sizeof(_MOBJL_Template_T));

mobjl->Template_Size = sizeof(_MOBJL_Template_T);

/* Materialize to obtain number of lock state descriptors */
matobjlk(mobjl, sys[0]);

/* Calculate size required to hold all lock state descriptors */
size  = sizeof(_MOBJL_Template_T) +
        (mobjl->Num_Descripts - 1)*sizeof(_LOCK_Descript_T);

/* Allocate the storage through realloc()  */
mobjl = (_MOBJL_Template_T *)realloc(mobjl, size);

/* Set all fields in the template to zero.                   */
memset(mobjl, '\0', sizeof(_MOBJL_Template_T));

mobjl->Template_Size = size;

/* Materialize again with storage allocated for all descriptors */
matobjlk(mobjl, sys[0]);
```

Header Files

Each MI function and builtin is prototyped in a header file provided in library QSYSINC, file MIH. If you wish to use the MI instructions and header files, you must have the library QSYSINC installed on your system.

Most of the MI functions and builtins are prototyped in a header file that corresponds to the MI instruction they reference. For example, the clrbts function is declared in library QSYSINC, file MIH, and member CLRBTS. Following is an illustration of how to include the MI header file that prototypes the clrbts function, from the QSYSINC library, in your program:

```
#include <QSYSINC/MIH/CLRBTS>
```

For ILE C/400, in releases prior to V3R6, the MI functions and builtins were declared in header files according to their use (MI group header files). For example, all computation functions were in the <micomput.h> header file in library QCLE. In V3R6 and following releases, the MI header files reside in the library QSYSINC. The H file in QSYSINC contain the MI header files which were previously in QCLE (the MI group header files), and these files, in turn, include the individual MI header files. If you have hard coded QCLE/H when including group MI header files it is necessary for you to duplicate the MI header files from QSYSINC/H to QCLE/H or change your source to remove the QCLE qualification. You may be able to reduce compile time by including the header files for individual MI instructions rather than the group MI header files.

Computation and Branching Instructions

The following lists the MI header files for computation and branching instructions:

QSYSINC/MIH/CLRBTS
QSYSINC/MIH/CPYBYTES
QSYSINC/MIH/CPRDATA
QSYSINC/MIH/CPYNV
QSYSINC/MIH/CVTBC
QSYSINC/MIH/CVTCB
QSYSINC/MIH/CVTCM
QSYSING/MIH/CVTCS
QSYSINC/MIH/CVTEFN
QSYSINC/MIH/CVTMC
QSYSINC/MIH/RETCA
QSYSINC/MIH/CVTSC
QSYSINC/MIH/DCPDATA
QSYSINC/MIH/EDIT
QSYSINC/MIH/EDIT_PACKED
QSYSINC/MIH/LBCPYNV
QSYSINC/MIH/SCANX
QSYSINC/MIH/SETBTS
QSYSINC/MIH/SETCA
QSYSINC/MIH/TSTBTS
QSYSINC/MIH/XLATEWT
QSYSINC/MIH/CVTCH
QSYSINC/MIH/CVTHC
QSYSINC/MIH/CPYBLA
QSYSINC/MIH/CPYBLAP

QSYSINC/MIH/CPYHEXNN
QSYSINC/MIH/CPYHEXNZ
QSYSINC/MIH/CPYHEXZZ
QSYSINC/MIH/CPYHEXZN
QSYSINC/MIH/EXTREXP
QSYSINC/MIH/SCANWC
QSYSINC/MIH/TRIML
QSYSINC/MIH/EXTREXP
QSYSINC/MIH/TRIML
QSYSINC/MIH/XLATEB

Note: The above header files were previously combined in the header file <micomput.h>.

Date/Time/Timestamp Instructions

The MI header file for date, time and timestamp instructions is:

QSYSINC/MIH/MIDTTM

This header file prototypes all the MI functions and builtins that provide access to the Date/Time/Timestamp instructions.

Note: The declarations in <QSYSINC/MIH/MIDTTM> were previously found in <mitime.h>.

Pointer/Name Resolution Addressing Instructions

The MI header files for pointer/name resolution addressing instructions are:

QSYSINC/MIH/CMPPTRA
QSYSINC/MIH/CMPPTRT
QSYSINC/MIH/RSLVSP

Note: The above header files were previously combined in the header file <miptrnam.h>.

Space Object Addressing Instructions

The MI header files for space object addressing instructions are:

QSYSINC/MIH/CMPPSPAD
QSYSINC/MIH/LSPCO
QSYSINC/MIH/SETSPFP
QSYSINC/MIH/SETSPPFP
QSYSINC/MIH/SETSPPO
QSYSINC/MIH/STSPPO

Note: The above header files were previously combined in the header file <mispcobj.h>.

Space Management Instructions

The MI header files for space management instructions are:

QSYSINC/MIH/MATS
QSYSINC/MIH/MODS

Note: The above header files were previously combined in the header file <mispace.h>.

Program Management Instructions

The MI header file for project management instructions is:

QSYSINC/MIH/MATPG

Note: The declarations is <QSYSINC/MIH/MATPG> were previously found in <mipgmgmt.h>.

Program Execution Instructions

The MI header files for program execution instructions are:

QSYSINC/MIH/MATACTAT
QSYSINC/MIH/MATAGPAT
QSYSINC/MIH/MODASA

Note: The above header files were previously combined in the header file <mipgexec.h>.

Independent Index Instructions

The MI header files for independent index instructions are:

QSYSINC/MIH/FNDINXEN
QSYSINC/MIH/INSINXEN
QSYSINC/MIH/MATINXAT
QSYSINC/MIH/RMVINXEN
QSYSINC/MIH/MODINX

Note: The above header files were previously combined in the header file <miindex.h>.

Queue Management Instructions

The MI header files for queue management instructions are:

QSYSINC/MIH/ENQ
QSYSINC/MIH/DEQ
QSYSINC/MIH/DEQWAIT
QSYSINC/MATQMSG
QSYSINC/MIH/MATQAT

Note: The above header files were previously combined in the header file <miqueue.h>.

Object Lock Management Instructions

The MI header files for object lock management instructions are:

QSYSINC/MIH/LOCK
QSYSINC/MIH/LOCKSL
QSYSINC/MIH/MATAOL
QSYSINC/MIH/MATOBJLK
QSYSINC/MIH/MATPRLK
QSYSINC/MIH/MATSELLK
QSYSINC/MIH/UNLOCK
QSYSINC/MIH/UNLOCKSL
QSYSINC/MIH/XFRLOCK

Note: The above header files were previously combined in the header file <milock.h>.

Authorization Management Instructions

The MI header file for authorization management instructions are:

QSYSINC/MIH/TESTAU

Note: The declarations in <QSYSINC/MIH/TESTAU> were previously found in <miauth.h>.

Process Management Instructions

The MI header files for process management instructions are:

QSYSINC/MIH/MATPRAGP
QSYSINC/MIH/MATPRATR
QSYSINC/MIH/WAITTIME

Note: The above header files were previously combined in the header file <miproces.h>.

Resource Management Instructions

The MI header files for resource management instructions are:

QSYSINC/MIH/ENSOBJ
QSYSINC/MIH/MATAGAT
QSYSINC/MIH/MATRMD
QSYSINC/MIH/SETACST

Note: The above header files were previously combined in the header file <mirsc.h>.

Machine Observation Instructions

The MI header files for machine observation instructions are:

QSYSINC/MIH/FNDRINVN
QSYSINC/MIH/MATINVAT
QSYSINC/MIH/MATPTR
QSYSINC/MIH/MATPTRL
QSYSINC/MIH/MATSOBJ

Note: The above header files were previously combined in the header file <mimchobs.h>.

Machine Interface Support Instructions

The MI header files for machine interface support instructions are:

QSYSINC/MIH/MATMATR
QSYSINC/MIH/MATMDATA
QSYSINC/MIH/MATTOD

Note: The above header files were previously combined in the header file <mimchint.h>.

Mutex Instructions

The MI header files for mutex instructions are:

QSYSINC/MIH/CRTMTX
QSYSINC/MIH/DESMTX
QSYSINC/MIH/LOCKMTX
QSYSINC/MIH/MATMTX
QSYSINC/MIH/MATPRMTX
QSYSINC/MIH/UNLKMTX

Note: The above header files were previously combined in the header file <mimtx.h>.

Job Information Instructions

The header file contains the declarations for the job information instructions that were previously found in the header file <milib.h>:

QSYSINC/MIH/MICOMMON

Original Program Model Description

The programming environment provided when the AS/400 system was first introduced is called the original program model (OPM). Application developers on the AS/400 enter source code into a source file and compile that source. If the compilation is a success, a program object is created. The set of functions, processes, and rules provided by the OS/400 to create and run a program is known as the OPM.

As an OPM compiler generates the program object, it generates additional code. The additional code initializes program variables and provides any necessary code for special processing that is needed by the particular language. The special processing could include processing any input parameters expected by this program. When a program is to start running, the additional compiler-generated code becomes the starting point (entry point) for the program.

Please refer to the *ILE Concepts*, SC41-4606 for more information on OPM.

Independent Index Instructions

This program illustrates how to call the system API, QUSCRTUI, to create a user index. This program must be run before any of the user index examples (insinxen, fndinxen, matinxat, modinx and rmvinxen).

Example

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   User Indexes  <miindex.h>                         */
/*                                                                    */
/* Function:        none   (just an example that can be used with     */
/*                          the other User Index examples)            */
/*                                                                    */
/* Description:     This program illustrates how to call the system   */
/*                  API, QUSCRTUI, to create a user index.  This      */
/*                  program should be run before any of the user      */
/*                  index examples: insinxen, fndinxen, matinxat,     */
/*                  modinx, rmvinxen)                                 */
/*                                                                    */
/*--------------------------------------------------------------------*/

                                       /* This header file contains   */
#include <QSYSINC/H/QUSCRTUI>          /* the prototype for the       */
                                       /* QUSCRTUI System API         */


/* Declare and initialize variables for the call to the QUSCRTUI API.  */

                                       /* Index name and library.     */
char  name_lib[20] = "MYUSRIDX  MYLIB     ";

char  type[]             = "F";        /* Fixed Length Entries        */
char  key_type[]         = "1";        /* Insert using "key"          */
char  immediate_update[] = "0";        /* No immediate update of index */
char  optimize[]         = "0";        /* Optimize for random reference*/

char  attribute[10]      = "EXAMPLE   ";   /* Arbitrary attribute name.*/
char  authority[10]      = "*ALL      ";   /* Authority for the Index. */

char  replace[10]        = "*NO       ";   /* Do not replace the index */
                                           /* if it already exists.    */

int   entry_length       = 110,            /* Length of each entry.    */
      key_length         =  10;            /* Length of the key.       */

char  description[50] = "User Index being used for keeping a sorted list";

 /*--------------------------------------------------------------------*/
 /* Define the "error code parameter" structure as defined in the      */
 /* System Programmer's Interface Reference manual.  A typedef of a    */
 /* structure in this format is provided in the <QSYSINC/H/QUSEC>      */
 /* header file.  The structure typedef is called Qus_EC_t and has     */
 /* different member names than the structure used in this example,    */
 /* although the example could be changed to use that typedef.         */
 /*--------------------------------------------------------------------*/
```

```
struct {
  int   bytes_available;
  int   bytes_used;
  char  exception_id[7];
  char  reserved;
  char  exception_data[1];
 } error_code;

int main(void)  {


 /*-------------------------------------------------------------------*/
 /*  Call the 'QUSCRTUI' System API to create the user queue with     */
 /*  the specified name and library and the above characteristics.    */
 /*-------------------------------------------------------------------*/


                                      /* Let any exception generated  */
  error_code.bytes_available = 0;     /* be sent to this program and  */
                                      /* appear in the joblog.        */

  QUSCRTUI( name_lib, attribute, type, entry_length, key_type,
            key_length, immediate_update, optimize, authority,
            description, replace, &error_code );
}
```

Queue Management Instructions

This program illustrates how to call the system API, QUSCRTUQ, to create a user queue. This program must be run before any of the user queue examples (enq, deq, deqi, matqat and matqmsg).

Example

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   User Queues <miqueue.h>                           */
/*                                                                    */
/* Function:        none     (just an example that can be used with   */
/*                            the other User Queue examples)          */
/*                                                                    */
/* Description:     This program illustrates how to call the system   */
/*                  API, QUSCRTUQ, to create a user queue.  This      */
/*                  program should be run before any of the user      */
/*                  queue examples: enq, deq, deqi, matqat,           */
/*                  matqmsg.                                          */
/*                                                                    */
/*                  Since User Queues are often used for inter-job    */
/*                  or inter-program communications, the entries on   */
/*                  the queue are referred to as "messages".          */
/*                                                                    */
/*--------------------------------------------------------------------*/

                                       /* This header file contains    */
#include <QSYSINC/H/QUSCRTUQ>          /* the prototype for the        */
                                       /* QUSCRTUQ System API          */


/* Declare and initialize variables for the call to the QUSCRTUQ API.  */

                                       /* Since this is not a keyed    */
int   key_length           =   0,      /* user queue, set this to zero */

      maximum_message_size =  75,      /* Maximum message size         */
      initial_messages     =  10,      /* Initial number of messages   */

      additional_messages  =  50;      /* Number of additional messages */
                                       /* that can be accommodated.    */

char  type[]             = "F";            /* First-In-First-Out (FIFO)*/

                                           /* Library and name of *USRQ*/
char  name_lib[]         = "MYUSRQ    MYLIB     ";

char  attribute[10]      = "EXAMPLE   ";   /* Arbitrary attribute name.*/
char  authority[10]      = "*ALL      ";   /* Authority for the Index. */

char  replace[10]       = "*NO       ";   /* Do not replace the queue */
                                           /* if it already exists.    */

char  description[50] = "User Queue used for inter-job communication";
```

```
 /*--------------------------------------------------------------------*/
 /* Define the "error code parameter" structure as defined in the      */
 /* System Programmer's Interface Reference manual.  A typedef of a    */
 /* structure in this format is provided in the <QSYSINC/H/QUSEC>      */
 /* header file.  The structure typedef is called Qus_EC_t and has     */
 /* different member names than the structure used in this example,    */
 /* although the example could be changed to use that typedef.         */
 /*--------------------------------------------------------------------*/

struct {
  int   bytes_available;
  int   bytes_used;
  char  exception_id[7];
  char  reserved;
  char  exception_data[1];
 } error_code;

int main(void)  {


 /*--------------------------------------------------------------------*/
 /*  Call the 'QUSCRTUQ' System API to create the user queue with      */
 /*  the specified name and library and the above characteristics      */
 /*--------------------------------------------------------------------*/

                                      /* Let any exception generated  */
  error_code.bytes_available = 0;     /* be sent to this program and  */
                                      /* appear in the joblog.        */

  QUSCRTUQ( name_lib, attribute, type, key_length,
            maximum_message_size, initial_messages,
            additional_messages, authority, description,
            replace, &error_code );
}
```

Establishing an Invocation Exit Program (ATIEXIT)

Format

```
#include <mipgexec.h>

int atiexit (_OS_func_t *exit_handler,
             void *parm)
```

Description

The atiexit function will establish an invocation exit handler at the oldest control boundary in an activation group. If the control boundary invocation is abnormally terminated, the registered exit handler will be invoked. The atiexit function is provided for OPM compatibility.

Invocations cancelled as a result of abort(), CEEMRCR API, RCLACTGRP option(*ABNORMAL), process termination, unhandled function check, and QMHSNDPM/QMHRSNEW APIs are considered abnormal termination.

Invocations cancelled as a result of a longjmp(), exit(), RCLACTGRP option(*NORMAL) are all considered normal termination.

When the atiexit function is called, the *exit_handler* parameter is copied into an internal buffer. Any changes made to these parameters after the function is called are not reflected. The *exit_handler* parameter is checked to ensure that it is a valid system pointer or NULL (this does not ensure that the system pointer is a valid pointer to a program object) If this check fails, the atiexit function returns a non-zero value and the previous value of the atiexit function does not change. If it succeeds, the *exit_handler* parameter is copied to an internal buffer, replacing its contents. Specifying a NULL pointer for *exit_handler* is equivalent to turning atiexit off.

Parameters

exit_handler(input)

A pointer to an OS_linkage exit handler program. This pointer is copied into an internal buffer when the atiexit function is called. Subsequent changes to this pointer will not be reflected.

parm (input)

A pointer to user data that will be passed to the exit handler. This pointer is copied into an internal buffer when the atiexit function is called. Subsequent changes to this pointer will not be reflected.

Notes on Usage

- The atiexit function cannot be called from within an atiexit-registered handler. This will result in a non-zero return value.
- The atiexit function cannot be called from the OPM default activation group. This will result in a non-zero return value.
- The caller of the exit handler acts like a control boundary with regards to exception percolation. If an unhandled exception is percolated out of an exit handler, then the following is done:
  1. The exception is handled, but the message remains in the joblog.
  2. The *LEFAIL condition is signalled to the caller of the control boundary.

Example

This example illustrates the use of the atiexit function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Program Execution     <mipgexec.h>                */
/*                                                                    */
/* Function:        atiexit                                           */
/*                                                                    */
/* Description:     This example uses 'atiexit' to establish an       */
/*                  invocation exit handler that will be invoked      */
/*                  when the invocation for main() is abnormally      */
/*                  terminated.                                       */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <mipgexec.h>

#pragma linkage(EXIT, OS)
void EXIT(void *);

#pragma linkage(REPORT, OS)
void REPORT(void);

int  rc = 99;

_OS_func_t *exit_ptr = EXIT;

main() {

  /* establish the exit handler  */
  atiexit(exit_ptr, &rc);

  /* The rest of the program goes here...  */

  /* Program not found...MCH3401 is generated  */
  REPORT();
}
```

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Program Execution     <mipgexec.h>                */
/*                                                                    */
/* Function:        atiexit - invocation exit handler                 */
/*                                                                    */
/* Description:     This is the invocation exit handler that was      */
/*                  registered through atiexit.                       */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <stdlib.h>

int main(int argc, char *argv[]) {

  /* Do some cleanup... */

  exit(*(int *)argv[1]); /* Exit using the return code passed */
}
```

Compute Date Duration (CDD)

Format

```
#include <QSYSINC/MIH/MIDTTM>

void cdd (_SPCPTR date_duration,
          _SPCPTRCN date1,
          _SPCPTRCN date2,
          _INST_Template_T2 *inst_t);
```

Description

The cdd function computes the date duration. The date specified by *date2* is subtracted from the date specified by *date1* and the value of the result is placed in *date_duration*. A negative value will be returned when *date1* is less than *date2*.

Parameters

date_duration (input/output)
Pointer to the location to receive the packed decimal duration.

date1 (input)
Pointer to the first date.

date2 (input)
Pointer to the second date.

inst_t (input)
Pointer to the instruction template which defines the data definitional attributes for *date_duration*, *date1*, and *date2*.

Notes on Usage

- The DDATs for *date1* and *date2* must be identical.
- The builtin function _CDD also provides access to the MI instruction.
- A macro version is available.

Example

This example illustrates the use of the cdd function.

```
/*------------------------------------------------------------------------*/
/*                                                                        */
/* Example Group:   Date/Time/Timestamp      <QSYSINC/MIH/MIDTTM>     */
/*                                                                        */
/* Function:        cdd     (Compute Date Duration)                   */
/*                                                                        */
/* Description:     This example uses 'cdd' to compute the date       */
/*                  duration of date1 and date2.                      */
/*                                                                        */
/*------------------------------------------------------------------------*/

#include <QSYSINC/MIH/MIDTTM>
#include <string.h>
#include <stdio.h>
#include <stdlib.h>
#include <stddef.h>
#include <decimal.h>

/* Internal format for start of Gregorian timeline: January 1, 0001 */
#define GREGORIAN_TIMELINE_START   1721424

/* Internal format for end of Gregorian timeline: January 1, 10000  */
#define GREGORIAN_TIMELINE_END     5373485

int main(void) {

  _INST_Template_T2   *inst_t2;
  _DDAT_T             *ddat_t1, *ddat_t2;
  _Era_Table_T        *era_t2;
  _Calendar_Table_T   *cal_t2;

  char buffer[50];

  int               DDAT_Length, Calendar_Offset;
  int               DDAT_Size, Template_Size;
  int               DDAT_Offset1, DDAT_Offset2;

  char              source2_d[] = "1992-05-21";
  char              source1_d[] = "1993-01-30";
  decimal(8,0)      duration;

  DDAT_Length = sizeof(_DDAT_T) +
                2*(sizeof(_Calendar_Table_T)) - sizeof(short) +
                sizeof(_Era_Table_T) - 1;

  Calendar_Offset = offsetof(_DDAT_T, Tables) +
                    sizeof(_Era_Table_T);

  DDAT_Size       = 2*DDAT_Length +
                    2*(sizeof(int)) +   /* DDAT_Offset */
                    10 +                /* reserved4   */
                    sizeof(short) +     /* Num_DDATs   */
                    sizeof(int);        /* DDAT_Size   */

  Template_Size   = 2*DDAT_Length + offsetof(_INST_Template_T2, DDAT) +
```

```
                  sizeof(int); /* ddat offset  */

DDAT_Offset1    = (offsetof(_INST_Template_T2, DDAT) -
                  offsetof(_INST_Template_T2, DDAT_Size)) +
                  sizeof(int); /* DDAT2 offset */

DDAT_Offset2    = (offsetof(_INST_Template_T2, DDAT) -
                  offsetof(_INST_Template_T2, DDAT_Size)) +
                  DDAT_Length + sizeof(int); /* DDAT2 offset */

inst_t2   = (_INST_Template_T2 *)malloc(Template_Size);

/* Fill in Instruction Template                       */

memset(inst_t2, '\0', sizeof(_INST_Template_T2));

inst_t2->Template_Size     = Template_Size;
inst_t2->DDAT_1            = 1;
inst_t2->DDAT_2            = 2;
inst_t2->DDAT_3            = 2;
inst_t2->Length_2          = 10;
inst_t2->Length_3          = 10;
inst_t2->DDAT_Size         = DDAT_Size;
inst_t2->Num_DDATs         = 2;
inst_t2->DDAT_Offset[0]    = DDAT_Offset1;
*(inst_t2->DDAT_Offset + 1)= DDAT_Offset2;

/* Set table pointers within instruction template    */

ddat_t1   = (_DDAT_T *)&(inst_t2->DDAT_Offset + 2);
ddat_t2   = (_DDAT_T *)((char *)ddat_t1 + DDAT_Length);
era_t2    = (_Era_Table_T *)&(ddat_t2->Tables);
cal_t2    = (_Calendar_Table_T *)((char *)ddat_t2 + Calendar_Offset);

/* Fill in DDAT 1                                    */

ddat_t1->Format_Code     =  _DATE_DUR;
ddat_t1->DDAT_Length     = DDAT_Length;
ddat_t1->Calendar_Offset = Calendar_Offset;

/* Fill in DDAT2                                     */

ddat_t2->DDAT_Length     = DDAT_Length;
ddat_t2->Format_Code     = _ISO_DATE;
ddat_t2->Calendar_Offset = Calendar_Offset;

/* Fill in Era Table for DDAT2                       */

era_t2->Num_Elems              = 1;
era_t2->Element[0].Origin_Date = GREGORIAN_TIMELINE_START;
era_t2->Element[0].Era_Name[0] = 'A';
era_t2->Element[0].Era_Name[1] = 'D';

/* Fill in Calendar Table for DDAT2                  */

cal_t2->Num_Elems                = 2;
cal_t2->Element->Effect_Date = GREGORIAN_TIMELINE_START;
cal_t2->Element->Type            = 0x0001;
```

```
  memset(cal_t2->Element->reserved, '\0', 10);
  (cal_t2->Element+1)->Effect_Date = GREGORIAN_TIMELINE_END;
  (cal_t2->Element+1)->Type        = 0;
  memset((cal_t2->Element+1)->reserved, '\0', 10);

  cdd(&duration, source1_d, source2_d, inst_t2);

  printf("The date duration (YYYYMMDD) is %08D(8,0)\n", duration);
}
```

Output

```
The date duration (YYYYMMDD) is 00000809
```

Clear Bit in String (CLRBTS)

Format

```
#include <QSYSINC/MIH/CLRBTS>

void clrbts (_SPCPTR bit_string,
             unsigned int bit_offset);
```

Description

The clrbts function clears the bit in *bit_string* as indicated by *bit_offset*.

Parameters

bit_string (input)

A pointer to a bit string with the bits numbered left to right from 0 to the total number of bits in the string minus 1.

bit_offset (input)

Indicates which bit of *bit_string* is to be set, with an offset of zero indicating the leftmost bit of the leftmost byte of *bit_string*. This value must be less than 64k.

Notes on Usage

- If the selected bit is beyond the end of the string, or the value of *bit_offset* is greater than or equal to 64k, the result of the operation is undefined.
- A macro version is available.
- The builtin function _CLRBTS also provides access to the MI instruction.

Exceptions

In some circumstances, if the selected bit is beyond the end of allocated storage, an MCH3203 exception may be signalled.

Example

This example illustrates the use of the clrbts function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Computation and Branching  <QSYSINC/MIH/CLRBTS>   */
/*                                                                    */
/* Function:        clrbts   (Clear Bit in String)                    */
/*                                                                    */
/* Description:     This example uses 'setbts', 'tstbts', and         */
/*                  'clrbts' to set, test, and clear the 17th bit     */
/*                  in the bit string.                                */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/CLRBTS>
#include <QSYSINC/MIH/SETBTS>
#include <QSYSINC/MIH/TSTBTS>
#include <stdio.h>

#define  FALSE 0
#define  TRUE  !FALSE

int main(void) {

  unsigned bit_string = 0;
  unsigned offset = 17;
  unsigned flag = FALSE;

  setbts(&bit_string, offset);

  flag = tstbts(&bit_string, offset);

  if (flag)
    printf("The %u'th bit has been set\n", offset);

  clrbts(&bit_string, offset);

  flag = tstbts(&bit_string, offset);

  if (!flag)
    printf("The %u'th bit has been cleared\n", offset);

}
```

Output

```
The 17'th bit has been set
The 17'th bit has been cleared
```

Compare Pointer for Space Addressability (CMPPSPAD)

Format

```
#include <QSYSINC/MIH/CMPPSPAD>

  int cmppspad (_SPCPTR space1,
                _SPCPTR space2);
```

Description

The cmppspad function compares space addressability. The space addressability contained in the pointer specified by *space1* is compared with the space addressability defined by *space2*. If the two data objects pointed to by space1 and space2 are contained in the same space object, a value of 1 is returned, otherwise, a value of 0 is returned.

Parameters

space1 (input) and space2 (input)

The two space pointers to be compared.

Notes on Usage

- cmppspad is a compatibility function. Use the cmppspad function for compatibility only, otherwise use the cmpptra function. The cmpptra function allows any type of pointer as arguments.
- Use C comparison operations to determine, for objects in the same space, if the offsets are greater than, less than, or equal.
- An open pointer that points to any type of pointer is a valid argument.

Exceptions

If an invalid space address is given for arguments 1 or 2, an MCH3601 is signalled.

Example

This example illustrates the use of the cmppspad function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Space Object Addressing    <QSYSINC/MIH/CMPPSPAD> */
/*                                                                    */
/* Function:        cmppspad   (Compare Pointer for Space             */
/*                              Addressability)                       */
/*                                                                    */
/* Description:     This example uses 'cmppspad' to determine if two  */
/*                  space pointers are addressing the same space.     */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <stdio.h>
#include <QSYSINC/MIH/CMPPSPAD>

int main(void) {

  int       i_array[50], rc;
  _SPCPTR   sp1 = i_array, sp2 = i_array + 25;

  rc = cmppspad(sp1, sp2);

  if (rc)
    printf("Objects are in the same space.\n");
  else
    printf("Objects are not in the same space.\n");
}
```

Output

```
Objects are in the same space.
```

Compare Pointer for Object Addressability (CMPPTRA)

Format

```
#include <QSYSINC/MIH/CMPPTRA>

int cmpptra (_ANYPTR pointer1,
             _ANYPTR pointer2);
```

Description

The cmpptra function compares the object addressability of 2 pointers. The object addressed by *pointer1* is compared with the object addressed by *pointer2* to determine if both pointers are addressing the same object. A 1 (TRUE) is returned if the pointers are addressing the same object, otherwise a 0 (FALSE) is returned.

For space pointers, TRUE is returned if they are addressing the same space. The space offset portion of the pointer is ignored in the comparison.

For system pointers, TRUE is returned if the system pointer is compared with a space pointer that addresses a byte in a space associated with the object that is addressed by the system pointer.

Parameters

pointer1 (input)

First pointer for compare operation. Must be a space pointer or system pointer.

pointer2 (input)

Second pointer for compare operation. Must be a space pointer or system pointer.

Notes on Usage

- A macro version is available.
- The builtin function _CMPPTRA also provides access to the MI instruction.

Exceptions

If a pointer does not exist in argument 1 or 2, an MCH3601 will be signalled. If a pointer type other than a system pointer or space pointer is passed, an MCH3602 will be signalled.

Example

This example illustrates the use of the cmpptra function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Pointer/Name Resolution Addressing                */
/*                  <QSYSINC/MIH/CMPPTRA>                             */
/*                                                                    */
/* Function:        cmpptra  (Compare Pointer for Object              */
/*                            Addressability)                         */
/*                                                                    */
/* Description:     This example uses 'cmpptra' to determine if       */
/*                  two pointers are addressing the same object.      */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/CMPPTRA>
#include <QSYSINC/MIH/RSLVSP>
#include <QSYSINC/MIH/SETSPPFP>
#include <stdio.h>

#include <QSYSINC/H/QUSCRTUS>

#define CREATION_SIZE  65536

int main(void) {
   _SPCPTR         sp;
   _SYSPTR         sysp;
   int             error_code = 0, result;

   QUSCRTUS("MYSPACE   QTEMP     ",  /* Create user space            */
            "MYSPACE   ",
            CREATION_SIZE,
            "\0",
            "*ALL      ",
            "MYSPACE example for Programmer's Reference        ",
            "*YES      ",
            &error_code);

  /* Resolve to created space object                                 */
  sysp = rslvsp(_Usrspc, "MYSPACE", "QTEMP", _AUTH_OBJ_MGMT);

  sp = setsppfp(sysp);    /* Obtain space pointer into space          */

  result = cmpptra(sp, sysp);

  if (result)
    printf("The pointers are addressing the same object\n");
  else
    printf("Error: the pointers are NOT addressing the same object\n");
}
```

Output

```
The pointers are addressing the same object
```

Compare Pointer Type (CMPPTRT)

Format

```
#include <QSYSINC/MIH/CMPPTRT>

int cmpptrt (_ANYPTR pointer,
             char type);
```

Description

The cmpptrt function compares the pointer type with the character scalar. If *pointer* is of the same type as indicated by the character value *type*, then 1 (TRUE) is returned, otherwise 0 (FALSE) is returned.

Parameters

pointer (input)

May be any one of the valid AS/400 pointer types.

type (input)

The name of the pointer type to compare to. All valid values are supplied through macros in the <milib.h> header file.

Notes on Usage

- The builtin function _CMPPTRT also provides access to the MI instruction.
- A macro version is available.

Exceptions

If the scalar value supplied for type is not valid, an MCH5003 is signalled.

Example

This example illustrates the use of the cmpptrt function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Pointer/Name Resolution Addressing                */
/*                  #include <QSYSINC/MIH/CMPPTRT>                    */
/*                                                                    */
/* Function:        cmpptrt  (Compare Pointer Type)                   */
/*                                                                    */
/* Description:     This example uses 'cmpptrt' to determine the      */
/*                  pointer's type.                                   */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/CMPPTRT>
#include <stdio.h>

int main(int arg, char **argv) {

  int       result = 0;

  result = cmpptrt(argv[1], _PTR_T_NULL);

  if (result)
    printf("The pointer is not set\n");
  else {
     result = cmpptrt(argv[1], _PTR_T_SYS);
     if (result)
        printf("The pointer is a system pointer\n");
     else {
        result = cmpptrt(argv[1], _PTR_T_SPC);
        if (result)
           printf("The pointer is a space pointer\n");
        else {
           result = cmpptrt(argv[1], _PTR_T_INV);
           if (result)
             printf("The pointer is an invocation pointer\n");
           else {
              result = cmpptrt(argv[1], _PTR_T_PROC);
              if (result)
                printf("The pointer is a function pointer\n");
              else {
                 result = cmpptrt(argv[1], _PTR_T_LBL);
                 if (result)
                   printf("The pointer is a label pointer\n");
                 else {
                    result = cmpptrt(argv[1], _PTR_T_SUSP);
                    if (result)
                      printf("The pointer is a suspend pointer\n");
                    else
                      printf("Unexpected error\n");
                 }
              }
           }
        }
     }
  }
}
```

Output

Output if the program is passed the argument NULL:

```
The pointer is not set
```

Compress Data (CPRDATA)

Format

```
#include <QSYSINC/MIH/CPRDATA>

int cprdata (_SPCPTR result,
             int result_length,
             _SPCPTRCN source,
             int src_length);
```

Description

The cprdata function compresses user data of a specified length. If the compressed result is longer than the result area (as specified by *result_length*), the compression is stopped and only *result_length* bytes are stored.

The cprdata function returns the number of bytes in the compressed result. This value is always set to the full length of the result, which may be larger than *result_length*.

Parameters

result (input/output)
Pointer to the result area to receive the compressed data.

result_length (input)
The result area length.

source (input)
The data to be compressed.

src_length (input)
The length of the source.

Notes on Usage

- Only non-pointer data can be compressed, so any pointers in the data to be compressed are destroyed in the output of the Decompress Data instruction.
- A simple terse algorithm is used.
- The builtin function _CPRDATA also provides access to the MI instruction.

Example

This example illustrates the use of the cprdata function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Computation and Branching  <QSYSINC/MIH/CPRDATA>  */
/*                                                                    */
/* Function:        cprdata  (Compress Data)                          */
/*                                                                    */
/* Description:     This example uses 'cprdata' and 'dcpdata' to      */
/*                  compress then decompress the input string.        */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/CPRDATA>
#include <QSYSINC/MIH/DCPDATA>
#include <string.h>
#include <stdio.h>

#define SIZE  50

int main(void) {

  char    cpr_data[SIZE];
  char    dpr_data[SIZE] = "Good Day";
  int     clength;
  int     dlength;

  clength = cprdata(cpr_data, SIZE, dpr_data, strlen(dpr_data));
  printf("The compressed length = %d\n", clength);

  dlength = dcpdata(dpr_data, SIZE, cpr_data);
  printf("The decompressed length = %d\n", dlength);

  if (memcmp(dpr_data, "Good Day", strlen(dpr_data)) != 0)
    printf("Error in decompression\n");
  else
    printf("Decompression successful\n");
}
```

Output

```
The compressed length = 26
The decompressed length = 8
Decompression successful
```

Compute Time Duration (CTD)

Format

```
#include <QSYSINC/MIH/MIDTTM>

void ctd (_SPCPTR time_duration,
          _SPCPTRCN time1,
          _SPCPTRCN time2,
          _INST_Template_T2 *inst_t);
```

Description

The ctd function determines the time duration. The time specified by *time2* is subtracted from the time specified by *time1* and the value of the result is placed in *time_duration*. A negative value will be returned when *time1* is less than *time2*.

Parameters

time_duration (input/output)
Pointer to the location to receive the packed decimal duration.

time1 (input)
Pointer to the first time.

time2 (input)
Pointer to the second time.

inst_t (input)
Pointer to the instruction template which defines the data definitional attributes for *time_duration*, *time1* and *time2*.

Notes on Usage

- The DDATs for *time1* and *time2* must be identical.
- The builtin function _CTD also provides access to the MI instruction.
- A macro version is available.

Example

This example illustrates the use of the ctd function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Date/Time/Timestamp     <QSYSINC/MIH/MIDTTM>      */
/*                                                                    */
/* Function:        ctd     (Comput Time Duration)                    */
/*                                                                    */
/* Description:     This example uses 'ctd' to compute the time       */
/*                  duration of time1 and time2.                      */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/MIDTTM>
#include <string.h>
#include <stdio.h>
#include <stdlib.h>
#include <stddef.h>
#include <decimal.h>

int main(void) {

  _INST_Template_T2   *inst_t2;
  _DDAT_T             *ddat_t1, *ddat_t2;

  int               DDAT_Length, Calendar_Offset;
  int               DDAT_Size, Template_Size;
  int               DDAT_Offset1, DDAT_Offset2;

  char              source2_d[] = "11.05.30";
  char              source1_d[] = "14.20.46";
  decimal(6,0)      duration;

  DDAT_Length = sizeof(_DDAT_T) +
                2*(sizeof(_Calendar_Table_T)) - sizeof(short) +
                sizeof(_Era_Table_T) - 1;

  Calendar_Offset = offsetof(_DDAT_T, Tables) +
                    sizeof(_Era_Table_T);

  DDAT_Size       = 2*DDAT_Length +
                    2*(sizeof(int)) +   /* DDAT_Offset */
                    10 +                /* reserved4   */
                    sizeof(short) +     /* Num_DDATs   */
                    sizeof(int);        /* DDAT_Size   */

  Template_Size   = 2*DDAT_Length + offsetof(_INST_Template_T2, DDAT) +
                    sizeof(int); /* ddat offset  */

  DDAT_Offset1    = (offsetof(_INST_Template_T2, DDAT) -
                    offsetof(_INST_Template_T2, DDAT_Size)) +
                    sizeof(int); /* DDAT2 offset */

  DDAT_Offset2    = (offsetof(_INST_Template_T2, DDAT) -
                    offsetof(_INST_Template_T2, DDAT_Size)) +
                    DDAT_Length + sizeof(int); /* DDAT2 offset */
```

```
  inst_t2   = (_INST_Template_T2 *)malloc(Template_Size);

  /* Fill in Instruction Template                       */

  memset(inst_t2, '\0', sizeof(_INST_Template_T2));

  inst_t2->Template_Size     = Template_Size;
  inst_t2->DDAT_1            = 1;
  inst_t2->DDAT_2            = 2;
  inst_t2->DDAT_3            = 2;
  inst_t2->Length_2          = 8;
  inst_t2->Length_3          = 8;
  inst_t2->DDAT_Size         = DDAT_Size;
  inst_t2->Num_DDATs         = 2;
  inst_t2->DDAT_Offset[0]    = DDAT_Offset1;
  *(inst_t2->DDAT_Offset + 1)= DDAT_Offset2;


  ddat_t1   = (_DDAT_T *)&(inst_t2->DDAT_Offset + 2);
  ddat_t2   = (_DDAT_T *)((char *)ddat_t1 + DDAT_Length);

  /* Fill in DDAT 1                                      */

  ddat_t1->DDAT_Length      =  DDAT_Length;
  ddat_t1->Format_Code      =  _TIME_DUR;
  ddat_t1->Hour_Zone        =  0;
  ddat_t1->Min_Zone         =  0;
  ddat_t1->Calendar_Offset =  Calendar_Offset;

  /* Fill in DDAT2                                       */

  ddat_t2->DDAT_Length     = DDAT_Length;
  ddat_t2->Format_Code     = _ISO_TIME;
  ddat_t2->Hour_Zone       = 24;
  ddat_t2->Min_Zone        = 60;
  ddat_t2->Calendar_Offset = Calendar_Offset;

  ctd(&duration, source1_d, source2_d, inst_t2);

  printf("The time duration (hhmmss) is %06D(6,0)\n", duration);
}
```

Output

```
The time duration (hhmmss) is 031516
```

Compute Timestamp Duration (CTSD)

Format

```
#include <QYSINC/MIH/MIDTTM>

void ctsd (_SPCPTR timestamp_duration,
           _SPCPTRCN timestamp1,
           _SPCPTRCN timestamp2,
           _INST_Template_T2 *inst_t);
```

Description

The ctsd function determines the timestamp duration. The timestamp specified by *timestamp2* is subtracted from the timestamp specified by *timestamp1* and the value of the result is placed in *timestamp_duration*. A negative timestamp will be returned when *timestamp1* is less than *timestamp2*.

Parameters

timestamp_duration (input/output)
Pointer to the location to receive the packed decimal duration.

timestamp1 (input)
Pointer to the first timestamp.

timestamp2 (input)
Pointer to the second timestamp.

inst_t (input)
Pointer to the instruction template which defines the data definitional attributes for *timestamp_duration*, *timestamp1*, and *timestamp2*.

Notes on Usage

- The DDATs for *timestamp1* and *timestamp2* must be identical.
- The builtin function _CTSD also provides access to the MI instruction.
- A macro version is available.

Example

This example illustrates the use of the ctsd function.

```
/*------------------------------------------------------------------*/
/*                                                                  */
/* Example Group:   Date/Time/Timestamp     <QSYSINC/MIH/MIDTTM>    */
/*                                                                  */
/* Function:        ctsd    (Compute Timestamp Duration)            */
/*                                                                  */
/* Description:     This example uses 'ctsd' to compute the timestamp */
/*                  duration of timestamp1 and timestamp2.          */
/*                                                                  */
/*------------------------------------------------------------------*/

#include <QSYSINC/MIH/MIDTTM>
#include <string.h>
#include <stdio.h>
#include <stdlib.h>
#include <stddef.h>
#include <decimal.h>

/* Internal format for start of Gregorian timeline: January 1, 0001 */
#define GREGORIAN_TIMELINE_START   1721424

/* Internal format for end of Gregorian timeline: January 1, 10000  */
#define GREGORIAN_TIMELINE_END     5373485

int main(void) {

  _INST_Template_T2   *inst_t2;
  _DDAT_T             *ddat_t1, *ddat_t2;
  _Era_Table_T        *era_t2;
  _Calendar_Table_T   *cal_t2;

  int                 DDAT_Length, Calendar_Offset;
  int                 DDAT_Size, Template_Size;
  int                 DDAT_Offset1, DDAT_Offset2;

  char                source2_d[] = "1992-02-21-09.15.02.000000";
  char                source1_d[] = "1993-11-30-11.22.31.000000";
  decimal(20,6)       duration;

  DDAT_Length = sizeof(_DDAT_T) +
                2*(sizeof(_Calendar_Table_T)) - sizeof(short) +
                sizeof(_Era_Table_T) - 1;

  Calendar_Offset = offsetof(_DDAT_T, Tables) +
                    sizeof(_Era_Table_T);

  DDAT_Size       = 2*DDAT_Length +
                    2*(sizeof(int)) +   /* DDAT_Offset */
                    10 +                /* reserved4   */
                    sizeof(short) +     /* Num_DDATs   */
                    sizeof(int);        /* DDAT_Size   */

  Template_Size   = 2*DDAT_Length + offsetof(_INST_Template_T2, DDAT) +
                    sizeof(int); /* ddat offset  */
```

```
DDAT_Offset1    = (offsetof(_INST_Template_T2, DDAT) -
                   offsetof(_INST_Template_T2, DDAT_Size)) +
                   sizeof(int); /* DDAT2 offset */

DDAT_Offset2    = (offsetof(_INST_Template_T2, DDAT) -
                   offsetof(_INST_Template_T2, DDAT_Size)) +
                   DDAT_Length + sizeof(int); /* DDAT2 offset */

inst_t2   = (_INST_Template_T2 *)malloc(Template_Size);

/* Fill in Instruction Template                      */

memset(inst_t2, '\0', sizeof(_INST_Template_T2));

inst_t2->Template_Size     = Template_Size;
inst_t2->DDAT_1            = 1;
inst_t2->DDAT_2            = 2;
inst_t2->DDAT_3            = 2;
inst_t2->Length_2          = 26;
inst_t2->Length_3          = 26;
inst_t2->DDAT_Size         = DDAT_Size;
inst_t2->Num_DDATs         = 2;
inst_t2->DDAT_Offset[0]    = DDAT_Offset1;
*(inst_t2->DDAT_Offset + 1)= DDAT_Offset2;


ddat_t1   = (_DDAT_T *)&(inst_t2->DDAT_Offset + 2);
ddat_t2   = (_DDAT_T *)((char *)ddat_t1 + DDAT_Length);
era_t2    = (_Era_Table_T *)&(ddat_t2->Tables);
cal_t2    = (_Calendar_Table_T *)((char *)ddat_t2 + Calendar_Offset);

/* Fill in DDAT 1                                    */

ddat_t1->DDAT_Length     =  DDAT_Length;
ddat_t1->Format_Code     =  _TIMESTAMP_DUR;
ddat_t1->Hour_Zone       =  0;
ddat_t1->Min_Zone        =  0;
ddat_t1->Calendar_Offset =  Calendar_Offset;

/* Fill in DDAT2                                     */

ddat_t2->DDAT_Length     = DDAT_Length;
ddat_t2->Format_Code     = _SAA_TIMESTAMP;
ddat_t2->Hour_Zone       = 24;
ddat_t2->Min_Zone        = 60;
ddat_t2->Calendar_Offset = Calendar_Offset;

/* Fill in Era Table for DDAT2                       */

era_t2->Num_Elems   = 1;
era_t2->Element[0].Origin_Date = GREGORIAN_TIMELINE_START;
era_t2->Element[0].Era_Name[0] = 'A';
era_t2->Element[0].Era_Name[1] = 'D';

/* Fill in Calendar Table for DDAT2                  */

cal_t2->Num_Elems                  = 2;
cal_t2->Element->Effect_Date       = GREGORIAN_TIMELINE_START;
```

```
  cal_t2->Element->Type               = 0x0001;
  memset(cal_t2->Element->reserved, '\0', 10);
  (cal_t2->Element+1)->Effect_Date    = GREGORIAN_TIMELINE_END;
  (cal_t2->Element+1)->Type           = 0;
  memset((cal_t2->Element+1)->reserved, '\0', 10);

  ctsd(&duration, source1_d, source2_d, inst_t2);

  printf("The timestamp duration (YYYYMMDDhhmmssuuuuuu) is %020D(20,6)\n",
         duration);
}
```

Output

```
The timestamp duration (YYYYMMDDhhmmssuuuuuu) is 0010909020729.000000
```

Convert Binary Synchronous Communications to Character (CVTBC)

Format

```
#include <QSYSINC/MIH/CVTBC>

int cvtbc (_SPCPTR receiver,
           unsigned int rcvr_length,
           _CVTBC_Control_T *controls,
           _SPCPTRCN source,
           unsigned int src_length);
```

Description

The cvtbc function converts a string value from the BSC (binary synchronous communications) compressed format to a character string. The function converts *source* using the information contained in *controls* and places the result into the location specified by *receiver*.

Parameters

receiver (input/output)
Pointer to the location to contain the result of the conversion.

rcvr_length (input)
The length of the receiver. The length must be between 1 and 32767.

controls (input/output)
Pointer to the controls template containing additional information for the conversion.

source (input)
Pointer to the location containing the source in BSC compressed format.

src_length (input)
The length of the source. The length must be between 1 and 32767.

Notes on Usage

- The builtin function _CVTBC also provides access to the MI instruction.

Return Code

Values returned by the function cvtbc are set as follows:

Value	Meaning
-1	Completed Record
0	Source Exhausted
1	Truncated Record

Example

This example illustrates the use of the cvtbc function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Computation and Branching  <QSYSINC/MIH/CVTBC>    */
/*                                                                    */
/* Function:        cvtbc  (Convert BSC to Character)                 */
/*                                                                    */
/* Description:     This example uses 'cvtcb' and 'cvtbc' to          */
/*                  convert the input string from character to BSC    */
/*                  format then back to character format.             */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/CVTBC>
#include <QSYSINC/MIH/CVTCB>
#include <string.h>
#include <stdio.h>

#define  SIZE  50

int main(void) {

  _CVTCB_Control_T     cvtcb_t = {0, 0x01};
  _CVTBC_Control_T     cvtbc_t = {0, 0x01};
  char                 cb[SIZE] = "This is the input string";
  char                 bc[SIZE];
  int                  bc_rc, cb_rc;

  cb_rc = cvtcb(bc, SIZE, &cvtcb_t, cb, SIZE);
  printf("The return code from cvtcb is %d\n", cb_rc);

  bc_rc = cvtbc(cb, SIZE, &cvtbc_t, bc, SIZE);
  printf("The return code from cvtbc is %d\n", bc_rc);

  if (memcmp(cb, "This is the input string", strlen(cb)) !=0 )
    printf("Error in conversion\n");
  else
    printf("Conversion successful\n");
}
```

Output

```
The return code from cvtcb is 0
The return code from cvtbc is 0
Conversion successful
```

Convert Character to Binary Synchronous Communications (CVTCB)

Format

```
#include <QSYSINC/MIH/CVTCB>

int cvtcb (_SPCPTR receiver,
           unsigned int rcvr_length,
           _CVTCB_Control_T *controls,
           _SPCPTRCN source,
           unsigned int src_length);
```

Description

The cvtcb function converts a string value from character to BSC (binary synchronous communications) compressed format. The function converts *source* using the information contained in *controls* and places the result into the location specified by *receiver*.

Parameters

receiver (input/output)
Pointer to the location to contain the result of the conversion.

rcvr_length (input)
Length of the receiver. Length must be between 1 and 32767.

controls (input/output)
Pointer to the controls template containing additional information for the conversion.

source (input)
Pointer to the location containing the source string to be converted.

src_length (input)
The length of the source. The length must be between 1 and 32767.

Notes on Usage

- The builtin function _CVTCB also provides access to the MI instruction.

Return Code

Values returned by the function cvtcb are set as follows:

Value	Meaning
-1	Receiver Overrun
0	Source Exhausted

Example

This example illustrates the use of the cvtcb function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Computation and Branching   <QSYSINC/MIH/CVTCB>   */
/*                                                                    */
/* Function:        cvtcb  (Convert Character to BSC)                 */
/*                                                                    */
/* Description:     This example uses 'cvtcb' and 'cvtbc' to          */
/*                  convert the input string from character to BSC    */
/*                  format then back to character format.             */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/CVTCB>
#include <QSYSINC/MIH/CVTBC>
#include <string.h>
#include <stdio.h>

#define  SIZE  50

int main(void) {

  _CVTCB_Control_T     cvtcb_t = {0, 0x01};
  _CVTBC_Control_T     cvtbc_t = {0, 0x01};
  char                 cb[SIZE] = "This is the input string";
  char                 bc[SIZE];
  int                  bc_rc, cb_rc;

  cb_rc = cvtcb(bc, SIZE, &cvtcb_t, cb, SIZE);
  printf("The return code from cvtcb is %d\n", cb_rc);

  bc_rc = cvtbc(cb, SIZE, &cvtbc_t, bc, SIZE);
  printf("The return code from cvtbc is %d\n", bc_rc);

  if (memcmp(cb, "This is the input string", strlen(cb)) !=0 )
    printf("Error in conversion\n");
  else
    printf("Conversion successful\n");
}
```

Output

```
The return code from cvtcb is 0
The return code from cvtbc is 0
Conversion successful
```

Convert Eight Bit Character to Hex Nibbles (CVTCH)

Format

```
#include <QSYSINC/MIH/CVTCH>

void cvtch (_SPCPTR receiver,
            _SPCPTRCN source,
            int size);
```

Description

The cvtch function takes each character (8-bit value) of *source* and converts it to a hexadecimal digit (4-bit value) and places into *receiver*.

Parameters

receiver (input/output)
Pointer to a 4-bit hexadecimal receiver.

source (input)
Pointer to an 8-bit character source.

size (input)
The length in bytes of the source.

Notes on Usage

- The characters in *source* must relate to valid hexadecimal digits or an exception is signaled.

  Characters Hex digits

  Hex F0-Hex F9 = Hex 0-Hex 9

  Hex C1-Hex C6 = Hex A-Hex F

- This is a compatibility function to provide the same semantics as the CVTCH MI instruction.
- If 0 is specified as *size*, no action is taken.

Exceptions

If any of the input characters are specified incorrectly, an MCH3601 or MCH0601 will be signalled.

Other exceptions possible from this function are:

MCH0602 - Boundary alignment
MCH0801 - Parameter Reference Violation
MCH3402 - Object Destroyed
MCH3602 - Pointer Type Invalid
MCH6801 - Object Domain Violation

Example

This example illustrates the use of the cvtch function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Computation and Branching  <QSYSINC/MIH/CVTCH>    */
/*                                                                    */
/* Function:        cvtch   (Convert Character to Hexadecimal)        */
/*                                                                    */
/* Description:     This example uses 'cvtch' and 'cvthc' to          */
/*                  convert the input string from character to        */
/*                  hexadecimal then back to character.               */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/CVTCH>
#include <QSYSINC/MIH/CVTHC>
#include <string.h>
#include <stdio.h>

int main(void) {

 char      c_array[9] = "A93B1FECD";
 char      h_array[6] = {0xA9, 0x3B, 0x1F, 0xEC, 0xD0, 0x00};

 char      char_array[9];
 char      hex_array[6];


 memcpy(char_array, c_array, sizeof(char_array));

 cvtch(hex_array, char_array, sizeof(char_array));

 if (memcmp(hex_array, h_array, sizeof(hex_array)) != 0)
    printf("Error in conversion\n");

 cvthc(char_array, hex_array, sizeof(hex_array)*2);

 if (memcmp(char_array, c_array, sizeof(char_array)) != 0)
    printf("Error in conversion\n");

}
```

Output

```
** no screen output **
```

Convert a Character String to Multi-Leaving Remote Job Entry (CVTCM)

Format

```
#include <QSYSINC/MIH/CVTCM>

int cvtcm (_SPCPTR receiver,
           unsigned int rcvr_length,
           _CVTCM_Control_T *controls,
           _SPCPTRCN source,
           unsigned int src_length);
```

Description

The cvtcm function converts a string of characters to Multi-Leaving Remote Job Entry (MRJE) compressed format. The information supplied in the *controls* is used to guide the conversion.

Parameters

receiver (input/output)
Pointer to the storage location to receive the results of the conversion.

rcvr_length (input)
Length of receiver. Length must be between 1 and 32767.

controls (input/output)
Pointer to the controls template.

source (input)
Pointer to the source.

src_length (input)
The length of the source to be converted. The length must be between 1 and 32767.

Notes on Usage

- The builtin function _CVTCM also provides access to the MI instruction.

Return Code

Values returned by the function cvtcm are:

Value	Meaning
-1	Receiver Overrun
0	Source Exhausted

Example

This example illustrates the use of the function cvtcm.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Computation and Branching  <QSYSINC/MIH/CVTCM>     */
/*                                                                    */
/* Function:        cvtcm   (Convert Character to MRJE)               */
/*                                                                    */
/* Description:     This example uses 'cvtcm' and 'cvtmc' to convert  */
/*                  the input string from character format to MRJE    */
/*                  format then back to character format.             */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/CVTCM>
#include <QSYSINC/MIH/CVTMC>
#include <string.h>
#include <stdio.h>

#define SIZE  50

int main(void) {

  char                cm[SIZE] = "This is the input string";
  char                mc[SIZE];

  _CVTCM_Control_T    cvtcm_t = {0,0, 0x00, 0x10, 0x00, 0x00, 0x00,
                                 0xf1};
  _CVTMC_Control_T    cvtmc_t = {0,0, 0x00, 0x10};
  int                 cm_rc, mc_rc;


  cm_rc = cvtcm(mc, SIZE, &cvtcm_t, cm, strlen(cm));
  printf("The return code from cvtcm is %d\n", cm_rc);

  mc_rc = cvtmc(cm, SIZE, &cvtmc_t, mc, cvtcm_t.Receiver);
  printf("The return code from cvtmc is %d\n", mc_rc);

  if (memcmp(cm, "This is the input string", strlen(cm)) != 0)
    printf("Error in conversion\n");
  else
    printf("Conversion successful\n");

}
```

Output

```
The return code from cvtcm is 0
The return code from cvtmc is 0
Conversion successful
```

Convert a Character String to System Network Architecture (CVTCS)

Format

```
#include <QSYSINC/MIH/CVTCS>

int cvtcs (_SPCPTR receiver,
           unsigned int rcvr_length,
           _CVTCS_Control_T *controls,
           _SPCPTRCN source,
           unsigned int src_length);
```

Description

The cvtcs function converts the source from character format to Systems Network Architecture (SNA) format. The information supplied in *controls* is used to guide the conversion.

Parameters

receiver (input/output)
Pointer to the storage location to receive the results of the conversion.

rcvr_length (input)
Length of the receiver. The length must be between 1 and 32767.

controls (input/output)
Pointer to the controls template.

source (input)
Pointer to the source.

src_length (input)
The length of the source. The length must be between 1 and 32767.

Notes on Usage

- The builtin function _CVTCS also provides access to the MI instruction.

Return Code

Values returned by the function cvtcs are:

Value	Meaning
-1	Receiver Overrun
0	Source Exhausted

Example

This example illustrates the use of the cvtcs function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Computation and Branching  <QSYSINC/MIH/CVTCS>     */
/*                                                                    */
/* Function:        cvtcs   (Convert Character to SNA)                */
/*                                                                    */
/* Description:     This example uses 'cvtcs' and 'cvtsc' to convert  */
/*                  from character format to SNA format then back     */
/*                  to character format.                              */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/CVTCS>
#include <QSYSINC/MIH/CVTSC>
#include <string.h>
#include <stdio.h>

#define SIZE  50

int main(void) {

  char                cs[SIZE] = "This is the input string";
  char                sc[SIZE];
  int                 cs_rc, sc_rc;
  _CVTCS_Control_T    cvtcs_t = {0,0, 0x80, 0x20, 0x00, 0x00, 0x00,
                                 0x34, 0x40, 0x40};
  _CVTSC_Control_T    cvtsc_t = {0,0, 0x80, 0x32, 0x34, 0x00, 0x00,
                                 _CVTSC_CONVERT_NO_TRANS, 0x00, 0};

  cs_rc = cvtcs(sc, SIZE, &cvtcs_t, cs, strlen(cs));
  printf("The return code from cvtcs is %d\n", cs_rc);

  sc_rc = cvtsc(cs, SIZE, &cvtsc_t, sc, cvtcs_t.Receiver);
  printf("The return code from cvtsc is %d\n", sc_rc);

  if (memcmp(cs, "This is the input string", strlen(cs)) != 0)
    printf("Error in conversion\n");
  else
    printf("Conversion successful\n");
}
```

Output

```
The return code from cvtcs is 0
The return code from cvtsc is 0
Conversion successful
```

Convert Date (CVTD)

Format

```
#include <QSYSINC/MIH/MIDTTM>

void cvtd (_SPCPTR result_date,
           _SPCPTRCN source_date,
           _INST_Template_T1 *inst_t);
```

Description

The cvtd function converts one calendar date to another calendar date. The date specified in *source_date* is converted to another calendar external or internal presentation and placed in *result_date*.

Parameters

result_date (input/output)

Pointer to the location to receive the converted date.

source_date (input)

Pointer to the source date.

inst_t (input)

Pointer to the instruction template which defines the data definitional attributes for *result_date* and *source_date*.

Notes on Usage

- The builtin function _CVTD also provides access to the MI instruction.
- A macro version is available.

Example

This example illustrates the use of the cvtd function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Date/Time/Timestamp     <QSYSINC/MIH/MIDTTM>      */
/*                                                                    */
/* Function:        cvtd    (Convert Date)                            */
/*                                                                    */
/* Description:     This example uses 'cvtd' to convert a calendar    */
/*                  date from ISO format to USA format.               */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/MIDTTM>
#include <string.h>
#include <stdio.h>
#include <stdlib.h>
#include <stddef.h>

/* Internal format for start of Gregorian timeline: January 1, 0001
*/

#define GREGORIAN_TIMELINE_START   1721424

/* Internal format for end of Gregorian timeline: January 1, 10000  */

#define GREGORIAN_TIMELINE_END     5373485
int main(void) {

  _INST_Template_T1   *inst_t1;
  _DDAT_T             *ddat_t1, *ddat_t2;
  _Era_Table_T        *era_t1, *era_t2;
  _Calendar_Table_T   *cal_t1, *cal_t2;

  int                 DDAT_Length, Calendar_Offset;
  int                 DDAT_Size, Template_Size;
  int                 DDAT_Offset1, DDAT_Offset2;
  char                result_d[10];
  char                source_d[10] = "1993-01-17";


  DDAT_Length = sizeof(_DDAT_T) +
                2*(sizeof(_Calendar_Table_T)) - sizeof(short) +
                sizeof(_Era_Table_T) - 1;

  Calendar_Offset = offsetof(_DDAT_T, Tables) +
                    sizeof(_Era_Table_T);

  DDAT_Size       = 2*DDAT_Length +
                    2*(sizeof(int)) +   /* DDAT_Offset */
                    10 +                /* reserved4   */
                    sizeof(short) +     /* Num_DDATs   */
                    sizeof(int);        /* DDAT_Size   */

  Template_Size   = 2*DDAT_Length + offsetof(_INST_Template_T1, DDAT) +
                    sizeof(int); /* ddat offset  */
```

```
DDAT_Offset1    = (offsetof(_INST_Template_T1, DDAT) -
                  offsetof(_INST_Template_T1, DDAT_Size)) +
                  sizeof(int); /* DDAT2 offset */

DDAT_Offset2    = (offsetof(_INST_Template_T1, DDAT) -
                  offsetof(_INST_Template_T1, DDAT_Size)) +
                  DDAT_Length + sizeof(int); /* DDAT2 offset */

inst_t1   = (_INST_Template_T1 *)malloc(Template_Size);

/* Fill in Instruction Template                      */

memset(inst_t1, '\0', sizeof(_INST_Template_T1));

inst_t1->Template_Size     = Template_Size;
inst_t1->DDAT_1            = 1;
inst_t1->DDAT_2            = 2;
inst_t1->Length_1          = 10;
inst_t1->Length_2          = 10;
inst_t1->DDAT_Size         = DDAT_Size;
inst_t1->Num_DDATs         = 2;
inst_t1->DDAT_Offset[0]    = DDAT_Offset1;
*(inst_t1->DDAT_Offset + 1)= DDAT_Offset2;


ddat_t1   = (_DDAT_T *)&(inst_t1->DDAT_Offset + 2);
era_t1    = (_Era_Table_T *)&(ddat_t1->Tables);
cal_t1    = (_Calendar_Table_T *)((char *)ddat_t1 + Calendar_Offset);
ddat_t2   = (_DDAT_T *)((char *)ddat_t1 + DDAT_Length);
era_t2    = (_Era_Table_T *)&(ddat_t2->Tables);
cal_t2    = (_Calendar_Table_T *)((char *)ddat_t2 + Calendar_Offset);

/* Fill in DDAT1                                     */

ddat_t1->DDAT_Length     = DDAT_Length;
ddat_t1->Format_Code     = _USA_DATE;
ddat_t1->Calendar_Offset = Calendar_Offset;

/* Fill in Era Table for DDAT1                       */

era_t1->Num_Elems   = 1;
era_t1->Element[0].Origin_Date = GREGORIAN_TIMELINE_START;
era_t1->Element[0].Era_Name[0] = 'A';
era_t1->Element[0].Era_Name[1] = 'D';

/* Fill in Calendar Table for DDAT1                  */

cal_t1->Num_Elems                  = 2;
cal_t1->Element->Effect_Date       = GREGORIAN_TIMELINE_START;
cal_t1->Element->Type              = 0x0001;
memset(cal_t1->Element->reserved, '\0', 10);
(cal_t1->Element+1)->Effect_Date   = GREGORIAN_TIMELINE_END;
(cal_t1->Element+1)->Type          = 0;
memset((cal_t1->Element+1)->reserved, '\0', 10);

/* Fill in DDAT2                                     */

ddat_t2->DDAT_Length     = DDAT_Length;
```

```
  ddat_t2->Format_Code     = _ISO_DATE;
  ddat_t2->Calendar_Offset = Calendar_Offset;

  /* Fill in Era Table for DDAT2                        */

  era_t2->Num_Elems              = 1;
  era_t2->Element[0].Origin_Date = GREGORIAN_TIMELINE_START;
  era_t2->Element[0].Era_Name[0] = 'A';
  era_t2->Element[0].Era_Name[1] = 'D';

  /* Fill in Calendar Table for DDAT2                   */

  cal_t2->Num_Elems                   = 2;
  cal_t2->Element->Effect_Date        = GREGORIAN_TIMELINE_START;
  cal_t2->Element->Type               = 0x0001;
  memset(cal_t2->Element->reserved, '\0', 10);
  (cal_t2->Element+1)->Effect_Date    = GREGORIAN_TIMELINE_END;
  (cal_t2->Element+1)->Type           = 0;
  memset((cal_t2->Element+1)->reserved, '\0', 10);

  cvtd(result_d, source_d, inst_t1);

  result_d[10] = '\0';
  printf("The converted date is %s\n", result_d);
}
```

Output

```
The converted date is 01/17/1993
```

Convert External Form to Numeric Value (CVTEFN)

Format

```
#include <QSYSINC/MIH/CVTEFN>

int cvtefni (_SPCPTRCN source,
             unsigned int src_length,
             char mask[3]);

double cvtefnd (_SPCPTRCN source,
                unsigned int src_length,
                char mask[3]);
```

Description

The cvtefni and cvtefnd functions scans a character string for a valid decimal number in display format, removes the display character, and converts the result to integer (in the case of cvtefni) or double (in the case of cvtefnd).

Parameters

source (input)

The character string value. A valid decimal number in display format.

src_length (input)

Length in bytes of source. The length must be between 1 and 32767.

mask (input)

The 3-byte character mask used in the conversion. Byte 1 of the mask indicates the byte value that is to be used for the currency symbol. Byte 2 of the mask indicates the byte value to be used for the comma symbol. Byte 3 of the mask indicates the byte value to be used for the decimal point symbol.

Notes on Usage

- The builtin functions _CVTEFN1 and CVTEFN2 also provide access to the MI instruction.

Example

This example illustrates the use of the cvtefn function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Computation and Branching  <QSYSINC/MIH/CVTEFN>   */
/*                                                                    */
/* Function:        cvtefni/d  (Convert External Form to Numeric)     */
/*                                                                    */
/* Description:     This example uses 'cvtefni' to convert from       */
/*                  external form to numeric integer and 'cvtefnd'    */
/*                  to convert from external form to numeric double.  */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/CVTEFN>
#include <string.h>
#include <stdio.h>

int main(void) {

  int      integer_result;
  double   double_result;
  char     integer_source[] = "$6,025";
  char     double_source[] = "$1,605.25";
  char     mask[] = "$,.";


  integer_result = cvtefni(integer_source, strlen(integer_source), mask);
  printf("The integer result is %d\n", integer_result);

  double_result = cvtefnd(double_source, strlen(double_source), mask);
  printf("The double result is %lf\n", double_result);

}
```

Output

```
The integer result is 6025
The double result is 1605.250000
```

Convert Hex to Character (CVTHC)

Format

```
#include <QSYSINC/MIH/CVTHC>

void cvthc (_SPCPTR receiver,
            _SPCPTRCN source,
            int size);
```

Description

The cvthc function takes each hexadecimal digit (4- bit value) of *source* and converts it to a character digit (8-bit value) and places into *receiver*.

Parameters

receiver (input/output)
Pointer to an 8-bit character value.

source (input)
Pointer to a 4-bit hexadecimal value.

size (input)
The length in nibbles of the source.

Notes on Usage

- The characters in *source* must relate to valid hexadecimal digits or an exception is signaled.

Hex Digits	Characters
Hex 0-Hex 9 =	Hex F0-Hex F9
Hex A-Hex F =	Hex C1-Hex C6

- This is a compatibility function to provide the same semantics as the CVTHC MI instruction.
- If 0 is specified as *size*, no action is taken.

Exceptions

If any of the input characters are specified incorrectly, an MCH3601 or MCH0601 will be signalled.

Other exceptions possible from this function are:

MCH0602 - Boundary alignment
MCH0801 - Parameter Reference Violation
MCH3402 - Object Destroyed
MCH3602 - Pointer Type Invalid
MCH6801 - Object Domain Violation

Example

This example illustrates the use of the cvthc function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Computation and Branching  <QSYSINC/MIH/CVTHC>    */
/*                                                                    */
/* Function:        cvthc   (Convert Hexadecimal to Character)        */
/*                                                                    */
/* Description:     This example uses 'cvtch' and 'cvthc' to          */
/*                  convert the input string from character to        */
/*                  hexadecimal then back to character.               */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/CVTHC>
#include <QSYSINC/MIH/CVTCH>
#include <string.h>
#include <stdio.h>

int main(void) {

 char      c_array[9] = "A93B1FECD";
 char      h_array[6] = {0xA9, 0x3B, 0x1F, 0xEC, 0xD0, 0x00};

 char      char_array[9];
 char      hex_array[6];


 memcpy(char_array, c_array, sizeof(char_array));

 cvtch(hex_array, char_array, sizeof(char_array));

 if (memcmp(hex_array, h_array, sizeof(hex_array)) != 0)
    printf("Error in conversion\n");

 cvthc(char_array, hex_array, sizeof(hex_array)*2);

 if (memcmp(char_array, c_array, sizeof(char_array)) != 0)
    printf("Error in conversion\n");

}
```

Output

```
** no screen output **
```

Convert Multi-Leaving Remote Job Entry to Character (CVTMC)

Format

```
#include <QSYSINC/MIH/CVTMC>

int cvtmc (_SPCPTR receiver,
           unsigned int rcvr_length,
           _CVTMC_Control_T *controls,
           _SPCPTRCN source,
           unsigned int src_length);
```

Description

The cvtmc function converts a character string from Multi-Leaving Remote Job Entry (MRJE) compressed format to character format. The information supplied in the *controls* is used to guide the conversion.

Parameters

receiver (input/output)
Pointer to the storage location to receive the results of the conversion.

rcvr_length (input)
Length of the receiver. The length must be between 1 and 32767.

controls (input/output)
Pointer to the controls template.

source (input)
Pointer to the source.

src_length (input)
Length of the source, including the null terminator. The length must be between 1 and 32767.

Notes on Usage

- The builtin function _CVTMC also provides access to the MI instruction.

Return Code

Values returned by the function cvtmc are:

Value	Meaning
-1	Receiver Overrun
0	Source Exhausted

Example

This example illustrates the use of the cvtmc function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Computation and Branching  <QSYSINC/MIH/CVTMC>     */
/*                                                                    */
/* Function:        cvtmc   (Convert MRJE to Character)               */
/*                                                                    */
/* Description:     This example uses 'cvtcm' and 'cvtmc' to convert  */
/*                  the input string from character format to MRJE    */
/*                  format then back to character format.             */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/CVTMC>
#include <QSYSINC/MIH/CVTCM>
#include <string.h>
#include <stdio.h>

#define SIZE  50

int main(void) {

  char                cm[SIZE] = "This is the input string";
  char                mc[SIZE];

  _CVTCM_Control_T    cvtcm_t = {0,0, 0x00, 0x10, 0x00, 0x00, 0x00,
                                 0xf1};
  _CVTMC_Control_T    cvtmc_t = {0,0, 0x00, 0x10};
  int                 cm_rc, mc_rc;


  cm_rc = cvtcm(mc, SIZE, &cvtcm_t, cm, strlen(cm));
  printf("The return code from cvtcm is %d\n", cm_rc);

  mc_rc = cvtmc(cm, SIZE, &cvtmc_t, mc, cvtcm_t.Receiver);
  printf("The return code from cvtmc is %d\n", mc_rc);

  if (memcmp(cm, "This is the input string", strlen(cm)) != 0)
    printf("Error in conversion\n");
  else
    printf("Conversion successful\n");

}
```

Output

```
The return code from cvtcm is 0
The return code from cvtmc is 0
Conversion successful
```

Convert System Network Architecture to Character (CVTSC)

Format

```
#include <QSYSINC/MIH/CVTSC>

int cvtsc (_SPCPTR receiver,
           unsigned int rcvr_length,
           _CVTSC_Control_T *controls,
           _SPCPTRCN source,
           unsigned int src_length);
```

Description

The cvtsc function converts a character string from Systems Network Architecture (SNA) format to character format. The information supplied in *controls* is used to guide the conversion.

Parameters

receiver (input/output)
Pointer to the storage location to receive the results of the conversion.

rcvr_length (output)
Length of the receiver. The length must be between 1 and 32767.

controls (input/output)
Pointer to the controls template.

source (input)
Pointer to the source.

src_length (input)
Length of the source. The length must be between 1 and 32767.

Notes on Usage

- The builtin function _CVTSC also provides access to the MI instruction.

Return Code

Values returned by the function cvtsc are:

Value	Meaning
-1	Receiver Overrun
0	Source Exhausted
1	Escape Code Encountered

Example

This example illustrates the use of the cvtsc function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Computation and Branching  <QSYSINC/MIH/CVTSC>    */
/*                                                                    */
/* Function:        cvtsc   (Convert SNA to Character)                */
/*                                                                    */
/* Description:     This example uses 'cvtcs' and 'cvtsc' to convert  */
/*                  from character format to SNA format then back     */
/*                  to character format.                              */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/CVTSC>
#include <QSYSINC/MIH/CVTCS>
#include <string.h>
#include <stdio.h>

#define SIZE  50

int main(void) {

  char                cs[SIZE] = "This is the input string";
  char                sc[SIZE];
  int                 cs_rc, sc_rc;
  _CVTCS_Control_T    cvtcs_t = {0,0, 0x80, 0x20, 0x00, 0x00, 0x00,
                                 0x34, 0x40, 0x40};
  _CVTSC_Control_T    cvtsc_t = {0,0, 0x80, 0x32, 0x34, 0x00, 0x00,
                                 _CVTSC_CONVERT_NO_TRANS, 0x00, 0};

  cs_rc = cvtcs(sc, SIZE, &cvtcs_t, cs, strlen(cs));
  printf("The return code from cvtcs is %d\n", cs_rc);

  sc_rc = cvtsc(cs, SIZE, &cvtsc_t, sc, cvtcs_t.Receiver);
  printf("The return code from cvtsc is %d\n", sc_rc);

  if (memcmp(cs, "This is the input string", strlen(cs)) != 0)
    printf("Error in conversion\n");
  else
    printf("Conversion successful\n");
}
```

Output

```
The return code from cvtcs is 0
The return code from cvtsc is 0
Conversion successful
```

Convert Time (CVTT)

Format

```
#include <QSYSINC/MIH/MIDTTM>

void cvtt (_SPCPTR result_time,
           _SPCPTRCN source_time,
           _INST_Template_T1 *inst_t);
```

Description

The cvtt function converts the time from one format to another format. The time specified in *source_time* is converted to another external or internal presentation and placed in *result_time*.

Parameters

result_time (input/output)

Pointer to the location to receive the converted time.

source_time (input)

Pointer to the source time.

inst_t (input)

Pointer to the instruction template which defines the data definitional attributes for *result_time* and *source_time*.

Notes on Usage

- The builtin function _CVTT also provides access to the MI instruction.
- A macro version is available.

Example

This example illustrates the use of the cvtt function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Date/Time/Timestamp     <QSYSINC/MIH/MIDTTM>      */
/*                                                                    */
/* Function:        cvtt    (Convert Time)                            */
/*                                                                    */
/* Description:     This example uses 'cvtt' to convert the time      */
/*                  from ISO time to USA time.                        */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/MIDTTM>
#include <string.h>
#include <stdio.h>
#include <stdlib.h>
#include <stddef.h>

int main(void) {

  _INST_Template_T1   *inst_t1;
  _DDAT_T             *ddat_t1, *ddat_t2;

  int                 DDAT_Length, Calendar_Offset;
  int                 DDAT_Size, Template_Size;
  int                 DDAT_Offset1, DDAT_Offset2;

  char                result_t[9];
  char                source_t[9] = "11.05.30";

  DDAT_Length = sizeof(_DDAT_T) +
                2*(sizeof(_Calendar_Table_T)) - sizeof(short) +
                sizeof(_Era_Table_T) - 1;

  Calendar_Offset = offsetof(_DDAT_T, Tables) +
                    sizeof(_Era_Table_T);

  DDAT_Size       = 2*DDAT_Length +
                    2*(sizeof(int)) +   /* DDAT_Offset */
                    10 +                /* reserved4   */
                    sizeof(short) +     /* Num_DDATs   */
                    sizeof(int);        /* DDAT_Size   */

  Template_Size   = 2*DDAT_Length + offsetof(_INST_Template_T1, DDAT) +
                    sizeof(int); /* ddat offset  */

  DDAT_Offset1    = (offsetof(_INST_Template_T1, DDAT) -
                    offsetof(_INST_Template_T1, DDAT_Size)) +
                    sizeof(int); /* DDAT2 offset */

  DDAT_Offset2    = (offsetof(_INST_Template_T1, DDAT) -
                    offsetof(_INST_Template_T1, DDAT_Size)) +
                    DDAT_Length + sizeof(int); /* DDAT2 offset */

  inst_t1   = (_INST_Template_T1 *)malloc(Template_Size);
```

```
  /* Fill in Instruction Template                       */

  memset(inst_t1, '\0', sizeof(_INST_Template_T1));

  inst_t1->Template_Size     = Template_Size;
  inst_t1->DDAT_1            = 1;
  inst_t1->DDAT_2            = 2;
  inst_t1->Length_1          = 8;
  inst_t1->Length_2          = 8;
  inst_t1->DDAT_Size         = DDAT_Size;
  inst_t1->Num_DDATs         = 2;
  inst_t1->DDAT_Offset[0]    = DDAT_Offset1;
  *(inst_t1->DDAT_Offset + 1)= DDAT_Offset2;


  ddat_t1   = (_DDAT_T *)&(inst_t1->DDAT_Offset + 2);
  ddat_t2   = (_DDAT_T *)((char *)ddat_t1 + DDAT_Length);

  /* Fill in DDAT1                                      */

  ddat_t1->DDAT_Length     = DDAT_Length;
  ddat_t1->Format_Code     = _USA_TIME;
  ddat_t1->Hour_Zone       = 24;
  ddat_t1->Min_Zone        = 60;
  ddat_t1->Calendar_Offset = Calendar_Offset;

  /* Fill in DDAT2                                      */

  ddat_t2->DDAT_Length     = DDAT_Length;
  ddat_t2->Format_Code     = _ISO_TIME;
  ddat_t2->Hour_Zone       = 24;
  ddat_t2->Min_Zone        = 60;
  ddat_t2->Calendar_Offset = Calendar_Offset;

  cvtt(result_t, source_t, inst_t1);

  result_t[8] = '\0';
  printf("The converted time is %s\n", result_t);
}
```

Output

```
The converted time is 11:05 AM
```

Convert Timestamp (CVTTS)

Format

```
#include <QSYSINC/MIH/CVTTS>

void cvtts (_SPCPTR result_timestamp,
            _SPCPTRCN source_timestamp,
            _INST_Template_T1 *inst_t);
```

Description

The cvtts function converts the timestamp from one format to another. The timestamp specified in *source_timestamp* is converted to another external or internal presentation and placed in *result_timestamp*.

Parameters

result_timestamp (input/output)
Pointer to the location to receive the converted timestamp.

source_timestamp (input)
Pointer to the source timestamp.

inst_t (input)
Pointer to the instruction template which defines the data definitional attributes for *result_timestamp*. and *source_timestamp*.

Notes on Usage

- The builtin function _CVTTS also provides access to the MI instruction.
- A macro version is available.

Example

This example illustrates the use of the cvtts function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Date/Time/Timestamp     <QSYSINC/MIH/MIDTTM>      */
/*                                                                    */
/* Function:        cvtts   (Convert Timestamp)                       */
/*                                                                    */
/* Description:     This example uses 'cvtts' to convert the time-    */
/*                  stamp from *YYYYMMDDhhmmss timestamp format to    */
/*                  SAA timestamp format.                             */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/MIDTTM>
#include <string.h>
#include <stdio.h>
#include <stdlib.h>
#include <stddef.h>

/* Internal format for start of Gregorian timeline: January 1, 0001 */
#define GREGORIAN_TIMELINE_START   1721424

/* Internal format for end of Gregorian timeline: January 1, 10000  */
#define GREGORIAN_TIMELINE_END     5373485

int main(void) {

  _INST_Template_T1   *inst_t1;
  _DDAT_T             *ddat_t1, *ddat_t2;
  _Era_Table_T        *era_t1, *era_t2;
  _Calendar_Table_T   *cal_t1, *cal_t2;

  int                 DDAT_Length, Calendar_Offset;
  int                 DDAT_Size, Template_Size;
  int                 DDAT_Offset1, DDAT_Offset2;

  char                result_ts[27];
  char                source_ts[15] = "19930117110530";

  DDAT_Length = sizeof(_DDAT_T) +
                2*(sizeof(_Calendar_Table_T)) - sizeof(short) +
                sizeof(_Era_Table_T) - 1;

  Calendar_Offset = offsetof(_DDAT_T, Tables) +
                    sizeof(_Era_Table_T);

  DDAT_Size       = 2*DDAT_Length +
                    2*(sizeof(int)) +   /* DDAT_Offset */
                    10 +                /* reserved4   */
                    sizeof(short) +     /* Num_DDATs   */
                    sizeof(int);        /* DDAT_Size   */

  Template_Size   = 2*DDAT_Length + offsetof(_INST_Template_T1, DDAT) +
                    sizeof(int); /* ddat offset  */

  DDAT_Offset1    = (offsetof(_INST_Template_T1, DDAT) -
```

```
                  offsetof(_INST_Template_T1, DDAT_Size)) +
                  sizeof(int); /* DDAT2 offset */

DDAT_Offset2    = (offsetof(_INST_Template_T1, DDAT) -
                  offsetof(_INST_Template_T1, DDAT_Size)) +
                  DDAT_Length + sizeof(int); /* DDAT2 offset */

inst_t1   = (_INST_Template_T1 *)malloc(Template_Size);

/* Fill in Instruction Template                       */

memset(inst_t1, '\0', sizeof(_INST_Template_T1));

inst_t1->Template_Size     = Template_Size;
inst_t1->DDAT_1            = 1;
inst_t1->DDAT_2            = 2;
inst_t1->Length_1          = 26;
inst_t1->Length_2          = 14;
inst_t1->DDAT_Size         = DDAT_Size;
inst_t1->Num_DDATs         = 2;
inst_t1->DDAT_Offset[0]    = DDAT_Offset1;
*(inst_t1->DDAT_Offset + 1)= DDAT_Offset2;


ddat_t1   = (_DDAT_T *)&(inst_t1->DDAT_Offset + 2);
era_t1    = (_Era_Table_T *)&(ddat_t1->Tables);
cal_t1    = (_Calendar_Table_T *)((char *)ddat_t1 + Calendar_Offset);
ddat_t2   = (_DDAT_T *)((char *)ddat_t1 + DDAT_Length);
era_t2    = (_Era_Table_T *)&(ddat_t2->Tables);
cal_t2    = (_Calendar_Table_T *)((char *)ddat_t2 + Calendar_Offset);

/* Fill in DDAT1                                      */

ddat_t1->DDAT_Length     = DDAT_Length;
ddat_t1->Format_Code     = _SAA_TIMESTAMP;
ddat_t1->Hour_Zone       = 24;
ddat_t1->Min_Zone        = 60;
ddat_t1->Calendar_Offset = Calendar_Offset;

/* Fill in Era Table for DDAT1                        */

era_t1->Num_Elems              = 1;
era_t1->Element[0].Origin_Date = GREGORIAN_TIMELINE_START;
era_t1->Element[0].Era_Name[0] = 'A';
era_t1->Element[0].Era_Name[1] = 'D';

/* Fill in Calendar Table for DDAT1                   */

cal_t1->Num_Elems                   = 2;
cal_t1->Element->Effect_Date        = GREGORIAN_TIMELINE_START;
cal_t1->Element->Type               = 0x0001;
memset(cal_t1->Element->reserved, '\0', 10);
(cal_t1->Element+1)->Effect_Date    = GREGORIAN_TIMELINE_END;
(cal_t1->Element+1)->Type           = 0;
memset((cal_t1->Element+1)->reserved, '\0', 10);

/* Fill in DDAT2                                      */
```

```
  ddat_t2->DDAT_Length     = DDAT_Length;
  ddat_t2->Format_Code     = _YYYYMMDDHHMMSS;
  ddat_t2->Hour_Zone       = 24;
  ddat_t2->Min_Zone        = 60;
  ddat_t2->Calendar_Offset = Calendar_Offset;

  /* Fill in Era Table for DDAT2                      */

  era_t2->Num_Elems              = 1;
  era_t2->Element[0].Origin_Date = GREGORIAN_TIMELINE_START;
  era_t2->Element[0].Era_Name[0] = 'A';
  era_t2->Element[0].Era_Name[1] = 'D';

  /* Fill in Calendar Table for DDAT2                 */

  cal_t2->Num_Elems                  = 2;
  cal_t2->Element->Effect_Date       = GREGORIAN_TIMELINE_START;
  cal_t2->Element->Type              = 0x0001;
  memset(cal_t2->Element->reserved, '\0', 10);
  (cal_t2->Element+1)->Effect_Date   = GREGORIAN_TIMELINE_END;
  (cal_t2->Element+1)->Type          = 0;
  memset((cal_t2->Element+1)->reserved, '\0', 10);

  cvtts(result_ts, source_ts, inst_t1);

  result_ts[26] = '\0';
  printf("The converted timestamp is %s\n", result_ts);
}
```

Output

```
The converted timestamp is 1996-12-17-11.05.30.000000
```

Copy Bytes Left-Adjusted (CPYBLA)

Format

```
#include <QSYSINC/MIH/CPYBLA>

void cpybla (_SPCPTR receiver,
             _SPCPTRCN source,
             int size);
```

Description

The cpybla function copies *size* bytes of *source* to *receiver*. No padding is done.

Parameters

receiver (output)

Pointer to the receiver.

source (input)

Pointer to the source.

size (input)

The number of bytes to copy. This must be between 0 and 16 773 104.

Notes on Usage

- This is a compatibility function to provide the same semantics as the CPYBLA MI instruction.
- Pointers within the source are not preserved by the operation.
- Behavior is undefined if copying takes place between overlapping locations.
- The builtin _CPYBYTES also provides access to an equivalent MI instruction. This builtin can only be used to copy non-pointer data.

Exceptions

If any of the input parameters are not valid, an MCH3601 or MCH0601 may be signalled.

Other exceptions possible from this function are:

MCH0602 - Boundary alignment
MCH0801 - Parameter Reference Violation
MCH3402 - Object Destroyed
MCH3602 - Pointer Type Invalid
MCH6801 - Object Domain Violation

Example

This example illustrates the use of the cpybla function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Computation and Branching  QSYSINC/MIH/CPYBLA>    */
/*                                                                    */
/* Function:        cpybla  (Copy Bytes Left-Adjusted)                */
/*                                                                    */
/* Description:     This example uses 'cpybla' to copy the source     */
/*                  string to the receiver.                           */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/CPYBLA>
#include <string.h>
#include <stdio.h>

int main(void) {

 char      receiver[] = "XXXXXXXXXXXXXX";
 char      source[] = "Good Day";

 cpybla(receiver, source, strlen(source));
 printf("The receiver string is %s\n", receiver);
}
```

Output

```
The receiver string is Good DayXXXXXX
```

Copy Bytes Left-Adjusted with Pad (CPYBLAP)

Format

```
#include <QSYSINC/MIH/CPYBLAP>

void cpyblap (_SPCPTR receiver,
              int rcvr_size,
              _SPCPTRCN source,
              int src_size,
              char pad);
```

Description

The cpyblap function copies bytes from *source* to *receiver*. If *source* is shorter than *receiver*, then *src_size* bytes from *source* are copied to *receiver*, and each excess byte of *receiver* is assigned the value of *pad*. If *source* is longer than *receiver*, then the leftmost bytes of *source* (equal in length to *rcvr_src*) are copied to *receiver*.

Parameters

receiver (input/output)
Pointer to the receiver.

rcvr_size (input)
The length of the receiver.

source (input)
Pointer to the source.

src_size (input)
The length of the source. The length must be between 0 and 16 773 104.

pad (input)
The pad character.

Notes on Usage

- This is a compatibility function to provide the same semantics as the CPYBLAP MI instruction.
- If *rcvr_size* is ≤0, no action is taken.
- If *src_size* is ≤0, all bytes of *receiver* are set to the *pad* character.
- Behavior is undefined if copying takes place between overlapping locations.
- Pointers within *source* are not preserved.

Exceptions

If any of the input parameters are not valid, an MCH3601 or MCH0601 may be signalled.

Other exceptions possible from this function are:

MCH0602 - Boundary alignment
MCH0801 - Parameter Reference Violation
MCH3402 - Object Destroyed
MCH3602 - Pointer Type Invalid
MCH6801 - Object Domain Violation

Example

This example illustrates the use of the cpyblap function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Computation and Branching  <QSYSINC/MIH/CPYBLAP>  */
/*                                                                    */
/* Function:        cpyblap  (Copy Bytes Left-Adjusted with Pad)      */
/*                                                                    */
/* Description:     This example uses 'cpyblap' to copy the source    */
/*                  string to the receiver with padding in the excess */
/*                  receiver bytes.                                   */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/CPYBLAP>
#include <string.h>
#include <stdio.h>

int main(void) {

 char      receiver[] = "XXXXXXXXXXXXXXX";
 char      source[] = "Good Day";

 cpyblap(receiver, strlen(receiver), source, strlen(source), '.');
 printf("The receiver string is %s\n", receiver);
}
```

Output

```
The receiver string is Good Day.......
```

Copy Hex Digit Numeric to Numeric (CPYHEXNN)

Format

```
#include <QSYSINC/MIH/CPYHEXNN>

char cpyhexnn (char *dest, char source);
```

Description

The cpyhexnn function copies the numeric hexadecimal digit value (rightmost 4 bits) of the byte referred to by *source* to the numeric hexadecimal digit value (rightmost 4 bits) of the leftmost byte referred to by *dest*. The function returns a copy of the modified byte.

Parameters

dest (input/output)

Pointer to the location whose leftmost byte will be modified.

source (input)

The source byte.

Notes on Usage

- This is a compatibility function to provide the same semantics as the CPYHEXNN MI instruction.

Exceptions

If *dest* does not point to a valid storage location, an MCH3601 will be signalled.

Example

This example illustrates the use of the cpyhexnn function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Computation and Branching  <QSYSINC/MIH/CPYHEXNN> */
/*                                                                    */
/* Function:        cpyhexnn  (Copy Hex Digit Numeric to Numeric)     */
/*                                                                    */
/* Description:     This example uses 'cpyhexnn' to copy the          */
/*                  numeric hexadecimal digit (rightmost 4 bits) of   */
/*                  the source to the numeric hexadecimal digit       */
/*                  (rightmost 4 bits) of the leftmost byte of the    */
/*                  destination.                                      */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/CPYHEXNN>
#include <stdio.h>

int main(void) {

 char      hex_dest[6] = "2A5F6";  /* in hex: 0xf2 0xc1 0xf5 0xc6 0xf6*/
 char      hex_source = 0xf3, h;

 h = cpyhexnn(hex_dest, hex_source);

 printf("The return byte is %x\n", h);
 printf("The leftmost byte of destination string is %x\n", *hex_dest);

}
```

Output

```
The return byte is f3
The leftmost byte of destination string is f3
```

Copy Hex Digit Numeric to Zone (CPYHEXNZ)

Format

```
#include <QSYSINC/MIH/CPYHEXNZ>

char cpyhexnz (char *dest, char source);
```

Description

The cpyhexnz function copies the numeric hexadecimal digit value (rightmost 4 bits) of the byte referred to by *source* to the zone hexadecimal digit value (leftmost 4 bits) of the leftmost byte referred to by *dest*. The function returns a copy of the modified byte.

Parameters

dest (input/output)

Pointer to the location whose leftmost byte will be modified.

source (input)

The source byte.

Notes on Usage

- This is a compatibility function to provide the same semantics as the CPYHEXNZ MI instruction.

Exceptions

If *dest* does not point to a valid storage location, an MCH3601 will be signalled.

Example

This example illustrates the use of the cpyhexnz function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Computation and Branching  <QSYSINC/MIH/CPYHEXNZ> */
/*                                                                    */
/* Function:        cpyhexnz  (Copy Hex Digit Numeric to Zone)        */
/*                                                                    */
/* Description:     This example uses 'cpyhexnz' to copy the          */
/*                  numeric hexadecimal digit (rightmost 4 bits) of   */
/*                  the source to the zone hexadecimal digit          */
/*                  (leftmost 4 bits) of the leftmost byte of the     */
/*                  destination.                                      */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/CPYHEXNZ>
#include <stdio.h>

int main(void) {

 char  hex_dest[6] = "2A5F6";  /* in hex: 0xf2 0xc1 0xf5 0xc6 0xf6 */
 char  hex_source = 0xf3, h;

 h = cpyhexnz(hex_dest, hex_source);

 printf("The return byte is %x\n", h);
 printf("The leftmost byte of destination string is %x\n", *hex_dest);

}
```

Output

```
The return byte is 32
The leftmost byte of destination string is 32
```

Copy Hex Digit Zone to Numeric (CPYHEXZN)

Format

```
#include <QSYSINC/MIH/CPYHEXZN>

char cpyhexzn (char *dest, char source);
```

Description

The cpyhexzn function copies the zone hexadecimal digit value (leftmost 4 bits) of the byte referred to by *source* to the numeric hexadecimal digit value (rightmost 4 bits) of the leftmost byte referred to by *dest*. The function returns a copy of the modified byte.

Parameters

dest (input/output)

Pointer to the location whose leftmost byte will be modified.

source (input)

The source byte.

Notes on Usage

- This is a compatibility function to provide the same semantics as the CPYHEXZN MI instruction.

Exceptions

If *dest* does not point to a valid storage location, an MCH3601 will be signalled.

Example

This example illustrates the use of the cpyhexzn function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Computation and Branching  <QSYSINC/MIH/CPYHEXZN> */
/*                                                                    */
/* Function:        cpyhexzn  (Copy Hex Digit Zone to Numeric)        */
/*                                                                    */
/* Description:     This example uses 'cpyhexzn' to copy the zone     */
/*                  hexadecimal digit (leftmost 4 bits) of the source */
/*                  to the numeric hexadecimal digit (rightmost 4     */
/*                  bits) of the leftmost byte of the destination.    */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/CPYHEXZN>
#include <stdio.h>

int main(void) {

 char  hex_dest[6] = "2A5F6";  /* in hex: 0xf2 0xc1 0xf5 0xc6 0xf6 */
 char  hex_source = 0xf3, h;

 h = cpyhexzn(hex_dest, hex_source);

 printf("The return byte is %x\n", h);
 printf("The leftmost byte of destination string is %x\n", *hex_dest);

}
```

Output

```
The return byte is ff
The leftmost byte of destination string is ff
```

Copy Hex Digit Zone to Zone (CPYHEXZZ)

Format

```
#include <CPYHEXZZ>

char cpyhexzz (char *dest, char source);
```

Description

The cpyhexzz function copies the zone hexadecimal digit value (leftmost 4 bits) of the byte referred to by *source* to the zone hexadecimal digit value (leftmost 4 bits) of the leftmost byte referred to by *dest*. The function returns a copy of the modified byte.

Parameters

dest (input/output)

Pointer to the location whose leftmost byte will be modified.

source (input)

The source byte.

Notes on Usage

- This is a compatibility function to provide the same semantics as the CPYHEXZZ MI instruction.

Exceptions

If *dest* does not point to a valid storage location, an MCH3601 will be signalled.

Example

This example illustrates the use of the cpyhexzz function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Computation and Branching  <QSYSINC/MIH/CPYHEXZZ> */
/*                                                                    */
/* Function:        cpyhexzz  (Copy Hex Digit Zone to Zone)           */
/*                                                                    */
/* Description:     This example uses 'cpyhexzz' to copy the zone     */
/*                  hexadecimal digit (leftmost 4 bits) of the source */
/*                  to the zone hexadecimal digit (leftmost 4 bits)   */
/*                  of the leftmost byte of the destination.          */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/CPYHEXZZ>
#include <stdio.h>

int main(void) {

 char  hex_dest[6] = "2A5F6";  /* in hex: 0xf2 0xc1 0xf5 0xc6 0xf6 */
 char  hex_source = 0xf3, h;

 h = cpyhexzz(hex_dest, hex_source);

 printf("The return byte is %x\n", h);
 printf("The leftmost byte of destination string is %x\n", *hex_dest);

}
```

Output

```
The return byte is f2
The leftmost byte of destination string is f2
```

Copy Numeric Value (CPYNV)

Format

```
#include <QSYSINC/MIH/CPYNV>

_SPCPTR cpynv (_NUM_Descr_T rcvr_descr,
               _SPCPTR receiver,
               _NUM_Descr_T src_descr,
               _SPCPTRCN source);
```

Description

The cpynv function copies the numeric value of *source* to *receiver*, with the appropriate conversions. The function returns a pointer to the receiver.

Parameters

rcvr_descr (input)
The receiver descriptor. Must be prepared using the NUM_DESCR macro.

receiver (input/output)
Pointer to the receiver location where the result will be placed.

src_descr (input)
The source descriptor. Must be prepared using the NUM_DESCR macro.

source (input)
Pointer to the source value.

Notes on Usage

- If necessary, *source* is converted to the same type as *receiver* before being copied.
- The builtin function _LBCPYNV (Late-bound Copy Numeric Value) provides access to the MI instruction.
- The builtin function _CPYNV also provides access to the equivalent MI instruction. When using the _CPYNV instruction, you must specify literal constants for the *receiver* and *source descriptor* values. _CPYNV is considerably faster than _LBCPYNV for the following conversions:

  zoned to packed, float, signed integer, or unsigned integer
  packed to zoned
  signed integer to zoned
  unsigned integer to zoned

Example

This example illustrates the use of the cpynv function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Computation and Branching   <QSYSINC/MIH/CPYNV>   */
/*                                                                    */
/* Function:        cpynv    (Copy Numeric Value)                     */
/*                                                                    */
/* Description:     This example uses 'cpynv' to convert a long       */
/*                  double number to zoned decimal.                   */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/CPYNV>
#include <stdio.h>

void convert_double_to_zone(unsigned char *, int, int, double);

int main(void) {

  char     zoned_output[15];
  double   float_input = 36584.89;

  convert_double_to_zone(zoned_output,
                         15,
                         5,
                         float_input);

  printf("The zoned decimal number ZND(15,5) is %.15s\n", zoned_output);
}

void convert_double_to_zone(unsigned char *znd, int digits, int fraction,
                            double dbl)
{
  cpynv(NUM_DESCR(_T_ZONED, digits, fraction), znd,
        NUM_DESCR(_T_FLOAT, 8, 0), &dbl);
}
```

Output

```
The zoned decimal number ZND(15,5) is 000003658489000
```

Decompress Data (DCPDATA)

Format

```
#include <QSYSINC/MIH/DCPDATA>

int dcpdata (_SPCPTR result,
             int result_length,
             _SPCPTRCN source);
```

Description

The dcpdata function decompresses user data. If the decompressed result is longer than the result area (as specified by *result_length*), the decompression is stopped and only *result_length* bytes are stored.

The dcpdata function returns the number of bytes in the decompressed result. This value is always set to the full length of the result, which may be larger than *result_length.*

Parameters

result (input/output)
Pointer to the result area to receive the decompressed data.

result_length (input)
The result area length.

source (input)
The data to be decompressed.

Notes on Usage

- The length of the source data is not supplied because this length is contained within the compressed data.
- The builtin function _DCPDATA also provides access to the MI instruction.

Example

This example illustrates the use of the dcpdata function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Computation and Branching  <QSYSINC/MIH/DCPDATA>  */
/*                                                                    */
/* Function:        dcpdata  (Decompress Data)                        */
/*                                                                    */
/* Description:     This example uses 'cprdata' and 'dcpdata' to      */
/*                  compress then decompress the input string.        */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/DCPDATA>
#include <QSYSINC/MIH/CPRDATA>
#include <string.h>
#include <stdio.h>

#define SIZE  50

int main(void) {

  char    cpr_data[SIZE];
  char    dpr_data[SIZE] = "Good Day";
  int     clength;
  int     dlength;

  clength = cprdata(cpr_data, SIZE, dpr_data, strlen(dpr_data));
  printf("The compressed length = %d\n", clength);

  dlength = dcpdata(dpr_data, SIZE, cpr_data);
  printf("The decompressed length = %d\n", dlength);

  if (memcmp(dpr_data, "Good Day", strlen(dpr_data)) != 0)
    printf("Error in decompression\n");
  else
    printf("Decompression successful\n");
}
```

Output

```
The compressed length = 26
The decompressed length = 8
Decompression successful
```

Decrement Date (DECD)

Format

```
#include <QSYSINC/MIH/DECD>

void decd (_SPCPTR result_date,
           _SPCPTRCN source_date,
           _SPCPTRCN duration,
           _INST_Template_T3 *inst_t);
```

Description

The decd function decrements the date by the date duration. The date specified by *source_date* is decreased by the date duration specified by *duration*. The resulting date from the operation is placed in *result_date*.

Parameters

result_date (input/output)
Pointer to the location to receive the result.

source_date (input)
Pointer to the source date.

duration (input)
Pointer to the packed decimal duration.

inst_t (input)
Pointer to the instruction template which defines the data definitional attributes for *result_date*, *source_date*, and *duration*.

Notes on Usage

- The DDATs for *result_date* and *source_date* must be identical.
- The builtin function _DECD also provides access to the MI instruction.
- A macro version is available.

Example

This example illustrates the use of the decd function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Date/Time/Timestamp     <QSYSINC/MIH/MIDTTM>      */
/*                                                                    */
/* Function:        decd    (Decrement Date)                          */
/*                                                                    */
/* Description:     This example uses 'decd' to decrement the date    */
/*                  by the date duration.                             */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/MIDTTM>
#include <string.h>
#include <stdio.h>
#include <stdlib.h>
#include <stddef.h>
#include <decimal.h>

/* Internal format for start of Gregorian timeline: January 1, 0001 */
#define GREGORIAN_TIMELINE_START   1721424

/* Internal format for end of Gregorian timeline: January 1, 10000  */
#define GREGORIAN_TIMELINE_END     5373485

int main(void) {

  _INST_Template_T3   *inst_t3;
  _DDAT_T             *ddat_t1, *ddat_t2;
  _Era_Table_T        *era_t1;
  _Calendar_Table_T   *cal_t1;

  int                 DDAT_Length, Calendar_Offset;
  int                 DDAT_Size, Template_Size;
  int                 DDAT_Offset1, DDAT_Offset2;

  char                result_d[11];
  char                source_d[11] = "1993-01-30";
  decimal(8,0)        duration = 00120310D;

  DDAT_Length = sizeof(_DDAT_T) +
               2*(sizeof(_Calendar_Table_T)) - sizeof(short) +
               sizeof(_Era_Table_T) - 1;

  Calendar_Offset = offsetof(_DDAT_T, Tables) +
                    sizeof(_Era_Table_T);

  DDAT_Size       = 2*DDAT_Length +
                    2*(sizeof(int)) +   /* DDAT_Offset */
                    10 +                /* reserved4   */
                    sizeof(short) +     /* Num_DDATs   */
                    sizeof(int);        /* DDAT_Size   */

  Template_Size   = 2*DDAT_Length + offsetof(_INST_Template_T3, DDAT) +
                    sizeof(int); /* ddat offset  */
```

```
DDAT_Offset1    = (offsetof(_INST_Template_T3, DDAT) -
                  offsetof(_INST_Template_T3, DDAT_Size)) +
                  sizeof(int); /* DDAT2 offset */

DDAT_Offset2    = (offsetof(_INST_Template_T3, DDAT) -
                  offsetof(_INST_Template_T3, DDAT_Size)) +
                  DDAT_Length + sizeof(int); /* DDAT2 offset */

inst_t3   = (_INST_Template_T3 *)malloc(Template_Size);

/* Fill in Instruction Template                       */

memset(inst_t3, '\0', sizeof(_INST_Template_T3));

inst_t3->Template_Size     = Template_Size;
inst_t3->DDAT_1            = 1;
inst_t3->DDAT_2            = 1;
inst_t3->DDAT_3            = 2;
inst_t3->Length_1          = 10;
inst_t3->Length_2          = 10;
inst_t3->F_Digits          = 0;
inst_t3->T_Digits          = 8;
inst_t3->Indicators        = _OUT_ADJUST | _IN_ADJUST;
inst_t3->DDAT_Size         = DDAT_Size;
inst_t3->Num_DDATs         = 2;
inst_t3->DDAT_Offset[0]    = DDAT_Offset1;
*(inst_t3->DDAT_Offset + 1)= DDAT_Offset2;

/* Set table pointers within instruction template    */

ddat_t1   = (_DDAT_T *)&(inst_t3->DDAT_Offset + 2);
era_t1    = (_Era_Table_T *)&(ddat_t1->Tables);
cal_t1    = (_Calendar_Table_T *)((char *)ddat_t1 + Calendar_Offset);
ddat_t2   = (_DDAT_T *)((char *)ddat_t1 + DDAT_Length);

/* Fill in DDAT1                                      */

ddat_t1->DDAT_Length     = DDAT_Length;
ddat_t1->Format_Code     = _ISO_DATE;
ddat_t1->Calendar_Offset = Calendar_Offset;


/* Fill in Era Table for DDAT1                        */

era_t1->Num_Elems   = 1;
era_t1->Element[0].Origin_Date = GREGORIAN_TIMELINE_START;
era_t1->Element[0].Era_Name[0] = 'A';
era_t1->Element[0].Era_Name[1] = 'D';

/* Fill in Calendar Table for DDAT1                   */

cal_t1->Num_Elems                = 2;
cal_t1->Element->Effect_Date = GREGORIAN_TIMELINE_START;
cal_t1->Element->Type           = 0x0001;
memset(cal_t1->Element->reserved, '\0', 10);
(cal_t1->Element+1)->Effect_Date = GREGORIAN_TIMELINE_END;
(cal_t1->Element+1)->Type          = 0;
memset((cal_t1->Element+1)->reserved, '\0', 10);
```

```
  /* Fill in DDAT 2                                        */

  ddat_t2->DDAT_Length     = DDAT_Length;
  ddat_t2->Format_Code     =  _DATE_DUR;
  ddat_t2->Calendar_Offset = Calendar_Offset;

  decd(result_d, source_d, &duration, inst_t3);

  result_d[10] = '\0';
  printf("The resulting date is %s\n", result_d);
}
```

Output

```
The resulting date is 1980-10-20
```

Decrement Time (DECT)

Format

```
#include <QSYSINC/MIH/DECT>

void dect (_SPCPTR result_time,
           _SPCPTRCN source_time,
           _SPCPTRCN duration,
           _INST_Template_T3 *inst_t);
```

Description

The dect function decrements the time by the time duration. The time specified by *source_time* is decreased by the time duration specified by *duration*. The resulting time from the operation is placed in *result_time*.

Parameters

result_time (input/output)
Pointer to the location to receive the result.

source_time (input)
Pointer to the source time.

duration (input)
Pointer to the packed decimal duration.

inst_t (input)
Pointer to the instruction template which defines the data definitional attributes for *result_time*, *source_time*, and *duration*.

Notes on Usage

- The DDATs for *result_time* and *source_time* must be identical.
- The builtin function _DECT also provides access to the MI instruction.
- A macro version is available.

Example

This example illustrates the use of the dect function.

```
/*------------------------------------------------------------------*/
/*                                                                  */
/* Example Group:   Date/Time/Timestamp     <QSYSINC/MIH/MIDTTM>    */
/*                                                                  */
/* Function:        dect    (Decrement Time)                        */
/*                                                                  */
/* Description:     This example uses 'dect' to decrement the time  */
/*                  by the time duration.                           */
/*                                                                  */
/*------------------------------------------------------------------*/

#include <QSYSINC/MIH/MIDTTM>
#include <string.h>
#include <stdio.h>
#include <stdlib.h>
#include <stddef.h>
#include <decimal.h>

int main(void) {

  _INST_Template_T3   *inst_t3;
  _DDAT_T             *ddat_t1, *ddat_t2;

  int                 DDAT_Length, Calendar_Offset;
  int                 DDAT_Size, Template_Size;
  int                 DDAT_Offset1, DDAT_Offset2;

  char                result_d[9];
  char                source_d[9] = "11.05.30";
  decimal(6,0)        duration = 000205D;

  DDAT_Length = sizeof(_DDAT_T) +
                2*(sizeof(_Calendar_Table_T)) - sizeof(short) +
                sizeof(_Era_Table_T) - 1;

  Calendar_Offset = offsetof(_DDAT_T, Tables) +
                    sizeof(_Era_Table_T);

  DDAT_Size       = 2*DDAT_Length +
                    2*(sizeof(int)) +   /* DDAT_Offset */
                    10 +                /* reserved4   */
                    sizeof(short) +     /* Num_DDATs   */
                    sizeof(int);        /* DDAT_Size   */

  Template_Size   = 2*DDAT_Length + offsetof(_INST_Template_T3, DDAT) +
                    sizeof(int); /* ddat offset  */

  DDAT_Offset1    = (offsetof(_INST_Template_T3, DDAT) -
                    offsetof(_INST_Template_T3, DDAT_Size)) +
                    sizeof(int); /* DDAT2 offset */

  DDAT_Offset2    = (offsetof(_INST_Template_T3, DDAT) -
                    offsetof(_INST_Template_T3, DDAT_Size)) +
                    DDAT_Length + sizeof(int); /* DDAT2 offset */
```

```
  inst_t3   = (_INST_Template_T3 *)malloc(Template_Size);

  /* Fill in Instruction Template                       */

  memset(inst_t3, '\0', sizeof(_INST_Template_T3));

  inst_t3->Template_Size     = Template_Size;
  inst_t3->DDAT_1            = 1;
  inst_t3->DDAT_2            = 1;
  inst_t3->DDAT_3            = 2;
  inst_t3->Length_1          = 8;
  inst_t3->Length_2          = 8;
  inst_t3->F_Digits          = 0;
  inst_t3->T_Digits          = 6;
  inst_t3->Indicators        = _NO_ADJUST_OR_TOLERATE;
  inst_t3->DDAT_Size         = DDAT_Size;
  inst_t3->Num_DDATs         = 2;
  inst_t3->DDAT_Offset[0]    = DDAT_Offset1;
  *(inst_t3->DDAT_Offset + 1)= DDAT_Offset2;

  ddat_t1   = (_DDAT_T *)&(inst_t3->DDAT_Offset + 2);
  ddat_t2   = (_DDAT_T *)((char *)ddat_t1 + DDAT_Length);

  /* Fill in DDAT1                                      */

  ddat_t1->DDAT_Length     = DDAT_Length;
  ddat_t1->Format_Code     = _ISO_TIME;
  ddat_t1->Hour_Zone       = 24;
  ddat_t1->Min_Zone        = 60;
  ddat_t1->Calendar_Offset = Calendar_Offset;

  /* Fill in DDAT2                                      */

  ddat_t2->DDAT_Length     =  DDAT_Length;
  ddat_t2->Format_Code     =  _TIME_DUR;
  ddat_t2->Hour_Zone       =  0;
  ddat_t2->Min_Zone        =  0;
  ddat_t2->Calendar_Offset =  Calendar_Offset;

  dect(result_d, source_d, &duration, inst_t3);

  result_d[8] = '\0';
  printf("The resulting time is %s\n", result_d);

}
```

Output

```
The resulting time is 11.03.25
```

Decrement Timestamp (DECTS)

Format

```
#include <QSYSINC/MIH/MIDTTM>

void dects (_SPCPTR result_timestamp,
            _SPCPTRCN source_timestamp,
            _SPCPTRCN duration,
            _INST_Template_T3 *inst_t);
```

Description

The dects function decrements the timestamp by the timestamp duration. The timestamp specified by *source_timestamp* is decreased by the date, time, or timestamp duration specified by *duration*. The resulting timestamp from the operation is placed in *result_timestamp*.

Parameters

result_timestamp (input/output)
Pointer to the location to receive the result.

source_timestamp (input)
Pointer to the source timestamp.

duration (input)
Pointer to the packed decimal duration.

inst_t (input)
Pointer to the instruction template which defines the data definitional attributes for *result_timestamp*, *source_timestamp*, and *duration*.

Notes on Usage

- The DDATs for *result_timestamp* and *source_timestamp* must be identical.
- The builtin function _DECTS also provides access to the MI instruction.
- A macro version is available.

Example

This example illustrates the use of the dects function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Date/Time/Timestamp     <QSYSINC/MIH/MIDTTM>      */
/*                                                                    */
/* Function:        dects   (Decrement Timestamp)                     */
/*                                                                    */
/* Description:     This example uses 'dects' to decrement the time-  */
/*                  stamp by the timestamp duration.                  */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/MIDTTM>
#include <stdio.h>
#include <stdlib.h>
#include <stddef.h>
#include <string.h>
#include <decimal.h>

/* Internal format for start of Gregorian timeline: January 1, 0001 */
#define GREGORIAN_TIMELINE_START   1721424

/* Internal format for end of Gregorian timeline: January 1, 10000  */
#define GREGORIAN_TIMELINE_END     5373485

int main(void) {


  _INST_Template_T3   *inst_t3;
  _DDAT_T             *ddat_t1, *ddat_t2;
  _Era_Table_T        *era_t1;
  _Calendar_Table_T   *cal_t1;


  int                 DDAT_Length, Calendar_Offset;
  int                 DDAT_Size, Template_Size;
  int                 DDAT_Offset1, DDAT_Offset2;

  char                result_d[27];
  char                source_d[27] = "1993-01-17-11.05.30.000000";
  decimal(20,6)       duration = 00000203012005.000000D;


  DDAT_Length = sizeof(_DDAT_T) +
                2*(sizeof(_Calendar_Table_T)) - sizeof(short) +
                sizeof(_Era_Table_T) - 1;

  Calendar_Offset = offsetof(_DDAT_T, Tables) +
                    sizeof(_Era_Table_T);

  DDAT_Size       = 2*DDAT_Length +
                    2*(sizeof(int)) +   /* DDAT_Offset */
                    10 +                /* reserved4   */
                    sizeof(short) +     /* Num_DDATs   */
                    sizeof(int);        /* DDAT_Size   */
```

```
Template_Size   = 2*DDAT_Length + offsetof(_INST_Template_T3, DDAT) +
                  sizeof(int); /* ddat offset  */

DDAT_Offset1    = (offsetof(_INST_Template_T3, DDAT) -
                  offsetof(_INST_Template_T3, DDAT_Size)) +
                  sizeof(int); /* DDAT2 offset */

DDAT_Offset2    = (offsetof(_INST_Template_T3, DDAT) -
                  offsetof(_INST_Template_T3, DDAT_Size)) +
                  DDAT_Length + sizeof(int); /* DDAT2 offset */

inst_t3   = (_INST_Template_T3 *)malloc(Template_Size);

/* Fill in Instruction Template                      */

memset(inst_t3, '\0', sizeof(_INST_Template_T3));

inst_t3->Template_Size     = Template_Size;
inst_t3->DDAT_1            = 1;
inst_t3->DDAT_2            = 1;
inst_t3->DDAT_3            = 2;
inst_t3->Length_1          = 26;
inst_t3->Length_2          = 26;
inst_t3->F_Digits          = 6;
inst_t3->T_Digits          = 20;
inst_t3->Indicators        = _OUT_ADJUST | _IN_ADJUST;
inst_t3->DDAT_Size         = DDAT_Size;
inst_t3->Num_DDATs         = 2;
inst_t3->DDAT_Offset[0]    = DDAT_Offset1;
*(inst_t3->DDAT_Offset + 1)= DDAT_Offset2;

/* Set table pointers within instruction template    */

ddat_t1   = (_DDAT_T *)&(inst_t3->DDAT_Offset + 2);
era_t1    = (_Era_Table_T *)&(ddat_t1->Tables);
cal_t1    = (_Calendar_Table_T *)((char *)ddat_t1 + Calendar_Offset);
ddat_t2   = (_DDAT_T *)((char *)ddat_t1 + DDAT_Length);

/* Fill in DDAT1                                     */

ddat_t1->DDAT_Length     = DDAT_Length;
ddat_t1->Format_Code     = _SAA_TIMESTAMP;
ddat_t1->Hour_Zone       = 24;
ddat_t1->Min_Zone        = 60;
ddat_t1->Calendar_Offset = Calendar_Offset;

/* Fill in Era Table for DDAT1                       */

era_t1->Num_Elems   = 1;
era_t1->Element[0].Origin_Date = GREGORIAN_TIMELINE_START;
era_t1->Element[0].Era_Name[0] = 'A';
era_t1->Element[0].Era_Name[1] = 'D';


/* Fill in Calendar Table for DDAT1                  */

cal_t1->Num_Elems                = 2;
cal_t1->Element->Effect_Date = GREGORIAN_TIMELINE_START;
```

```
  cal_t1->Element->Type           = 0x0001;
  memset(cal_t1->Element->reserved, '\0', 10);
  (cal_t1->Element+1)->Effect_Date = GREGORIAN_TIMELINE_END;
  (cal_t1->Element+1)->Type           = 0;
  memset((cal_t1->Element+1)->reserved, '\0', 10);


  /* Fill in DDAT 2                                      */

  ddat_t2->DDAT_Length     = DDAT_Length;
  ddat_t2->Format_Code =  _TIMESTAMP_DUR;
  ddat_t2->Hour_Zone   =  0;
  ddat_t2->Min_Zone    =  0;
  ddat_t2->Calendar_Offset = Calendar_Offset;

  dects(result_d, source_d, &duration, inst_t3);

  result_d[26] = '\0';
  printf("The resulting timestamp is %s\n", result_d);

}
```

Output

```
The resulting timestamp is 1996-12-14-09.45.25.000000
```

Dequeue (DEQ)

Format

```
#include <QSYSINC/MIH/DEQ>

void deq (_DEQ_Msg_Prefix_T *msg_prefix,
          _SPCPTR message,
          _SYSPTR queue);
```

Description

The deq function retrieves a queue message based on the queue type (FIFO, LIFO, or keyed) specified during the queue's creation. If a message is not found that satisfies the dequeue selection criteria, the process waits until a message arrives to satisfy the dequeue or until the dequeue wait time-out expires.

Parameters

msg_prefix (input/output)
Pointer to the message prefix template. This contains the criteria for message selection.

message (output)
Pointer to the location to receive the message text.

queue (input)
Pointer to the queue from which the message is to be dequeued.

Notes on Usage

- The builtin function _DEQWAIT also provides access to the MI instruction.

Example

This example illustrates the use of the deq function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   User Queues <QSYSINC/MIH/DEQ>                     */
/*                                                                    */
/* Function:        deq  (dequeue)                                    */
/*                                                                    */
/* Description:     This example will dequeue the next message from   */
/*                  the user queue and output it to the screen.  If   */
/*                  there are no entries are on the queue, this       */
/*                  program will wait indefinitely until one appears. */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/DEQ>
#include <QSYSINC/MIH/RSLVSP>
#include <stdio.h>

                                        /* Template used for setting  */
                                        /* options for the dequeue.   */
_DEQ_Msg_Prefix_T   message_prefix;     /* Also used as the receiver  */
                                        /* for the dequeued message.  */
```

```
_SYSPTR             queue_ptr;          /* Pointer to the user queue.  */

char                message_text[ 75 ]; /* Buffer for dequeued message.*/


int main(void) {

                                        /* Get a pointer to the *USRQ. */
  queue_ptr = rslvsp( _Usrq, "MYUSRQ", "MYLIB", _AUTH_ALL );

  message_prefix.Wait_Forever = 1;      /* Wait indefinitely until an  */
                                        /* entry appears on the queue. */

  /*-------------------------------------------------------------------*/
  /* Dequeue the next message from the user queue and store it in the  */
  /* 'message_text' buffer.  If the queue is empty, this program will  */
  /* be suspended until an entry appears (by some other job running a  */
  /* a program that enqueues an entry on the queue).                   */
  /*-------------------------------------------------------------------*/

  deq( &message_prefix, message_text, queue_ptr );

                                     /* Display the received message    */
                                     /* to the screen.                  */

  printf("Each entry/message is %d bytes long.\n",
          message_prefix.Msg_Size );

  printf("The following was received from the User Queue. \n");
  printf("> %.75s \n\n", message_text );
}
```

Output

```
Each entry/message is 75 bytes long.
The following was received from the User Queue.
> This is the first message being entered.
```

Dequeue Message with Indicator (DEQI)

Format

```
#include <QSYISNC/MIH/DEQ>

int deqi (_DEQ_Msg_Prefix_T *msg_prefix,
          _SPCPTR message,
          _SYSPTR queue);
```

Description

The deqi function retrieves a queue message based on the queue type (FIFO, LIFO, or keyed) specified during the queue's creation. If a message satisfying the dequeue selection criteria is not available, the function will return immediately with the return code set as indicated below. The process is not placed in a wait state.

Parameters

msg_prefix (input/output)
Pointer to the message prefix template. This contains the criteria for message selection.

message (output)
Pointer to the location to receive the message text.

queue (input)
Pointer to the queue from which the message is to be dequeued.

Notes on Usage

- The builtin function _DEQI also provides access to the MI instruction.

Return Code

Values returned by the function deqi are:

Value	Meaning
1	Message dequeued
0	No message meeting dequeue criteria on the queue

Example

This example illustrates the use of the deqi function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   User Queues <QSYSINC/MIH/DEQ>                     */
/*                                                                    */
/* Function:        deqi  (dequeue and set indicator)                 */
/*                                                                    */
/* Description:     This example dequeues the next message from the   */
/*                  user queue and displays it to the screen.  If     */
/*                  there are no entries, this program continues and  */
/*                  the return code (indicator) from 'deqi' will      */
/*                  indicate whether or not there was anything on the */
/*                  queue to be dequeued.                             */
/*                                                                    */
/*--------------------------------------------------------------------*/
```

```
#include <QSYSINC/MIH/DEQ>
#include <QSYSINC/MIH/RSLVSP>
#include <stdio.h>
#include <stdlib.h>

                                        /* Stores information returned */
_DEQ_Msg_Prefix_T   message_prefix;     /* by the 'deqi' function.     */

_SYSPTR             queue_ptr;          /* Pointer to the user queue.  */

char                message_text[ 75 ]; /* Buffer for dequeued message.*/

int                 return_code;        /* "indicator" returned by deqi*/


int main(void) {

                                        /* Get a pointer to the *USRQ. */
  queue_ptr = rslvsp( _Usrq, "MYUSRQ", "MYLIB", _AUTH_ALL );


 /*--------------------------------------------------------------------*/
 /* The 'deqi' function unlike the 'deq' function will always return   */
 /* right away whether or not an entry was found on the user queue.    */
 /*--------------------------------------------------------------------*/

  return_code = deqi( &message_prefix, message_text, queue_ptr );

  if ( return_code == 0 ) {
    printf("The queue was empty. 'deqi' returned 0.\n");
    exit( 1 );
  }
                                     /* Inform the user of the message  */
                                     /* that was received from the queue*/

  printf("'deqi' returned %d indicating a successful dequeue\n",
          return_code );

  printf("The following was received from the User Queue. \n");
  printf("> %.75s \n", message_text );
}
```

Output

```
'deqi' returned 1 indicating a successful dequeue
The following was received from the User Queue.
> This is the second message being entered.
```

Edit (EDIT)

Format

```
#include <QSYSINC/MIH/EDIT>

void edit (_SPCPTR receiver,
           unsigned int rcvr_length,
           _SPCPTRCN source,
           _NUM_Descr_T src_descr,
           _SPCPTR mask,
           unsigned int mask_length);
```

Description

The edit function transforms the value of a numeric *source* from its internal form to character form suitable for display at a source/sink device and places the result in *receiver*. There are a number of general editing functions (such as unconditional insertion of a mask character string), that can be performed during the transformation.

Parameters

receiver (input/output)
Pointer to the location to receive the transformed result.

rcvr_length (input)
The length of the receiver area. This value must be between 1 and 256.

source (input)
The source string address.

src_descr (input)
The source descriptor. Must be prepared using the NUM_DESCR macro.

mask (input)
The mask string address.

mask_length (input)
The mask string length. This value must be between 1 and 256.

Notes on Usage

- The builtin function _LBEDIT (Late-bound Edit) also provides access to the MI instruction.

Example

This example illustrates the use of the edit function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Computation and Branching  <QSYSINC/MIH/EDIT>     */
/*                                                                    */
/* Function:        edit  (Edit)                                      */
/*                                                                    */
/* Description:     This example uses 'edit' to transform the integer */
/*                  source into character form suitable for display.  */
/*                  The edit mask controls the blank padding and      */
/*                  the insertion of the appropriate sign.            */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/EDIT>
#include <string.h>
#include <stdio.h>

#define SIZE  11

int main(void) {

  char         receiver[SIZE+1];
  char         edit_mask[18] =
                     {0x34, 0xb1, 0x40, 0x4e, 0x34, 0x60, 0x34,
                      0xB2, 0xB2, 0xB2, 0xB2, 0xB2, 0xB2, 0xb2,
                      0xB2, 0xB2, 0xB2, 0xB2};

  unsigned    mask_len = sizeof(edit_mask);
  int         source = 12652;

  edit(receiver, SIZE, &source, NUM_DESCR(_T_UNSIGNED, 4, 0),
                                              edit_mask, mask_len);
  receiver[SIZE] = '\0';
  printf("The transformed result is >>%s<<\n", receiver);
}
```

Output

```
The transformed result is >>     +12652<<
```

Edit Packed Decimal (EDIT_PACKED)

Format

```
#include <QSYSINC/MIH/EDIT>

void edit_packed (_SPCPTR receiver,
                  unsigned int rcvr_length,
                  _SPCPTRCN source,
                  unsigned int src_length,
                  _SPCPTR mask,
                  unsigned int mask_length);
```

Description

The edit_packed function transforms the value of a packed decimal source from its internal form to character form suitable for display at a source/sink device and places the result in receiver. There are a number of general editing functions (such as unconditional insertion of a mask character string), that can be performed during the transformation.

Parameters

receiver (input/output)
Pointer to the location to receive the transformed result.

rcvr_length (input)
The length of the receiver area. This value must be between 1 and 256.

source (input)
Pointer to the packed decimal source.

src_length (input)
The source length. This value must be between 1 and 31.

mask (input)
The mask string address.

mask_length (input)
The mask length. This value must be between 1 and 256.

Notes on Usage

- The builtin function _EDITPD also provides access to the MI instruction.
- This function is faster than edit for a packed decimal source.

Example

This example illustrates the use of the edit_packed decimal function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Computation and Branching  <QSYSINC/MIH/EDIT>     */
/*                                                                    */
/* Function:        edit_packed  (Edit Packed Decimal)                */
/*                                                                    */
/* Description:     This example uses 'edit_packed' to transform the  */
/*                  packed decimal source into character form         */
/*                  suitable for display. The edit mask controls the  */
/*                  blank padding and the insertion of the            */
/*                  appropriate sign.                                 */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/EDIT>
#include <decimal.h>
#include <string.h>
#include <stdio.h>

#define SIZE  11

int main(void) {

  char         receiver[SIZE+1];
  char         edit_mask[18] =
                     {0x34, 0xb1, 0x40, 0x4e, 0x34, 0x60, 0x34,
                      0xB2, 0xB2, 0xB2, 0xB2, 0xB2, 0xB2, 0xb2,
                      0xB2, 0xB2, 0xB2, 0xB2};

  unsigned         mask_len = sizeof(edit_mask);
  _Decimal(10,0)  source = 12652D;

  edit_packed(receiver, SIZE, &source, digitsof(source), edit_mask,
              mask_len);
  receiver[SIZE] = '\0';
  printf("The transformed result is >>%s<<\n", receiver);
}
```

Output

```
The transformed result is >>     +12652<<
```

Enqueue (ENQ)

Format

```
#include <QSYSINC/MIH/ENQ>

void enq (_SYSPTR queue,
          _ENQ_Msg_Prefix_T *msg_prefix,
          _SPCPTR message);
```

Description

The enq function enqueues a message according to the queue type attribute specified during the queue's creation.

Parameters

queue (input)

Pointer to the queue to which the message is to be enqueued.

msg_prefix(input)

Pointer to the message prefix template. This contains information about the message being enqueued.

message (output)

Pointer to the message text to be enqueued.

Notes on Usage

- The builtin function _ENQ also provides access to the MI instruction.

Example

This example illustrates the use of the enq function.

```
/*---------------------------------------------------------------------*/
/*                                                                     */
/* Example Group:   User Queues <QSYSINC/MIH/ENQ>                      */
/*                                                                     */
/* Function:        enq   (enqueue)                                    */
/*                                                                     */
/* Description:     Prompt the user for a string/message that will be  */
/*                  enqueued (placed) on a user queue named MYUSRQ in  */
/*                  library MYLIB.                                     */
/*                                                                     */
/*---------------------------------------------------------------------*/
#include <QSYSINC/MIH/ENQ>
#include <QSYSINC/MIH/RSLVSP>
#include <stdio.h>


_SYSPTR             queue_ptr;          /* Pointer to the user queue.  */

_ENQ_Msg_Prefix_T   message_prefix;     /* Provides description of the */
                                        /* message being enqueud.      */

                                        /* Stores the input received   */
char                message_text[ 75 ]; /* from the user which will    */
                                        /* then be enqueued.           */
```

```
int main(void) {

                                        /* Get a pointer to the *USRQ  */
  queue_ptr = rslvsp( _Usrq, "MYUSRQ", "MYLIB", _AUTH_ALL );

                                        /* Prompt the user for the     */
                                        /* message.                    */

  printf("Enter some text you wish to have put on the User Queue:\n");
  gets( message_text );

 /*--------------------------------------------------------------------*/
 /* Enqueue the user's message onto the user queue.  The length of     */
 /* the message is passed in the "prefix" argument (basically a        */
 /* description of the message being enqueued).                        */
 /*--------------------------------------------------------------------*/

  message_prefix.Msg_Len = 75;

  enq( queue_ptr, &message_prefix, message_text );

  printf("Your message has been enqueued onto the user queue. \n" );
}
```

Output

```
Enter some text you wish to have put on the User Queue:
This is the first message being entered.
Your message has been enqueued onto the user queue.
```

Ensure Object (ENSOBJ)

Format

```
#include <QSYSINC/MIH/ENSOBJ>

void ensobj (_SYSPTR object);
```

Description

The ensobj function protects the specified object from volatile storage loss.

The machine ensures that any changes made to the specified object are recorded on nonvolatile storage media. The access state of the object is not changed.

No action is taken for temporary objects since temporary objects are not preserved during machine failure.

Parameters

object (input)

Pointer to the system object to be protected.

Notes on Usage

- The builtin function _ENSOBJ also provides access to the MI instruction.

Example

This example illustrates the use of the ensobj function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Resource Management Data(RMD) <QSYSINC/MIH/ENSOBJ>*/
/*                                                                    */
/* Function:        ensobj    (Ensure Object)                         */
/*                                                                    */
/* Description:     'ensobj' forces objects from volatile (main       */
/*                  memory) to non-volatile (disk) storage.  This     */
/*                  particular example shows how to use 'ensobj' to   */
/*                  "flush" a user queue out to disk to ensure data   */
/*                  is not lost in the event of a power loss, etc.    */
/*                                                                    */
/*--------------------------------------------------------------------*/
#include <QSYSINC/MIH/ENSOBJ>
#include <QSYSINC/MIH/RSLVSP>

                                       /* The pointer to the object   */
_SYSPTR              some_object;      /* that will be "forced" to    */
                                       /* auxillary storage (disk).   */


int main(void) {

                                       /* Get a pointer to the object */
 some_object = rslvsp( _Usrq, "MYUSRQ", "MYLIB", _AUTH_ALL );


 ensobj( some_object );                /* Force the object to disk.   */

}
```

Output

```
** no screen output **
```

Extract Exponent (EXTREXP)

Format

```
#include <QSYSINC/MIH/EXTREXP>

int extrexp (double source);
```

Description

The extrexp function extracts the exponent portion of a floating-point scalar and returns the value as a 4 byte integer.

Parameters

source (input)

An 8-byte floating-point number.

Return Values

value of source	result
0.0	0.0
+/-INFINITY	32767
NaN	-32768

Example

This example illustrates the use of the extrexp function.

```
/*--------------------------------------------------------------------*/
/* Example Group:   Computation and Branching  <QSYSINC/MIH/EXTREXP>  */
/*                                                                    */
/* Function:        extrexp     (Extract Exponent)                    */
/*                                                                    */
/* Description:     This example uses 'extrexp' to return the         */
/*                  exponent portion of the floating-point value.     */
/*                  e.g. significand * 2 ** exponent                  */
/*                       extrexp(6734.219) = 1.6440964 * 2 ** 12      */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/EXTREXP>
#include <stdio.h>

int main(void) {

  double    source = 6734.219;
  int       exponent;

  exponent = extrexp(source);
  printf("The exponent = %d\n", exponent);

}
```

Output

```
The exponent = 12
```

Find Independent Index Entry (FNDINXEN)

Format

```
#include <QSYSINC/MIH/FNDINXEN>

_SPCPTR fndinxen (_SPCPTR receiver,
                  _SYSPTR index_obj,
                  _IIX_Opt_List_T *option_list,
                  _SPCPTR search_arg);
```

Description

The fndinxen function searches the independent index according to the search criteria specified in the option list and the search argument. The desired entry or entries are returned in the receiver. A pointer to the receiver area is also returned by the function.

Parameters

receiver (input/output)

Pointer to the buffer to receive the returned entry or entries.

index_obj (input)

Pointer to the independent index object to be searched.

option_list (input/output)

Pointer to the option list template. This template contains additional information on the search.

search_arg (input)

Pointer to the search argument(s).

Notes on Usage

- The builtin function _FNDINXEN also provides access to the MI instruction.

Example

This example illustrates the use of the fndinxen function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   User Indexes   <QSYSINC/MIH/FNDINXEN>             */
/*                                                                    */
/* Function:        fndinxen   (Find Index Entry)                     */
/*                                                                    */
/* Description:     Search for an entry using a particular customer   */
/*                  number (stored as an integer).  If an entry is    */
/*                  found in the user index, then display the text    */
/*                  of the entry to the screen.                       */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/FNDINXEN>
#include <QSYSINC/MIH/RSLVSP>
#include <stdio.h>

typedef struct Customer_Entry  {       /* The format/layout of each    */
   int   customer_number;              /* entry in the user index.     */
   char  last_name[ 50 ];
   char  first_name[ 40 ];
   char  phone_number[9];              /* Using phone format: 999-9999 */
} Customer_Entry;

                                       /* Template used for setting    */
_IIX_Opt_List_T   find_options;        /* options for the "find".      */
                                       /* Also used as the receiver    */
                                       /* for any returned information.*/

_SYSPTR           index_ptr;           /* Pointer to the user index.   */


                                       /* The receiver buffer for any  */
Customer_Entry    found_customer;      /* entry that may be returned   */
                                       /* from the 'fndinxen'.         */

                                       /* Our criterion is to find an  */
int               which_customer       /* entry in the user index with */
                   = 55555;            /* this customer number.        */

int main(void) {
                                       /* Get a pointer to the *USRIDX */
 index_ptr = rslvsp( _Usridx, "MYUSRIDX", "MYLIB", _AUTH_ALL );


 find_options.Rule = _FIND_EQUALS;     /* Find a matching customer     */
                                       /* number.                      */

 find_options.Arg_Length               /* The "search key" is the      */
            = sizeof(int);             /* 4-byte integer customer      */
                                       /* number.                      */
```

```
                                        /* In case more than one entry  */
 find_options.Occ_Count = 1;            /* exists with this customer    */
                                        /* number, only return the      */
                                        /* first entry found.           */

 /*-------------------------------------------------------------------*/
 /* Search for the entry that matches the customer number stored in   */
 /* 'which_customer' and store the entry in 'found_customer'.  The    */
 /* find options specified in the 'find_options' template are used to */
 /* control the search.  After the call to 'fndinxen', this template  */
 /* also stores the number of entries found.  If one entry is found,  */
 /* its contents will be displayed to the screen.                     */
 /*-------------------------------------------------------------------*/

 fndinxen( &found_customer, index_ptr, &find_options, &which_customer );


  if ( find_options.Ret_Count == 0)
    printf("Customer number %d was not found.\n", which_customer);

  else
    if (find_options.Ret_Count == 1) {

       printf("An entry was found for customer number: %d \n",
               which_customer );

       printf("Customer Name is:  %s %s \n", found_customer.first_name,
                                             found_customer.last_name);

       printf("Phone Number is:   %s \n",found_customer.phone_number);
    }
}
```

Output

```
An entry was found for customer number: 55555
Customer Name is:  Mary Wilson
Phone Number is:   777-7777
```

Find Relative Invocation Number (FNDRINVN)

Format

```
#include <QSYSINC/MIH/FNDRINVN>

int fndrinvn (_INV_Template_T *inv_t
              int srch_option,
              _SPCPTRCN srch_arg,
              char compare);
```

Description

The fndrinvn function searches a specified range of invocations until an invocation is found which satisfies the search criteria. If no invocation in the specified range satisfies the search criteria, a value of zero is returned by the function. Otherwise, the identity of the first invocation to satisfy the search criteria is returned by the function. The return value is specified relative to the starting invocation. A positive number indicates a displacement in the direction of newer invocations, while a negative indicates a displacement in the direction of older invocations.

Parameters

inv_t (input)

Pointer to the search range template or NULL. The search range template identifies the starting invocation and the range of the search. Specifying NULL will default to a range starting with the current invocation and proceeding through all existing older invocations.

srch_option (input)

Specifies the invocation attribute to be examined.

srch_arg (input)

Pointer to the search argument. This is a value between one and 16 bytes depending on the search option specified.

compare (input)

Specifies the compare operation.
0X00 = Match. The function will identify the first invocation which matches the specified search criteria.
0X01 = Mismatch. The function will identify the first invocation which does not match the specified search criteria.

Notes on Usage

- The starting invocation is skipped in the search and no exception is signalled if the search criterion is not satisfied.
- The builtin functions _FNDRINVN1 and _FNDRINVN2 also provide access to the MI instruction.

Example

This example illustrates the use of the fndrinvn function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Machine Observation   <QSYSINC/MIH/FNDRINVN>      */
/*                                                                    */
/* Function:        fndrinvn   (Find Relative Invocation Number)      */
/*                                                                    */
/* Description:     This example uses 'fndrinvn' to search the call   */
/*                  stack for an invocation with the specified        */
/*                  invocation mark. Please Note: the 'fndrinvn'      */
/*                  function itself has an entry on the call stack    */
/*                  and this must be taken into account when          */
/*                  calculating relative invocation offsets. This     */
/*                  is not necessary if either one of _FNDRINVN1 or   */
/*                  _FNDRINVN2 builtins are used.                     */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/FNDRINVN>
#include <QSYSINC/MIH/MATINVAT>
#include <string.h>
#include <stdio.h>

void func(void);

int               inv_mark, rel_off;
_INV_Template_T   inv_t;

int main(void) {

   func();
}

void func(void) {

   memset(&inv_t, 0, sizeof(_INV_Template_T));

   inv_t.Inv_Offset = -2;  /* main()'s invocation  */

   /* Get invocation mark for main()     */

   matinvat(&inv_mark, &inv_t, _MTVA_INV_MARK, sizeof(inv_mark));

   /* Use the invocation mark from matinvat as the search criteria */
   /* for fndrinvn. The relative invocation number returned should */
   /* -2 indicating success at the invocation of main().           */

   rel_off = fndrinvn(NULL, _FNDR_INV_MARK, &inv_mark, _FNDR_MATCH);
   printf("The search is stopped at %d invocations from the current\n",
           rel_off);
}
```

Output

The search is stopped at -2 invocations from the current

Increment Date (INCD)

Format

```
#include <QSYSINC/MIH/MIDTTM>

void incd (_SPCPTR result_date,
           _SPCPTRCN source_date,
           _SPCPTRCN duration,
           _INST_Template_T3 *inst_t);
```

Description

The incd function increments the date by the date duration. The date specified by *source_date* is increased by the date duration specified by *duration*. The resulting date from the operation is placed in *result_date*.

Parameters

result_date (input/output)
Pointer to the location to receive the result.

source_date (input)
Pointer to the source date.

duration (input)
Pointer to the packed decimal duration.

inst_t (input)
Pointer to the instruction template which defines the data definitional attributes for *result_date*, *source_date*, and *duration*.

Notes on Usage

- The builtin function _INCD also provides access to the MI instruction.
- A macro version is available.
- The DDATs for *result_date* and *source_date* must be identical.

Example

This example illustrates the use of the incd function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Date/Time/Timestamp     <QSYSINC/MIH/MIDTTM>      */
/*                                                                    */
/* Function:        incd    (Increment Date)                          */
/*                                                                    */
/* Description:     This example uses 'incd' to increment the date    */
/*                  by the date duration.                             */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/MIDTTM>
#include <string.h>
#include <stdio.h>
#include <stdlib.h>
#include <stddef.h>
#include <decimal.h>

/* Internal format for start of Gregorian timeline: January 1, 0001 */
#define GREGORIAN_TIMELINE_START   1721424

/* Internal format for end of Gregorian timeline: January 1, 10000  */
#define GREGORIAN_TIMELINE_END     5373485

int main(void) {

  _INST_Template_T3   *inst_t3;
  _DDAT_T             *ddat_t1, *ddat_t2;
  _Era_Table_T        *era_t1;
  _Calendar_Table_T   *cal_t1;

  int                 DDAT_Length, Calendar_Offset;
  int                 DDAT_Size, Template_Size;
  int                 DDAT_Offset1, DDAT_Offset2;

  char                result_d[11];
  char                source_d[11] = "1993-01-30";
  decimal(8,0)        duration = 01610801D;

  DDAT_Length = sizeof(_DDAT_T) +
                2*(sizeof(_Calendar_Table_T)) - sizeof(short) +
                sizeof(_Era_Table_T) - 1;

  Calendar_Offset = offsetof(_DDAT_T, Tables) +
                    sizeof(_Era_Table_T);

  DDAT_Size       = 2*DDAT_Length +
                    2*(sizeof(int)) +   /* DDAT_Offset */
                    10 +                /* reserved4   */
                    sizeof(short) +     /* Num_DDATs   */
                    sizeof(int);        /* DDAT_Size   */

  Template_Size   = 2*DDAT_Length + offsetof(_INST_Template_T3, DDAT) +
                    sizeof(int); /* ddat offset  */
```

```
DDAT_Offset1    = (offsetof(_INST_Template_T3, DDAT) -
                  offsetof(_INST_Template_T3, DDAT_Size)) +
                  sizeof(int); /* DDAT2 offset */

DDAT_Offset2    = (offsetof(_INST_Template_T3, DDAT) -
                  offsetof(_INST_Template_T3, DDAT_Size)) +
                  DDAT_Length + sizeof(int); /* DDAT2 offset */

inst_t3   = (_INST_Template_T3 *)malloc(Template_Size);

/* Fill in Instruction Template                      */

memset(inst_t3, '\0', sizeof(_INST_Template_T3));

inst_t3->Template_Size     = Template_Size;
inst_t3->DDAT_1            = 1;
inst_t3->DDAT_2            = 1;
inst_t3->DDAT_3            = 2;
inst_t3->Length_1          = 10;
inst_t3->Length_2          = 10;
inst_t3->F_Digits          = 0;
inst_t3->T_Digits          = 8;
inst_t3->Indicators        = _OUT_ADJUST | _IN_ADJUST;
inst_t3->DDAT_Size         = DDAT_Size;
inst_t3->Num_DDATs         = 2;
inst_t3->DDAT_Offset[0]    = DDAT_Offset1;
*(inst_t3->DDAT_Offset + 1)= DDAT_Offset2;

/* Set table pointers within instruction template    */

ddat_t1   = (_DDAT_T *)&(inst_t3->DDAT_Offset + 2);
era_t1    = (_Era_Table_T *)&(ddat_t1->Tables);
cal_t1    = (_Calendar_Table_T *)((char *)ddat_t1 + Calendar_Offset);
ddat_t2   = (_DDAT_T *)((char *)ddat_t1 + DDAT_Length);

/* Fill in DDAT1                                     */

ddat_t1->DDAT_Length     = DDAT_Length;
ddat_t1->Format_Code     = _ISO_DATE;
ddat_t1->Calendar_Offset = Calendar_Offset;


/* Fill in Era Table for DDAT1                       */

era_t1->Num_Elems   = 1;
era_t1->Element[0].Origin_Date = GREGORIAN_TIMELINE_START;
era_t1->Element[0].Era_Name[0] = 'A';
era_t1->Element[0].Era_Name[1] = 'D';

/* Fill in Calendar Table for DDAT1                  */

cal_t1->Num_Elems                = 2;
cal_t1->Element->Effect_Date = GREGORIAN_TIMELINE_START;
cal_t1->Element->Type           = 0x0001;
memset(cal_t1->Element->reserved, '\0', 10);
(cal_t1->Element+1)->Effect_Date = GREGORIAN_TIMELINE_END;
(cal_t1->Element+1)->Type           = 0;
memset((cal_t1->Element+1)->reserved, '\0', 10);
```

```
  /* Fill in DDAT 2                                        */

  ddat_t2->DDAT_Length     = DDAT_Length;
  ddat_t2->Format_Code     =  _DATE_DUR;
  ddat_t2->Calendar_Offset = Calendar_Offset;

  incd(result_d, source_d, &duration, inst_t3);

  result_d[10] = '\0';
  printf("The resulting date is %s\n", result_d);
}
```

Output

```
The resulting date is 2154-10-01
```

Increment Time (INCT)

Format

```
#include <QSYSINC/MIH/MIDTTM>

void inct (_SPCPTR result_time,
           _SPCPTRCN source_time,
           _SPCPTRCN duration,
           _INST_Template_T3 *inst_t);
```

Description

The inct function increments the time by the time duration. The time specified by *source_time* is increased by the time duration specified by *duration*. The resulting time from the operation is placed in *result_time*.

Parameters

result_time (input/output)
Pointer to the location to receive the result.

source_time (input)
Pointer to the source time.

duration (input)
Pointer to the packed decimal duration.

inst_t (input)
Pointer to the instruction template which defines the data definitional attributes for *result_date*, *source_date* and *duration*.

Notes on Usage

- The DDATs for *result_time* and *source_time* must be identical.
- The builtin function _INCT also provides access to the MI instruction.
- A macro version is available.

Example

This example illustrates the use of the inct function.

```
/*------------------------------------------------------------------------*/
/*                                                                        */
/* Example Group:   Date/Time/Timestamp     <QSYSINC/MIH/MIDTTM>          */
/*                                                                        */
/* Function:        inct    (Increment Time)                              */
/*                                                                        */
/* Description:     This example uses 'inct' to increment the time        */
/*                  by the time duration.                                 */
/*                                                                        */
/*------------------------------------------------------------------------*/

#include <QSYSINC/MIH/MIDTTM>
#include <string.h>
#include <stdio.h>
#include <stdlib.h>
#include <stddef.h>
#include <decimal.h>

int main(void) {

  _INST_Template_T3   *inst_t3;
  _DDAT_T             *ddat_t1, *ddat_t2;

  int                 DDAT_Length, Calendar_Offset;
  int                 DDAT_Size, Template_Size;
  int                 DDAT_Offset1, DDAT_Offset2;

  char                result_d[9];
  char                source_d[9] = "11.05.30";
  decimal(6,0)        duration = 000205D;

  DDAT_Length = sizeof(_DDAT_T) +
                2*(sizeof(_Calendar_Table_T)) - sizeof(short) +
                sizeof(_Era_Table_T) - 1;

  Calendar_Offset = offsetof(_DDAT_T, Tables) +
                    sizeof(_Era_Table_T);

  DDAT_Size       = 2*DDAT_Length +
                    2*(sizeof(int)) +   /* DDAT_Offset */
                    10 +                /* reserved4   */
                    sizeof(short) +     /* Num_DDATs   */
                    sizeof(int);        /* DDAT_Size   */

  Template_Size   = 2*DDAT_Length + offsetof(_INST_Template_T3, DDAT) +
                    sizeof(int); /* ddat offset  */

  DDAT_Offset1    = (offsetof(_INST_Template_T3, DDAT) -
                    offsetof(_INST_Template_T3, DDAT_Size)) +
                    sizeof(int); /* DDAT2 offset */

  DDAT_Offset2    = (offsetof(_INST_Template_T3, DDAT) -
                    offsetof(_INST_Template_T3, DDAT_Size)) +
                    DDAT_Length + sizeof(int); /* DDAT2 offset */
```

```
  inst_t3   = (_INST_Template_T3 *)malloc(Template_Size);

  /* Fill in Instruction Template                       */

  memset(inst_t3, '\0', sizeof(_INST_Template_T3));

  inst_t3->Template_Size     = Template_Size;
  inst_t3->DDAT_1            = 1;
  inst_t3->DDAT_2            = 1;
  inst_t3->DDAT_3            = 2;
  inst_t3->Length_1          = 8;
  inst_t3->Length_2          = 8;
  inst_t3->F_Digits          = 0;
  inst_t3->T_Digits          = 6;
  inst_t3->Indicators        = _NO_ADJUST_OR_TOLERATE;
  inst_t3->DDAT_Size         = DDAT_Size;
  inst_t3->Num_DDATs         = 2;
  inst_t3->DDAT_Offset[0]    = DDAT_Offset1;
  *(inst_t3->DDAT_Offset + 1)= DDAT_Offset2;

  ddat_t1   = (_DDAT_T *)&(inst_t3->DDAT_Offset + 2);
  ddat_t2   = (_DDAT_T *)((char *)ddat_t1 + DDAT_Length);

  /* Fill in DDAT1                                      */

  ddat_t1->DDAT_Length     = DDAT_Length;
  ddat_t1->Format_Code     = _ISO_TIME;
  ddat_t1->Hour_Zone       = 24;
  ddat_t1->Min_Zone        = 60;
  ddat_t1->Calendar_Offset = Calendar_Offset;

  /* Fill in DDAT2                                      */

  ddat_t2->DDAT_Length     =  DDAT_Length;
  ddat_t2->Format_Code     =  _TIME_DUR;
  ddat_t2->Hour_Zone       =  0;
  ddat_t2->Min_Zone        =  0;
  ddat_t2->Calendar_Offset =  Calendar_Offset;

  inct(result_d, source_d, &duration, inst_t3);

  result_d[8] = '\0';
  printf("The resulting time is %s\n", result_d);
}
```

Output

```
The resulting time is 11.07.35
```

Increment Timestamp (INCTS)

Format

```
#include <QSYSINC/MIH/MIDTTM>

void incts (_SPCPTR result_timestamp,
            _SPCPTRCN source_timestamp,
            _SPCPTRCN duration,
            _INST_Template_T3 *inst_t);
```

Description

The incts function increments the date by the timestamp. The timestamp specified by *source_timestamp* is increased by the date, time, or timestamp duration specified by *duration*. The resulting timestamp from the operation is placed in *result_timestamp*.

Parameters

result_timestamp (input/output)
Pointer to the location to receive the result.

source_timestamp (input)
Pointer to the source timestamp.

duration (input)
Pointer to the packed decimal duration.

inst_t (input)
Pointer to the instruction template which defines the data definitional attributes for *result_timestamp*, *source_timestamp*, and *duration*.

Notes on Usage

- The DDATs for *result_timestamp* and *source_timestamp* must be identical.
- The builtin function _INCTS also provides access to the MI instruction.
- A macro version is available.

Example

This example illustrates the use of the incts function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Date/Time/Timestamp     <QSYSINC/MIH/MIDTTM>      */
/*                                                                    */
/* Function:        incts   (Increment Timestamp)                     */
/*                                                                    */
/* Description:     This example uses 'incts' to increment the time-  */
/*                  stamp by the timestamp duration.                  */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/MIDTTM>
#include <stdio.h>
#include <stdlib.h>
#include <stddef.h>
#include <string.h>
#include <decimal.h>

/* Internal format for start of Gregorian timeline: January 1, 0001 */
#define GREGORIAN_TIMELINE_START   1721424

/* Internal format for end of Gregorian timeline: January 1, 10000  */
#define GREGORIAN_TIMELINE_END     5373485

int main(void) {


  _INST_Template_T3   *inst_t3;
  _DDAT_T             *ddat_t1, *ddat_t2;
  _Era_Table_T        *era_t1;
  _Calendar_Table_T   *cal_t1;


  int                 DDAT_Length, Calendar_Offset;
  int                 DDAT_Size, Template_Size;
  int                 DDAT_Offset1, DDAT_Offset2;

  char                result_d[27];
  char                source_d[27] = "1993-01-17-11.05.30.000000";
  decimal(20,6)       duration = 00000203012005.000000D;


  DDAT_Length = sizeof(_DDAT_T) +
                2*(sizeof(_Calendar_Table_T)) - sizeof(short) +
                sizeof(_Era_Table_T) - 1;

  Calendar_Offset = offsetof(_DDAT_T, Tables) +
                    sizeof(_Era_Table_T);

  DDAT_Size       = 2*DDAT_Length +
                    2*(sizeof(int)) +   /* DDAT_Offset */
                    10 +                /* reserved4   */
                    sizeof(short) +     /* Num_DDATs   */
                    sizeof(int);        /* DDAT_Size   */
```

```
Template_Size   = 2*DDAT_Length + offsetof(_INST_Template_T3, DDAT) +
                  sizeof(int); /* ddat offset  */

DDAT_Offset1    = (offsetof(_INST_Template_T3, DDAT) -
                  offsetof(_INST_Template_T3, DDAT_Size)) +
                  sizeof(int); /* DDAT2 offset */

DDAT_Offset2    = (offsetof(_INST_Template_T3, DDAT) -
                  offsetof(_INST_Template_T3, DDAT_Size)) +
                  DDAT_Length + sizeof(int); /* DDAT2 offset */

inst_t3   = (_INST_Template_T3 *)malloc(Template_Size);

/* Fill in Instruction Template                       */

memset(inst_t3, '\0', sizeof(_INST_Template_T3));

inst_t3->Template_Size     = Template_Size;
inst_t3->DDAT_1            = 1;
inst_t3->DDAT_2            = 1;
inst_t3->DDAT_3            = 2;
inst_t3->Length_1          = 26;
inst_t3->Length_2          = 26;
inst_t3->F_Digits          = 6;
inst_t3->T_Digits          = 20;
inst_t3->Indicators        = _OUT_ADJUST | _IN_ADJUST;
inst_t3->DDAT_Size         = DDAT_Size;
inst_t3->Num_DDATs         = 2;
inst_t3->DDAT_Offset[0]    = DDAT_Offset1;
*(inst_t3->DDAT_Offset + 1)= DDAT_Offset2;

/* Set table pointers within instruction template    */

ddat_t1   = (_DDAT_T *)&(inst_t3->DDAT_Offset + 2);
era_t1    = (_Era_Table_T *)&(ddat_t1->Tables);
cal_t1    = (_Calendar_Table_T *)((char *)ddat_t1 + Calendar_Offset);
ddat_t2   = (_DDAT_T *)((char *)ddat_t1 + DDAT_Length);

/* Fill in DDAT1                                      */

ddat_t1->DDAT_Length     = DDAT_Length;
ddat_t1->Format_Code     = _SAA_TIMESTAMP;
ddat_t1->Hour_Zone       = 24;
ddat_t1->Min_Zone        = 60;
ddat_t1->Calendar_Offset = Calendar_Offset;

/* Fill in Era Table for DDAT1                        */

era_t1->Num_Elems   = 1;
era_t1->Element[0].Origin_Date = GREGORIAN_TIMELINE_START;
era_t1->Element[0].Era_Name[0] = 'A';
era_t1->Element[0].Era_Name[1] = 'D';


/* Fill in Calendar Table for DDAT1                   */

cal_t1->Num_Elems                 = 2;
cal_t1->Element->Effect_Date = GREGORIAN_TIMELINE_START;
```

```
  cal_t1->Element->Type           = 0x0001;
  memset(cal_t1->Element->reserved, '\0', 10);
  (cal_t1->Element+1)->Effect_Date = GREGORIAN_TIMELINE_END;
  (cal_t1->Element+1)->Type           = 0;
  memset((cal_t1->Element+1)->reserved, '\0', 10);


  /* Fill in DDAT 2                                    */

  ddat_t2->DDAT_Length     = DDAT_Length;
  ddat_t2->Format_Code =  _TIMESTAMP_DUR;
  ddat_t2->Hour_Zone   =  0;
  ddat_t2->Min_Zone    =  0;
  ddat_t2->Calendar_Offset = Calendar_Offset;

  incts(result_d, source_d, &duration, inst_t3);

  result_d[26] = '\0';
  printf("The resulting timestamp is %s\n", result_d);

}
```

Output

```
The resulting timestamp is 1996-12-20-12.25.35.000000
```

Insert Independent Index Entry (INSINXEN)

Format

```
#include <QSYSINC/MIH/INSINXEN>

void insinxen (_SYSPTR new_entry,
               _SPCPTR index_obj,
               _IIX_Opt_List_T *option_list);
```

Description

The insinxen function inserts one or more new entries into an independent index, according to the criteria specified. Each entry is inserted into the index based on the binary value of the argument.

Parameters

index_obj (input)

Pointer to the independent index object to receive the new entry or entries.

new_entry (input)

Pointer to the new entry or entries to be inserted.

option_list (input)

Pointer to the option list template. This template contains additional information regarding the insertion of the new entry or entries.

Notes on Usage

- The builtin function _INSINXEN also provides access to the MI instruction.
- When a NULL is passed as the second operand of insinxen, error message MCH5601 or MCH3601 will be generated.

Example

This example illustrates the use of the insinxen function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   User Indexes   <QSYSINC/MIH/INSINXEN>             */
/*                                                                    */
/* Function:        insinxen   (Insert Index Entry)                   */
/*                                                                    */
/* Description:     This example will insert 3 entries into the user  */
/*                  index.  Each entry will consist of a customer     */
/*                  number, first name, last name, and phone number.  */
/*                  The customer number (stored as an integer) will   */
/*                  be used as the key.  'insinxen' will insert each  */
/*                  entry at the appropriate position based on the    */
/*                  value stored in the key field of the entry        */
/*                  (entries are sorted in ascending order).          */
/*                                                                    */
/*                  This example operates on a keyed user index that  */
/*                  has fixed-length entries (note that entries in    */
/*                  a user index have a maximum size of 120 bytes).   */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/INSINXEN>
#include <QSYSINC/MIH/RSLVSP>
#include <stdio.h>

typedef struct Customer_Entry  {       /* The format/layout of each    */
   int   customer_number;              /* entry in the user index.     */
   char  last_name[ 50 ];
   char  first_name[ 40 ];
   char  phone_number[9];              /* Using phone format: 999-9999 */
} Customer_Entry;

                                       /* Template used for setting    */
_IIX_Opt_List_T  insert_options;       /* options for the "insert".    */
                                       /* Also used as the receiver    */
                                       /* for any returned data.       */

_SYSPTR          index_ptr;            /* Pointer to the user index.   */

                                       /* Declare and initialize a     */
                                       /* few example entries.         */

Customer_Entry   customer1 =  {9999999, "Smith",  "John",  "555-5555" },
                 customer2 =  {  55555, "Wilson", "Mary",  "777-7777" },
                 customer3 =  {      1, "Chan",   "Julie", "123-4567" };

int main(void) {
                                       /* Get a pointer to the *USRIDX */
  index_ptr = rslvsp( _Usridx, "MYUSRIDX", "MYLIB", _AUTH_ALL );

                                       /* For Keyed User Indexes must  */
  insert_options.Rule                  /* specify "insert and replace" */
              = _INSERT_REPLACE;       /* instead of just "insert".    */
```

```
                                        /* 1 entry is to be inserted for*/
  insert_options.Occ_Count = 1;         /* each use of 'insinxen'. You  */
                                        /* could also have all 3 entries*/
                                        /* inserted with one 'insinxen'.*/

 /*-------------------------------------------------------------------*/
 /* Insert each of the three entries into the user index and check    */
 /* the return count to ensure that each insert was successful.       */
 /*-------------------------------------------------------------------*/

  insinxen( index_ptr, &customer1, &insert_options );

  if (insert_options.Ret_Count != 1)    /* If 1 entry was not inserted, */
                                        /* then it either failed or more*/
      printf("First Insert Failed\n"); /* than 1 entry was inserted    */
                                        /* (but we only asked for 1 to  */
                                        /* be inserted).                */

  insinxen( index_ptr, &customer2, &insert_options );

  if (insert_options.Ret_Count != 1)
      printf("Second Insert Failed\n");


  insinxen( index_ptr, &customer3, &insert_options );

  if (insert_options.Ret_Count != 1)
      printf("Third Insert Failed\n");
}
```

Output

```
** No output **
```

Lock Object (LOCK)

Format

```
#include <QSYSINC/MIH/LOCK>

void lock (_SYSPTR object,
           MI_Time wait_time,
           char lock_state);
```

Description

The lock function requests that a single lock for the system object be allocated to the issuing process.

Parameters

object (input)

Pointer to the system object to be locked.

wait_time (input)

The wait time requested. This specifies the maximum amount of time that a process competes for the requested lock. Use the mitime function to form this value.

lock_state (input)

The lock state requested.

Notes on Usage

- The lock request type will be set for the user by default, depending on what is specified as the wait time. The following rule will be used: If *wait_time* = 0, _LOCK_NORMAL will be used as the request type. If *wait_time* > 0, _LOCK_SYNCH will be used as the request type.
- The lock entry will always be marked as active by the lock function. So, for the function version it is not necessary to OR the lock state with _LOCK_ENTRY_ACTIVE.
- The builtin function _LOCK and macro Lock also provide access to the MI instruction.

Example

This example illustrates the use of the lock function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Locks   <QSYSINC/MIH/LOCK>                        */
/*                                                                    */
/* Function:        lock    (Lock Object)                             */
/*                                                                    */
/* Description:     This example illustrates the use of the 'lock'    */
/*                  function by placing an Exclusive-No-Read (LENR)   */
/*                  lock on an object (a user queue in this example). */
/*                  This kind of lock prevents any other user (job)   */
/*                  from placing any kind of lock on the same object  */
/*                  (using the 'lock' function or ALCOBJ command).    */
/*                  Several types of locks can be placed on objects.  */
/*                                                                    */
/*                  This example shows how a timeout value is created */
/*                  using the 'mitime' and passing the timeout value  */
/*                  to the 'lock' function.  If the lock request      */
/*                  cannot be satisfied within the timeout value, an  */
/*                  exception will be generated/raised.               */
/*                                                                    */
/*                  The DSPJOB command is called using the 'system'   */
/*                  function to display all of the object locks for   */
/*                  the job in which this program is run.             */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/LOCK>
#include <QSYSINC/MIH/RSLVSP>
#include <miptrnam.h>
#include <stdio.h>
#include <stdlib.h>

_SYSPTR      some_object;              /* The object being locked.    */

_MI_Time     timeout;                  /* Amount of time to wait for  */
                                       /* the lock to be placed.      */

int          hours       =  0,         /* Time components used to     */
             minutes     =  0,         /* create an _MI_Time value    */
             seconds     = 12,         /* that can be passed to the   */
             hundredths  =  0;         /* 'lock' function.            */


int main(void) {
                                       /* Get a pointer to the object */
   some_object = rslvsp( _Usrq, "MYUSRQ", "MYLIB", _AUTH_ALL );

 /*------------------------------------------------------------------*/
 /* Format an 'mitime' value to represent the timeout to be used by  */
 /* the 'lock' function when trying to obtain an Exclusive-No-Read   */
 /* (LENR) lock on the object. If the lock request cannot be satisfied */
 /* in the specified amount of time, then an exception will be raised. */
 /* The CL DSPJOB command is called to display all of the object locks */
 /* owned by the job/process that runs this program.                 */
 /*------------------------------------------------------------------*/
```

```
   mitime( &timeout, hours, minutes, seconds, hundredths );

   lock( some_object, timeout, _LENR_LOCK );

   system( "DSPJOB OPTION(*JOBLCK)" );

}
```

Output

```
                              Display Job Locks
                                                          System:   TORAS4YL
 Job:   OMXNA3S4       User:   VISCA          Number:   009616

 Job status:   ACTIVE

 Type options, press Enter.
   5=Display job member locks
                                    Object                          Member
 Opt    Object        Library       Type         Lock       Status   Locks
        MAIN          QSYS          *MENU        *SHRNUP     HELD
                                                  *SHRNUP     HELD
        MYUSRQ        MYLIB         *USRQ        *EXCL       HELD
        OMXNA3S4      QSYS          *DEVD        *EXCLRD     HELD
                                                  *EXCLRD     HELD
                                                  *EXCLRD     HELD
                                                  *EXCLRD     HELD
        QADM          QSYS          *LIB         *SHRRD      HELD
                                                                    More...
 F3=Exit   F5=Refresh   F10=Display job record locks   F12=Cancel
```

Lock Space Location (LOCKSL)

Format

```
#include <QSYSINC/MIH/LOCKSL>

void locksl (_SPCPTR location,
             char lock_state);
```

Description

The locksl function grants the space location to the issuing process according to the lock request. For this function, if the requested lock cannot be immediately granted, the process will enter a synchronous wait for the lock for a period up to the interval specified by the process default time-out value.

Parameters

location (input)

Pointer to the space location to be locked.

lock_state (input)

The lock type request.

Notes on Usage

- The builtin functions _LOCKSL1 and _LOCKSL2 also provide access to the MI instruction.
- The _LOCKSL2 builtin supports multiple space location lock requests.

Example

This example illustrates the use of the locksl function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Locks   <QSYSINC/MIH/LOCKSL>                      */
/*                                                                    */
/* Function:        locksl  (Lock Space Location)                     */
/*                                                                    */
/* Description:     Place an Exclusive-No-Read (LENR) on a particular  */
/*                  byte (space location) of some object (a user      */
/*                  queue in this example).  This type of lock is     */
/*                  "symbolic" in that it does not prevent the space  */
/*                  location from being referenced or updated.        */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/LOCKSL>
#include <QSYSINC/MIH/RSLVSP>
#include <QSYSINC/MIH/SETSPPFP>
#include <QSYSINC/MIH/MATOBJLK>
#include <stdio.h>

                                       /* The object from which some  */
_SYSPTR              some_object;      /* byte (space) location will  */
                                       /* be locked.                  */

_SPCPTR              some_byte;        /* The pointer to the location */
                                       /* that is being locked.       */

                                       /* The receiver template used  */
_MOBJL_Template_T    allocated_locks;  /* by 'matobjlk'.              */


int main(void) {

                                       /* Get a pointer to the object */
  some_object = rslvsp( _Usrq, "MYUSRQ", "MYLIB", _AUTH_ALL );

                                       /* Set a space pointer from    */
                                       /* the system pointer.         */
  some_byte = setsppfp( some_object );

 /*-------------------------------------------------------------------*/
 /* Request the Exclusive-No-Read (LENR) lock on the space location.  */
 /* A default timeout called the "Process Default Timeout" is used as */
 /* the timeout value.  If the lock request is not satisfied in that  */
 /* time, an exception is raised.                                     */
 /*-------------------------------------------------------------------*/

   locksl( some_byte, _LENR_LOCK );
```

```
 /*--------------------------------------------------------------------*/
 /* In order to verify that the LENR lock was placed on the space      */
 /* location (byte), we can look at the bit pattern returned by        */
 /* 'matobjlk' in the 'Lock_Alloc' field of the template. The fifth    */
 /* bit (bit 4) of this field represents the Lock-Exclusive-No-Read    */
 /* (LENR) lock.  By using the bitwise AND (&) operator, we can        */
 /* determine if the bit is set by ANDing it with the provided bit     */
 /* mask, _LENR_LOCK (which is defined in <milock.h> as hex 08 - bit   */
 /* pattern 0000 1000).                                                */
 /*--------------------------------------------------------------------*/

   allocated_locks.Template_Size = sizeof( _MOBJL_Template_T );

   matobjlk( &allocated_locks, some_byte );


   if ( allocated_locks.Lock_Alloc  &   _LENR_LOCK ) {

       printf("There is an Exclusive-No-Read lock on the space  \n");
       printf("location with address: %p \n\n", some_byte  );
   }
   else
       printf("Error.  The LENR lock request was not satisifed. \n");
}
```

Output

```
There is an Exclusive-No-Read lock on the space
location with address: SPP:0401MYLIB :0a02MYUSRQ :0:0:e28
```

Lock Space Location with Time-Out (LOCKSL2)

Format

```
#include <QSYSINC/MIH/LOCKSL2>

void locksl2 (_SPCPTR location,
              _MI_Time wait_time,
              char lock_state);
```

Description

The locksl2 function grants the space location to the issuing process according to the lock request.

Parameters

location (input)

Pointer to the space location to be locked.

wait_time (input)

Wait_time value. Specifies the amount of time that the process competes for the requested lock.

lock_state (input)

The lock type request.

Notes on Usage

- The lock request type will be set for the user by default, depending on what is specified as the wait time. The following rule will be used: If *wait_time* = 0, _LOCK_NORMAL will be used as the request type. If *wait_time* > 0, _LOCK_SYNCH will be used as the request type.
- The builtin functions _LOCKSL1 and _LOCKSL2 also provide access to the MI instruction.
- The _LOCKSL2 builtin supports multiple space location lock requests.

Example

This example illustrates the use of the locksl2 function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Locks   <QSYSINC/MIH/LOCKSL>                      */
/*                                                                    */
/* Function:        locksl2   (Lock Space Location with a timeout)    */
/*                                                                    */
/* Description:     Place an Exclusive-Allow-Read (LEAR) on a specific */
/*                  byte (space location) of some object (a user      */
/*                  queue in this example).  'locksl2' is similar to  */
/*                  'locksl' except that it allows you to specify a   */
/*                  timeout value instead of using the default process */
/*                  timeout value.                                    */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/LOCKSL>
#include <QSYSINC/MIH/RSLVSP>
#include <QSYSINC/MIH/SETSPPFP>
#include <QSYSINC/MIH/MATOBJLK>
#include <stdio.h>

                                        /* The receiver template used  */
_MOBJL_Template_T  allocated_locks;     /* by 'matobjlk'.              */

                                        /* The object from which some  */
_SYSPTR            some_object;         /* byte (space) location will  */
                                        /* locked.                     */

_SPCPTR            some_byte;           /* The pointer to the location */
                                        /* that is being locked.       */

_MI_Time           timeout;             /* Amount of time to wait for  */
                                        /* the lock to be placed.      */

int                hours       =  0,    /* Time components used to     */
                   minutes     =  0,    /* create an _MI_Time value    */
                   seconds     = 10,    /* that can be passed to the   */
                   hundredths  =  0;    /* 'lock' function.            */

int main(void) {

                                        /* Get a pointer to the object */
   some_object = rslvsp( _Usrq, "MYUSRQ", "MYLIB", _AUTH_ALL );


                                        /* Set a space pointer from    */
                                        /* the system pointer.         */
   some_byte = setsppfp( some_object );
```

```
 /*--------------------------------------------------------------------*/
 /* Format an 'mitime' value to represent the timeout to be used by    */
 /* the 'lock' function when trying to obtain an Exclusive-Allow-Read  */
 /* (LEAR) lock on the object. If the lock request cannot be satisfied */
 /* in the specified amount of time, then an exception will be raised. */
 /* The CL DSPJOB command is called to display all of the object locks */
 /* owned by the job/process that runs this program.                   */
 /*--------------------------------------------------------------------*/

   mitime( &timeout, hours, minutes, seconds, hundredths );

   locksl2( some_byte, timeout, _LEAR_LOCK );


 /*--------------------------------------------------------------------*/
 /* In order to verify that the LEAR lock was placed on the space      */
 /* location (byte), we can look at the bit pattern returned by        */
 /* 'matobjlk' in the 'Lock_Alloc' field of the template. The fourth   */
 /* bit (bit 3) of this field represents the Lock-Exclusive-Allow-Read */
 /* (LEAR) lock.  By using the bitwise AND (&) operator, we can        */
 /* determine if the bit is set by ANDing it with the provided bit     */
 /* mask, _LEAR_LOCK (which is defined in <milock.h> as hex 10 - bit   */
 /* pattern 0001 0000).                                                */
 /*--------------------------------------------------------------------*/


   allocated_locks.Template_Size = sizeof( _MOBJL_Template_T );

   matobjlk( &allocated_locks, some_byte );


   if ( allocated_locks.Lock_Alloc  &   _LEAR_LOCK ) {

       printf("There is an Exclusive-Allow-Read lock on the space  \n");
       printf("location with address: %p \n\n", some_byte  );
   }
   else
       printf("Error.  The LEAR lock request was not satisifed. \n");
}
```

Output

```
There is an Exclusive-Allow-Read lock on the space
location with address: SPP:0401MYLIB :0a02MYUSRQ :0:0:eda
```

Materialize Activation Attribute (MATACTAT)

Format

```
#include <QSYSINC/MIH/MATACTAT>

void matactat (_MTACT_Template_T *receiver
               unsigned int act_mark,
               char attr_selection);
```

Description

The matactat function materializes the information for the program activation into the receiver template.

Parameters

receiver (input/output)

Pointer to the receiver template.

act_mark (input)

The activation mark of the activation whose attributes are to be materialized. A value of zero indicates a request for information about the activation of the invoking program.

attr_selection (input)

Identifies the information to be materialized.

Notes on Usage

- The builtin function _MATACTAT also provides access to the MI instruction.

Example

This example illustrates the use of the matactat function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Program Execution     <QSYSINC/MIH/MATACTAT>      */
/*                                                                    */
/* Function:        matactat  (Materialize Activation Attributes)     */
/*                                                                    */
/* Description:     This example uses 'matactat' to materialize       */
/*                  the program model of the caller to main().        */
/*                  Please note: the invocations for the ILE program  */
/*                  entry procedure and for the matinvat library      */
/*                  function, must be taken into account when         */
/*                  calculating the relative invocation offset.       */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <stdio.h>
#include <string.h>
#include <stdlib.h>
#include <QSYSINC/MIH/MATACTAT>
#include <QSYSINC/MIH/MATINVAT>

#define  MY_CALLER  -3   /* -2 = _C_PEP  (program entry procedure) */
                         /* -1 = main()                            */
                         /*  0 = matinvat library function         */

int main(void) {

  unsigned             act_mark;
  _INV_Template_T      inv_t;
  _MTACT_Template_T    mtact_t;

  memset(&inv_t, 0, sizeof(_INV_Template_T));

  inv_t.Inv_Offset = MY_CALLER;  /* caller's invocation  */

  /* Materialize the activation mark of our caller       */
  matinvat(&act_mark, &inv_t, _MTVA_ACT_MARK, sizeof(act_mark));

  mtact_t.Template_Size = sizeof(_MTACT_Template_T);
  matactat(&mtact_t, act_mark, _MTACT_BASIC_ACT_ATTR);

  /* Program Models: OPM = 0x00, ILE = 0x01              */
  printf("The program model of our caller is %x\n",
          mtact_t.Data.Basic_Attr.Program_Model);
}
```

Output

```
The program model of our caller is 1
```

Materialize Access Group Attributes (MATAGAT)

Format

```
#include <QSYSINC/MIH/MATAGAT>

void matagat (_MAGAT_Template_T *receiver,
              _SYSPTR access_group);
```

Description

The matagat function materializes the attributes of the access group and the identification of objects currently contained in the access group.

Parameters

receiver (input/output)

Pointer to the receiver template.

access_group (input)

Pointer to the access group whose attributes are to be materialized.

Notes on Usage

- The builtin function _MATAGAT also provides access to the MI instruction.

Example

This example illustrates the use of the matagat function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Resource Management Data(RMD) <QSYSINC/MIH/MATAGAT>*/
/*                                                                    */
/* Function:        matagat     (Materialize Access Group Attributes)  */
/*                                                                    */
/* Description:     This example uses 'matagat' to materialize all     */
/*                  of the objects that are part of an Access Group.   */
/*                  Since the Process Access Group (PAG) is a readily  */
/*                  available Access Group (using 'matpratr'), it      */
/*                  will be used as the Access Group of which the      */
/*                  attributes will be materialized.                   */
/*                                                                    */
/*                  Access Groups should not be confused with          */
/*                  Activation Groups.                                 */
/*                                                                    */
/* Note:            This example will only work on a system running    */
/*                  with security level 30 or lower since it attempts  */
/*                  to materialize the PAG.                            */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/MATAGAT>
#include <QSYSINC/MIH/MATPRATR>
#include <stdio.h>
#include <stdlib.h>

                                       /* Receiver template that will*/
_MPRT_Template_T     process_attributes; /* contain a pointer to the   */
                                       /* Process Access Group (PAG).*/

                                       /* Pointer to the receiver    */
                                       /* template for 'matagat'.    */
_MAGAT_Template_T   *access_group_attributes;


                                       /* Pointer to an access group */
_SYSPTR              access_group_ptr;  /* (specifically the PAG in   */
                                       /* this example).             */

                                       /* Pointer used to loop       */
_SYSPTR             *object_pointer;    /* through each system pointer*/
                                       /* returned by 'matagat'.     */

int                  object_count,      /* The number of objects in   */
                                       /* the access group.          */

                                       /* Loop counter for displaying*/
                     object,           /* each object pointer in the */
                                       /* Access Group.              */

                     new_size;         /* Number of bytes required   */
                                       /* to hold all information    */
                                       /* returned by 'matagat'.     */
int main(void) {
```

```
/*--------------------------------------------------------------------*/
/* We need to get a pointer to an access group, so 'matpratr'         */
/* (Materialize Process Attributes) is used to get a pointer to       */
/* the Process Access Group (PAG), which is just a special kind of    */
/* access group.                                                      */
/*--------------------------------------------------------------------*/

  process_attributes.Ptr_Attr3.Template_Size = sizeof( _MPRT_PTR_T );

  matpratr( &process_attributes, NULL, _MPRT_PAG );

  access_group_ptr = process_attributes.Ptr_Attr3.Mptr_Ptr;

/*--------------------------------------------------------------------*/
/* Call 'matagat' first just to find out how many objects there are   */
/* in this access group so that we can evaluate the amount of space   */
/* required to accommodate information on each of the objects that    */
/* are part of this access group.  The amount of storage required     */
/* for the complete fixed-portion of the template will be the exact   */
/* size of the template.                                              */
/*--------------------------------------------------------------------*/

  access_group_attributes =
          (_MAGAT_Template_T *) malloc( sizeof( _MAGAT_Template_T ) );

  access_group_attributes->Template_Size =  sizeof(_MAGAT_Template_T);

  matagat( access_group_attributes,  access_group_ptr );


                                    /* output some of the attributes */

  printf("Characteristics of this access group: \n\n" );

  printf("Object Name:                              %30s  \n",
                 access_group_attributes->Object_ID.Name );

  printf("Type and Subtype:                         %10.4X \n",
                 access_group_attributes->Object_ID.Type_Subtype );

  printf("Access Group Size:                        %10d \n",
                 access_group_attributes->Group_Size );

  printf("Available space in the access group:    %10d \n",
                 access_group_attributes->Group_Space );

  printf("Number of objects in the access group:  %4d \n",
                 access_group_attributes->Object_Count );

  printf("\n\n");
```

```
 /*--------------------------------------------------------------------*/
 /* Now that we know exactly how many objects there are, we can        */
 /* determine the amount of space needed to receive all of the         */
 /* information 'matagat' can provide.  The additional space required  */
 /* has to accommodate one system pointer for each object in the       */
 /* access group.                                                      */
 /*--------------------------------------------------------------------*/

  object_count  =  access_group_attributes->Object_Count;

  new_size = sizeof( _MAGAT_Template_T ) +
           ( object_count * sizeof( _SYSPTR ) );

  access_group_attributes = (_MAGAT_Template_T *)
                            realloc( access_group_attributes, new_size);

  access_group_attributes->Template_Size =  new_size;


  matagat( access_group_attributes,  access_group_ptr );


  printf("The following are the pointers to the objects that make up\n");
  printf("the Process Access Group (PAG) for this job. \n\n");

  object_pointer = &(access_group_attributes->Object_Ptr);

  for ( object=0;  object < object_count;  object++, object_pointer++ ) {

    printf("System pointer to object %3d is:  %p \n",  object+1,
            object_pointer );
  }
}
```

Output

```
Characteristics of this access group:
Object Name:                              PAG
Type and Subtype:                           01EF
Access Group Size:                       3342336
Available space in the access group:     1072128
Number of objects in the access group:   9
The following are the pointers to the objects that make up
the Process Access Group (PAG) for this job.
System pointer to object   1 is:  SPP:0000 :1aefQPADEV0025VISCA     003997 :17bd
System pointer to object   2 is:  SPP:0000 :1aefQPADEV0025VISCA     003997 :17be
System pointer to object   3 is:  SPP:0000 :1aefQPADEV0025VISCA     003997 :17bf
System pointer to object   4 is:  SPP:0000 :1aefQPADEV0025VISCA     003997 :17c0
System pointer to object   5 is:  SPP:0000 :1aefQPADEV0025VISCA     003997 :17c1
System pointer to object   6 is:  SPP:0000 :1aefQPADEV0025VISCA     003997 :17c2
System pointer to object   7 is:  SPP:0000 :1aefQPADEV0025VISCA     003997 :17c3
System pointer to object   8 is:  SPP:0000 :1aefQPADEV0025VISCA     003997 :17c4
System pointer to object   9 is:  SPP:0000 :1aefQPADEV0025VISCA     003997 :17c5
```

Materialize Activation Group Attributes (MATAGPAT)

Format

```
#include <QSYSINC/MIH/MATAGPAT>

void matagpat (_MAGP_Template_T *receiver,
               unsigned int act_grp_mark,
               char attr_selection);
```

Description

The matagpat function materializes the attributes for the specified activation group into the receiver template.

Parameters

receiver (input/output)

Pointer to the receiver template.

act_grp_mark (input)

The activation group mark of the activation group whose attributes are to be materialized. An activation group mark of zero will materialize the attributes of the activation group associated with the current invocation.

attr_selection (input)

Specifies the information to be materialized.

Notes on Usage

- The builtin function _MATAGPAT also provides access to the MI instruction.

Example

This example illustrates the use of the matagpat function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Program Execution     <QSYSINC/MIH/MATAGPAT>      */
/*                                                                    */
/* Function:        matagpat    (Materialize Activation Group         */
/*                               Attributes)                          */
/*                                                                    */
/* Description:     This example uses 'matagpat' to materialize the   */
/*                  name of the root program for the first            */
/*                  activation group in the list of activation        */
/*                  groups for the process.                           */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <stdio.h>
#include <stdlib.h>
#include <QSYSINC/MIH/MATAGPAT>
#include <QSYSINC/MIH/MATPRAGP>
#include <QSYSINC/MIH/MATPTR>


int main(void) {

  _MPTR_Template_T  mpt;
  _MPRAG_Template_T         *mprgp;
  int                       num_AGs;
  unsigned                  AG_mark;
  int                       mpragp_req_size;
  _MAGP_Template_T          magp;
  char                      attr;

  /* Use matpragp to obtain list of AG marks within the process */
  mprgp = (_MPRAG_Template_T *)malloc(sizeof(_MPRAG_Template_T));
  mprgp->Template_Size = sizeof(_MPRAG_Template_T);
  matpragp(mprgp);
  num_AGs = mprgp->Act_Grp_Count;
  mpragp_req_size = sizeof(_MPRAG_Template_T) + ((num_AGs - 1)*
                        sizeof(unsigned));
  mprgp = (_MPRAG_Template_T *)malloc(mpragp_req_size);
  mprgp->Template_Size = mpragp_req_size;
  matpragp(mprgp);
  AG_mark = mprgp->Act_Grp_List[0];

  /* Materialize the program pointer to the root program of the */
  /* first AG in the list.                                      */
  magp.Template_Size = sizeof(_MAGP_Template_T);
  matagpat(&magp, AG_mark, _MAGP_BASIC_AG_ATTR);

  /* Materialize the program name                               */
  mpt.Obj_Ptr.Template_Size = sizeof(_OBJPTR_T);
  matptr(&mpt, magp.Data.Basic_Attr.Program);

  printf("The root program of AG %u is %.10s\n", AG_mark,
          mpt.Obj_Ptr.Object_ID.Name);
```

```
}
```

Output

```
The root program of AG 74499 is MATAGPAT
```

Materialize Allocated Object Locks (MATAOL)

Format

```
#include <QSYSINC/MIH/MATAOL>

void matael (_MAOL_Template_T *receiver,
             _ANYPTR pointer);
```

Description

The mataol function materializes the current allocated locks on a designated system object or space location.

Parameters

receiver (input/output)

Pointer to the receiver template where the materialized locks will be returned.

pointer (input)

Pointer to the system object or space location whose allocated locks are to be materialized. The argument must be a system pointer or a space pointer.

Notes on Usage

- The builtin function _MATAOL also provides access to the MI instruction.

Example

This example illustrates the use of the mataol function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Locks   <QSYSINC/MIH/MATAOL>                      */
/*                                                                    */
/* Function:        mataol  (Materialize Allocated Locks)             */
/*                                                                    */
/* Description:     Use the CL ALCOBJ (Allocate Object) command to    */
/*                  place a lock on some object and then use 'mataol' */
/*                  to confirm the lock worked.                       */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/MATAOL>
#include <QSYSINC/MIH/RSLVSP>
#include <stdio.h>
#include <stdlib.h>

                                       /* The receiver template for   */
_MAOL_Template_T     allocated_locks;  /* 'mataol'.                   */

_SYSPTR              some_object;      /* The object being locked.    */

int main(void) {

                                       /* Get a pointer to the object. */
 some_object = rslvsp( _Usrq, "MYUSRQ", "MYLIB", _AUTH_ALL );
```

```
/*--------------------------------------------------------------------*/
/* Use the CL ALCOBJ command to place a lock on the user queue (this  */
/* could also be done with the 'lock' function).  'mataol' is then    */
/* used to materialize all of the object locks held for the queue.    */
/*--------------------------------------------------------------------*/

  system( "ALCOBJ OBJ((MYLIB/MYUSRQ *USRQ *EXCL)) ");


  allocated_locks.Template_Size = sizeof( _MAOL_Template_T );

  mataol( &allocated_locks, some_object );


/*--------------------------------------------------------------------*/
/* In order to verify that the Exclusive lock was placed on the       */
/* object, we can look at the bit pattern returned by 'mataol'.       */
/* The bit pattern in the first byte (0th element of the array)       */
/* of 'Lock_Status' represents "Current Cumulative Locks" and         */
/* the fifth bit (bit 4) of this field represents the                 */
/* Lock-Exclusive-No-Read (LENR) lock.  By using the bitwise AND      */
/* operator, we can determine if the bit is set by ANDing it with     */
/* provided bit mask, _LENR_LOCK (which is defined in <milock.h> as   */
/* hex 08 - bit pattern of 0000 1000).                                */
/*--------------------------------------------------------------------*/

if ( allocated_locks.Lock_Status[ 0 ] & _LENR_LOCK ) {

    printf("There is an Exclusive-No-Read lock on the object.\n");
}
else
    printf("Error.  An Exclusive-No-Read lock is not held on the object.\n");

}
```

Output

```
There is an Exclusive-No-Read lock on the object.
```

Materialize Invocation Attributes (MATINVAT)

Format

```
#include <QSYSINC/MIH/MATINVAT>

void matinvat (_SPCPTR receiver,
               _INV_Template_T *inv_t,
               int attr_id,
               int rcvr_length);
```

Description

The matinvat function materializes the attributes of the invocation into the receiver template. The attributes materialized and the source invocation are specified through *attr_id* and *inv_t*, respectively.

Parameters

receiver (output)

Pointer to the location to receive the materialized attribute.

inv_t (input)

Pointer to the invocation identification template or NULL. Specifying NULL indicates that the current identification template invocation is to be used for the source and originating invocations.

attr_id (input)

The attribute identifier. Indicates which attribute of the source invocation is to be materialized.

rcvr_length (input)

The length of the receiver.

Notes on Usage

- May be used to materialize a single attribute only.
- The builtin functions _MATINVAT1 and _MATINVAT2 also provide access to the MI instruction. Use the builtin form to materialize more than 1 attribute.

Example

This example illustrates the use of the matinvat function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Machine Observation   <QSYSINC/MIH/MATINVAT>      */
/*                                                                    */
/* Function:        matinvat   (Materialize Invocation Attributes)    */
/*                                                                    */
/* Description:     This example uses 'matinvat' to materialize the   */
/*                  invocation type of the nearest OPM program in     */
/*                  the call stack. Please Note: the 'fndrinvn' and   */
/*                  'matinvat' functions themselves have entries on   */
/*                  the call stack. This must be taken into account   */
/*                  when calculating relative invocation offsets.     */
/*                  This is not necessary if the builtin forms -      */
/*                  _MATINVAT1 or _MATINVAT2 and _FNDRINVN1 or        */
/*                  _FNDRINVN2 are used.                              */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/MATINVAT>
#include <QSYSINC/MIH/FNDRINVN>
#include <string.h>
#include <stdio.h>

char              srch_arg = _OPM_PROGRAM, inv_type;
int               rel_off;
_INV_Template_T   inv_t;

int main(void) {

   /* Find relative offset of first OPM program invocation in stack */
   rel_off = fndrinvn(NULL, _FNDR_RTN_TYPE, &srch_arg, _FNDR_MATCH);

   memset(&inv_t, 0, sizeof(_INV_Template_T));

   inv_t.Inv_Offset = rel_off;  /* previous invocation  */

   /* What is the invocation type of this OPM program?  */
   matinvat(&inv_type, &inv_t, _MTVA_INV_TYPE, sizeof(inv_type));

   switch(inv_type)
   {
      case _CALLX:
         printf("The nearest OPM program is a CALLX\n");
         break;
      case _XCTL:
         printf("The nearest OPM program is a XCTL\n");
         break;
      case _EVENT_HDLR:
         printf("The nearest OPM program is an event handler\n");
         break;
      case _OPM_CALLX_HDLR:
         printf("The nearest OPM program is a external exception handler\n");
         break;
      case _PROCESS_PROB_STATE:
         printf("The nearest OPM program is an IP in problem state\n");
```

```
            break;
         case _PROCESS_INIT_STATE:
            printf("The nearest OPM program is an IP in init state\n");
            break;
         case _PROCESS_TERM_STATE:
            printf("The nearest OPM program is an IP in term state\n");
            break;
         case _OPM_INV_EXIT:
            printf("The nearest OPM program is an invocation exit\n");
            break;
         case _RETURN:
            printf("The nearest OPM program is a return/XCTL trap handler\n");
            break;
         case _CALLPGM:
            printf("The nearest OPM program is a CALLPGM\n");
            break;
         default:
            printf("invalid type\n");
            break;
      }
}
```

Output

```
The nearest OPM program is a XCTL
```

Materialize Independent Index Entries (MATINXAT)

Format

```
#include <QSYSINC/MIH/MATINXAT>

void matinxat (_IIX_Template_T *receiver,
               _SYSPTR index_obj);
```

Description

The matinxat function materializes the creation attributes and current operational statistics of the independent index.

Parameters

receiver (input/output)

Pointer to the receiver template

index_obj (input)

Pointer to the independent index whose attributes are to be materialized.

Notes on Usage

- The builtin function _MATINXAT also provides access to the MI instruction.

Example

This example illustrates the use of the matinxat function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   User Indexes   <QSYSINC/MIH/MATINXAT>             */
/*                                                                    */
/* Function:        matinxat   (Materialize Index Attributes)         */
/*                                                                    */
/* Description:     Materialize information about the user index.     */
/*                  The number of "inserts" made and the number of    */
/*                  "finds" done will be displayed to the screen.     */
/*                                                                    */
/*                  If entries have been inserted, removed, or search */
/*                  for, then the numbers reported by this program    */
/*                  will be nonzero.                                 */
/*                                                                    */
/*--------------------------------------------------------------------*/
#include <QSYSINC/MIH/MATINXAT>
#include <QSYSINC/MIH/RSLVSP>
#include <stdio.h>

                                      /* The receiver template for    */
_IIX_Template_T     index_attributes;  /* 'matinxat'.                  */

_SYSPTR             index_ptr;         /* Pointer to the user index.   */


int main(void) {
                                      /* Get a pointer to the *USRIDX */
   index_ptr = rslvsp( _Usridx, "MYUSRIDX", "MYLIB", _AUTH_ALL );
```

```
 /*--------------------------------------------------------------------*/
 /* Materialize the attributes of the user index into the receiver     */
 /* template and output the number of entries inserted, removed and    */
 /* searched for, as well as the number currently in the user index.   */
 /*--------------------------------------------------------------------*/

   index_attributes.Template_Size = sizeof( _IIX_Template_T );

   matinxat( &index_attributes, index_ptr );


   printf("Number of entries inserted:                %d \n",
           index_attributes.Count_Insert );

   printf("Number of entries removed:                 %d \n",
           index_attributes.Count_Remove );

   printf("Number of entries currently in the index:  %d \n",
           index_attributes.Count_Insert
         - index_attributes.Count_Remove   );

   printf("Number of find requests:                   %d \n",
           index_attributes.Count_Find   );

}
```

Output

```
Number of entries inserted:                4
Number of entries removed:                 1
Number of entries currently in the index:  3
Number of find requests:                   1
```

Materialize Machine Attributes (MATMATR)

Format

```
#include <QSYSINC/MIH/MATMATR>

void matmatr (_MMTR_Template_T *receiver,
              short attr);
```

Description

The matmatr function makes available the unique values of machine attributes. Through the attribute selection value, up to 22 different machine attributes may be selected for materialization.

Parameters

receiver (input/output)

Pointer to the materialization template.

attr (input)

The attribute selection value. This argument identifies which group of machine attributes are to be materialized.

Notes on Usage

- The builtin function _MATMATR1 also provides access to the MI instruction.

Example

This example illustrates the use of the matmatr function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Machine Interface   <QSYSINC/MIH/MATMATR>         */
/*                                                                    */
/* Function:        matmatr  (Materialize Machine Attributes)         */
/*                                                                    */
/* Description:     Use the 'matmatr' MI function to get back the     */
/*                  CPU Serial Number of the AS/400 on which this     */
/*                  program is run.                                   */
/*                                                                    */
/*--------------------------------------------------------------------*/
#include <QSYSINC/MIH/MATMATR>
#include <stdio.h>
                                       /* The receiver template for    */
                                       /* 'matmatr'.                   */
_MMTR_Template_T    machine_attributes;


int main(void) {

 /*--------------------------------------------------------------------*/
 /* The CPU serial number is in the first 16 bytes of the receiver     */
 /* template, so only request that 16 bytes of the template are        */
 /* materialized.  Use the provided flag _MMTR_SERIAL to request the   */
 /* "serial number" materialization option.                            */
 /*--------------------------------------------------------------------*/

   machine_attributes.Options.Template_Size = 16;

   matmatr( &machine_attributes,  _MMTR_SERIAL );


   printf("Serial Number of this AS/400 is: %8.8s \n",
           machine_attributes.Options.Data.Serial );
}
```

Output

```
Serial Number of this AS/400 is:  1015013
```

Materialize Machine Data (MATMDATA)

Format

```
#include <QSYSINC/MIH/MATMDATA>

void matmdata (_MDATA_Template_T *receiver,
               short options);
```

Description

The matmdata function materializes the values of various machine data.

Parameters

receiver (output)

Pointer to the machine data template.

options (input)

The machine data options. This argument determines which machine data are materialized. The option must be a literal.

Notes on Usage

- The builtin function _MATMDATA also provides access to the MI instruction.

Example

This example illustrates the use of the matmdata function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Machine Interface   <QSYSINC/MIH/MATMDATA>        */
/*                                                                    */
/* Function:        matmdata   (Materialize Machine Data)             */
/*                                                                    */
/* Description:     'matmdata' can be used to determine whether extra  */
/*                  checking is done when parameters are passed from   */
/*                  program to program.  This extra checking is done   */
/*                  when the system is running with Security Level 50  */
/*                  (C2 Department of Defense Security).              */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/MATMDATA>
#include <stdio.h>
                                       /* The receiver template for    */
_MDATA_Template_T   machine_data;      /* 'matmdata'.                  */

int main(void) {

 /* Materialize only the integrity flag bit setting and store the      */
 /* result in the machine data receiver template.                      */

   matmdata( &machine_data, _MDATA_INTEGRITY_FLAG );


 /* Output whether the flag is on or off.                            */

   printf("The system Parameter Integrity Validation flag is %s \n",
           machine_data.Integ_Flag ?   "On"  :  "Off"  );

}
```

Output

```
The system Parameter Integrity Validation flag is Off
```

Materialize Object Locks (MATOBJLK)

Format

```
#include <QSYSINC/MIH/MATOBJLK>

void matobjlk (_MOBJL_Template_T *receiver,
               _ANYPTR object);
```

Description

The matobjlk function materializes the current lock status of the designated system object or space location.

Parameters

receiver (input/output)

Pointer to the receiver template where the materialized lock status will be returned.

object (input)

Pointer to the system object or space location whose lock status is to be materialized. The argument must be a system pointer or a space pointer.

Notes on Usage

- The builtin function _MATOBJLK also provides access to the MI instruction.

Example

This example illustrates the use of the matobjlk function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Locks   <QSYSINC/MIH/MATOBJLK>                     */
/*                                                                    */
/* Function:        matobjlk  (Materialize Object Locks)              */
/*                                                                    */
/* Description:     Use the CL ALCOBJ (Allocate Object) command to    */
/*                  place a lock on some object.  Very much like      */
/*                  the 'mataol' example, 'matobjlk' will then be     */
/*                  used to verify the lock.                          */
/*                                                                    */
/*                  'matobjlk' returns a little more information than */
/*                  'mataol' in that you can find out whether other   */
/*                  jobs/tasks are waiting synchronously or           */
/*                  asynchronous for the lock.                        */
/*                                                                    */
/*--------------------------------------------------------------------*/
#include <QSYSINC/MIH/MATOBJLK>
#include <QSYSINC/MIH/RSLVSP>
#include <stdio.h>
#include <stdlib.h>


                                     /* The receiver template for     */
_MOBJL_Template_T    allocated_locks;  /* 'matobjlk'.                   */

_SYSPTR              some_object;      /* The object being locked.      */
```

```
int main(void) {
                                        /* Get a pointer to the object. */
 some_object = rslvsp( _Usrq, "MYUSRQ", "MYLIB", _AUTH_ALL );

 /*--------------------------------------------------------------------*/
 /* Use the CL ALCOBJ command to place a lock on the user queue (this  */
 /* could also be done with the 'lock' function).  'matobjlk' is then  */
 /* used to materialize all of the object locks held for the queue.    */
 /*--------------------------------------------------------------------*/

   system( "ALCOBJ OBJ((MYLIB/MYUSRQ *USRQ *EXCL)) ");

   allocated_locks.Template_Size = sizeof( _MOBJL_Template_T );

   matobjlk( &allocated_locks, some_object );

 /*--------------------------------------------------------------------*/
 /* In order to verify that the Exclusive lock was placed on the       */
 /* object, we can look at the bit pattern returned by 'matobjlk' in   */
 /* the 'Lock_Alloc' field of the template. The fifth bit (bit 4) of   */
 /* this field represents the Lock-Exclusive-No-Read (LENR) lock.  By  */
 /* using the bitwise AND (&) operator, we can determine if the bit is */
 /* set by ANDing it with the provided bit mask, _LENR_LOCK (which     */
 /* is defined in <milock.h> as hex 08 - bit pattern 0000 1000).       */
 /*--------------------------------------------------------------------*/

 if ( allocated_locks.Lock_Alloc & _LENR_LOCK ) {

     printf("There is an Exclusive-No-Read lock on the object \n");
 }
 else
     printf("Error.  An Exclusive-No-Read lock is not held on the object.\n");

}
```

Output

```
There is an Exclusive-No-Read lock on the object.
```

Materialize Program (MATPG)

Format

```
#include <QSYSINC/MIH/MATPG>

void matpg (_MATPG_Template_T *receiver,
            _SYSPTR program);
```

Description

The matpg function materializes the program into the receiver template. The values in the materialization relate to the current attributes of the program. Components of the program template, other than the control information component, may not be available for materialization because they were removed with the deletion of observability or were absent when the program was created.

Parameters

receiver (input/output)

Pointer to the receiver template.

program (input)

Pointer to the program object to be materialized.

Notes on Usage

- The matpg function can only be used with OPM programs.
- The builtin function _MATPG also provides access to the MI instruction.

Example

This example illustrates the use of the matpg function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Program Management    <QSYSINC/MIH/MATPG>         */
/*                                                                    */
/* Function:        matpg    (Materialize Program)                    */
/*                                                                    */
/* Description:     This example uses 'matpg' to materialize the      */
/*                  language version/release level of an OPM program. */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <stdio.h>
#include <QSYSINC/MIH/MATPG>
#include <QSYSINC/MIH/RSLVSP>
#include <string.h>
#include <stdlib.h>

int main(void) {

  _SYSPTR            pgm_ptr;
  _MATPG_Template_T  mpg_t;

  memset(&mpg_t, 0, sizeof(_MATPG_Template_T));

  /* Create an OPM program to pass to matpg */
  system("CRTCLPGM QTEMP/T1520CL1 QCLE/QACLSRC");

  pgm_ptr = rslvsp(_Program,  "T1520CL1", "QTEMP", _AUTH_ALL);

  mpg_t.Template_Size = sizeof(_MATPG_Template_T);
  matpg(&mpg_t, pgm_ptr);

  printf("The program was created for version/release: %x\n",
          mpg_t.Lang_Version);
}
```

Output

```
The program was created for version/release: 370
```

Materialize Pointer (MATPTR)

Format

```
#include <QSYSINC/MIH/MATPTR>

void matptr (_MPTR_Template_T *receiver,
             _ANYPTR pointer);
```

Description

The matptr function returns the materialized form of *pointer* in the receiver template.

Parameters

receiver (input/output)

Pointer to the receiver template.

pointer (input)

The pointer to materialize. May be any one of the ILE pointer types: system pointer, space pointer, invocation pointer, procedure pointer, label pointer, or suspend pointer.

Notes on Usage

- The builtin function _MATPTR also provides access to the MI instruction.
- Constants for pointer types are defined in <milib.h>.

Example

This example illustrates the use of the matptr function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Machine Observation   <QSYSINC/MIH/MATPTR>        */
/*                                                                    */
/* Function:        matptr   (Materialize Pointer)                    */
/*                                                                    */
/* Description:     This example uses 'matptr' to materialize a       */
/*                  program pointer.                                  */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/MATPTR>
#include <QSYSINC/MIH/RSLVSP>
#include <stdio.h>

int main(void) {

  _SYSPTR           lib_ptr;
  _MPTR_Template_T  mpt;

  /* Resolve to program MYPGM in the current library list */

  lib_ptr = rslvsp(_Program,  "MYPGM", "*LIBL", _AUTH_OBJ_MGMT);

  /* Materialize the program pointer                      */

  mpt.Obj_Ptr.Template_Size = sizeof(_OBJPTR_T);
  matptr(&mpt, lib_ptr);

  printf("Object name : %.10s\n", mpt.Obj_Ptr.Object_ID.Name);
  printf("Library     : %.10s\n", mpt.Obj_Ptr.Library_ID.Name);
  printf("Type        : %x\n", mpt.Obj_Ptr.Ptr_Type);
  printf("Authority   : %u\n",
          mpt.Obj_Ptr.Auth_Or_Off.Ptr_Authorization);
}
```

Output

```
Object name : MYPGM
Library     : QTEMP
Type        : 1
Authority   : 0
```

Materialize Pointer Locations (MATPTRL)

Format

```
#include <QSYSINC/MIH/MATPTRL>

void matptrl (_MPTL_Template_T *receiver,
              _SPCPTRCN source,
              int length);
```

Description

The matptrl function finds the pointers in a subset of a space and produces a bit mapping of their relative locations.

The area addressed by the source space pointer is scanned for a length equal to that specified in *length*. A bit in *receiver* is set for each 16 bytes of *source*. A bit in *receiver* is set to binary 1 if a pointer exists in the source space, or the bit is set to binary 0 if no pointer exists in the source space.

Bits are set from left to right (bit0, bit1,...) in *receiver* as the 16-byte areas in *source* are interrogated from left to right.

Parameters

receiver (input/output)
Pointer to the receiver template.

source (input)
Pointer to the source area. The area addressed must be 16-byte aligned.

length (input)
The length of area to scan.

Notes on Usage

- The builtin function _MATPTRL also provides access to the MI instruction.

Example

This example illustrates the use of the matptrl function.

```
/*------------------------------------------------------------------*/
/*                                                                  */
/* Example Group:   Machine Observation   <QSYSINC/MIH/MATPTRL>     */
/*                                                                  */
/* Function:        matptrl  (Materialize Pointer Locations)        */
/*                                                                  */
/* Description:     This example uses 'matptrl' to produce a bit map  */
/*                  of pointer locations in the space.              */
/*                                                                  */
/*------------------------------------------------------------------*/

#include <QSYSINC/MIH/MATPTRL>
#include <QSYSINC/MIH/RSLVSP>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#pragma linkage(PGMA, OS)
void PGMA(void);
void print_bitmap(void);

#define  SIZE 128

_MPTL_Template_T mptl;

int main(void) {
   _SYSPTR          pgm_ptr, qtemp_ptr, spc_ptr;
   _SPCPTR          source;

  /* Allocate initialized storage for source                   */
  source = (_SPCPTR)calloc(SIZE, 1);

  /* Produce a bit map of source before storing pointers.      */
  mptl.Template_Size = sizeof(_MPTL_Template_T);
  matptrl(&mptl, source, SIZE);

  print_bitmap();

  /* Resolve to user space MYSPACE in the current library list */
  spc_ptr = rslvsp(_Usrspc,  "MYSPACE", "*LIBL", _AUTH_NONE);

  /* Store pointers in source at offsets 16, 80 and 112. This  */
  /* will cause bits 1, 5 and 7 (starting with bit 0 on the    */
  /* left) to be set to binary 1 in the resulting bit map.     */

  pgm_ptr   = (_SYSPTR)PGMA;
  qtemp_ptr = _QTEMP_POINTER;

  memcpy(source + 16,  &pgm_ptr,   sizeof(pgm_ptr));
  memcpy(source + 80,  &qtemp_ptr, sizeof(qtemp_ptr));
  memcpy(source + 112, &spc_ptr,   sizeof(spc_ptr));

  /* Produce a bit map of source                               */
  matptrl(&mptl, source, SIZE);
```

```
  print_bitmap();

}
  void print_bitmap(void) {

     unsigned  pos = 7;

     printf("Offset in source (bytes)           Pointer Found\n");
     printf("   0 - 15                             %s\n",
            (mptl.Locations & (1 << pos--)) ? "Yes" : "No");
     printf("  16 - 31                             %s\n",
            (mptl.Locations & (1 << pos--)) ? "Yes" : "No");
     printf("  32 - 47                             %s\n",
            (mptl.Locations & (1 << pos--)) ? "Yes" : "No");
     printf("  48 - 63                             %s\n",
            (mptl.Locations & (1 << pos--)) ? "Yes" : "No");
     printf("  64 - 79                             %s\n",
            (mptl.Locations & (1 << pos--)) ? "Yes" : "No");
     printf("  80 - 95                             %s\n",
            (mptl.Locations & (1 << pos--)) ? "Yes" : "No");
     printf("  96 - 111                            %s\n",
            (mptl.Locations & (1 << pos--)) ? "Yes" : "No");
     printf(" 112 - 127                            %s\n\n",
            (mptl.Locations & (1 << pos--)) ? "Yes" : "No");
}
```

Output

```
Offset in source (bytes)           Pointer Found
   0 - 15                             No
  16 - 31                             No
  32 - 47                             No
  48 - 63                             No
  64 - 79                             No
  80 - 95                             No
  96 - 111                            No
 112 - 127                            No

Offset in source (bytes)           Pointer Found
   0 - 15                             No
  16 - 31                             Yes
  32 - 47                             No
  48 - 63                             No
  64 - 79                             No
  80 - 95                             Yes
  96 - 111                            No
 112 - 127                            Yes
```

Materialize Process Activation Groups (MATPRAGP)

Format

```
#include <QSYSINC/MIH/MATPRAGP>

void matpragp (_MPRAG_Template_T *receiver);
```

Description

The matpragp function provides a list of the activation groups which exist in the current process.

Parameters

receiver (input/output)

Pointer to the receiver template. The materialization template identified by the receiver must be 16-byte aligned in memory.

Notes on Usage

- A macro version is available.
- The builtin function _MATPRAGP also provides access to the MI instruction.

Example

This example illustrates the use of the matpragp function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Process    <QSYSINC/MIH/MATPRAGP>                 */
/*                                                                    */
/* Function:        matpragp  (Materialize Process Activation Groups) */
/*                                                                    */
/* Description:     This function materializes all of the activation  */
/*                  groups associated with the job.  Note 'matpragp'  */
/*                  is called first to find out how many there are so */
/*                  that we can allocate enough space to accommodate  */
/*                  all of the information returned by the second     */
/*                  call to 'matpragp'.                               */
/*                                                                    */
/*--------------------------------------------------------------------*/
#include <QSYSINC/MIH/MATPRAGP>
#include <stdio.h>
#include <stdlib.h>
                                      /* Pointer to the receiver      */
_MPRAG_Template_T   *template;        /* template for 'matpragp'.     */


                                      /* Loop counter for displaying  */
int                  actgrp,          /* each activation group        */
                                      /* number.                      */

                     new_size;        /* Number of bytes required     */
                                      /* to hold all information      */
                                      /* returned by 'matpragp'.      */


int main(void) {

 /*-------------------------------------------------------------------*/
 /* Call 'matpragp' first just to find out how many activation groups */
 /* there are in the job/process that is running this program.        */
 /*-------------------------------------------------------------------*/

  template = (_MPRAG_Template_T *) malloc( sizeof(_MPRAG_Template_T) );

  template->Template_Size = sizeof( _MPRAG_Template_T );

  matpragp( template );

  printf("Number of activation groups associated with this job:  %d \n",
          template->Act_Grp_Count );

 /*-------------------------------------------------------------------*/
 /* Now that we know exactly how many activation groups there are,    */
 /* we can allocate enough space to accommodate the "variable-length" */
 /* portion of the template and then call 'matpragp' again to get all */
 /* of the activation group numbers.  Each activation group number is */
 /* 4-bytes long.                                                     */
 /*-------------------------------------------------------------------*/

  new_size = sizeof(_MPRAG_Template_T) + (template->Act_Grp_Count * 4 );
```

```
 template = (_MPRAG_Template_T *) realloc( template, new_size );

 template->Template_Size = new_size;

 matpragp( template );


/*--------------------------------------------------------------------*/
/* Loop through and output each activation group number in an output  */
/* field of 8 positions.                                              */
/*--------------------------------------------------------------------*/

 for (actgrp=0;  actgrp < template->Act_Grp_Count;  actgrp++ ) {

     printf("%8d \n", template->Act_Grp_List[ actgrp ] );

 }

/*--------------------------------------------------------------------*/
/* You can also see the activation groups by using the CL DSPJOB      */
/* command (but using 'matpragp' is faster).  To call the command     */
/* from this program you would code the following:                    */
/*   system( "DSPJOB OPTION(*ACTGRP)" );                              */
/*--------------------------------------------------------------------*/

}
```

Output

```
Number of activation groups associated with this job:  3
    3977
       2
       1
```

Materialize Process Attributes (MATPRATR)

Format

```
#include <QSYSISNC/MIH/MATPRATR>

void matpratr (_MPRT_Template_T *receiver,
               _SYSPTR control_spc,
               char options);
```

Description

The matpratr function causes either one specific attribute or all the attributes of the designated process to be materialized.

Parameters

receiver (input/output)

Pointer to the receiver template.

control_spc (input)

The process control space pointer or NULL. A value of NULL indicates that the process issuing the instruction is the subject process.

options (input)

The materialization options.

Notes on Usage

- The builtin functions _MATPRATR1 and _MATPRATR2 also provide access to the MI instruction.

Example

This example illustrates the use of the matpratr function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Processes  <QSYSINC/MIH/MATPRATR>                 */
/*                                                                    */
/* Function:        matpratr    (Materialize Process Attributes)      */
/*                                                                    */
/* Description:     This function can return a lot of different       */
/*                  information regarding the job/process in which it */
/*                  is run or for some other process.  This example   */
/*                  shows how to return information on the number     */
/*                  of synchronous read and write operations          */
/*                  performed by the specified job/process.           */
/*                                                                    */
/*--------------------------------------------------------------------*/
#include <QSYSINC/MIH/MATPRATR>
#include <stdio.h>


_MPRT_Template_T process_attributes;   /* The receiver template for    */
                                       /* 'matpratr'.                  */
int main(void) {


 /*--------------------------------------------------------------------*/
 /* Materialize performance information for this job/process (since    */
 /* NULL is used for the second argument of 'matpratr').               */
 /*--------------------------------------------------------------------*/

   process_attributes.Scalar_Attr.Template_Size = sizeof( _MPRT_Template_T );

   matpratr( &process_attributes, NULL, _MPRT_PROC_PERF );


   printf("Currently this process has the following number of  \n");
   printf("Reads and Writes: \n\n" );

   printf("Synchronous Database Reads:                   %d \n",
           process_attributes.Scalar_Attr.Data.Proc_Perf.Num_Read_DB_S );

   printf("Synchronous Non-Database Reads:               %d \n",
           process_attributes.Scalar_Attr.Data.Proc_Perf.Num_Read_NDB_S );

   printf("Total Synchronous Writes (both DB and NDB):   %d \n",
           process_attributes.Scalar_Attr.Data.Proc_Perf.Num_Write_S    );
}
```

Output

```
Currently this process has the following number of
Reads and Writes:

Synchronous Database Reads:                   438
Synchronous Non-Database Reads:               765
Total Synchronous Writes (both DB and NDB):   1203
```

Materialize Process Locks (MATPRLK)

Format

```
#include <QSYSINC/MIH/MATPRLK>

void matprlk (_MPRL_Template_T *receiver,
              _SYSPTR pcs);
```

Description

The matprlk function materializes the lock status of the specified process. This information identifies each object or space location for which the process has a lock allocated or for which the process is in a synchronous or asynchronous wait.

Parameters

receiver (input/output)

Pointer to the receiver template where the materialized lock status will be returned.

pcs (input)

Pointer to the process control space of the process whose lock status is to be materialized or NULL. If NULL is specified, the lock status of the current process is materialized.

Notes on Usage

- The builtin functions _MATPRLK1 and _MATPRLK2 also provide access to the MI instruction.

Example

This example illustrates the use of the matprlk function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Locks   <QSYSINC/MIH/MATPRLK>                     */
/*                                                                    */
/* Function:        matprlk  (Materialize Process Locks)              */
/*                                                                    */
/* Description:     The CL ALCOBJ (Allocate Object) command is used   */
/*                  to place a lock on some object.  Very much like   */
/*                  the 'mataol' and 'matobjlk' examples, we will use */
/*                  'matprlk' to materialize and display the locks.   */
/*                  However, unlike the other two functions, 'matprlk'*/
/*                  provides information about all of the objects     */
/*                  locked by the job/process that runs this program  */
/*                  as opposed to lock information for a particular   */
/*                  object.                                           */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/MATPRLK>
#include <QSYSINC/MIH/RSLVSP>
#include <stdio.h>
#include <stdlib.h>

_MPRL_Template_T  *process_locks;      /* Pointer to receiver template.*/
```

```
int                new_size,           /* Number of bytes needed for   */
                                       /* the fixed and variable parts */
                                       /* of the 'matprlk' template.   */

                   lock_count;         /* Loop counter to loop through */
                                       /* each lock held by the job.   */


int main(void) {

 /*--------------------------------------------------------------------*/
 /* Use the CL ALCOBJ command to place an Exclusive, Allow Read lock   */
 /* on a user queue (we could have used 'lock' to place a LEAR lock on */
 /* the object to accomplish the same thing).                          */
 /*--------------------------------------------------------------------*/

   system( "ALCOBJ OBJ((MYLIB/MYUSRQ *USRQ *EXCLRD)) ");

 /*--------------------------------------------------------------------*/
 /* Have 'matprlk' return only the fixed portion of the template since */
 /* we do not yet know how much space is needed for the variable       */
 /* portion (since it depends on how many locks there are).  Using     */
 /* NULL as the second argument (the Process Control Space) will have  */
 /* 'matprlk' return lock information for the process/job that is      */
 /* running this program.                                              */
 /*--------------------------------------------------------------------*/

   process_locks = (_MPRL_Template_T *) malloc( sizeof(_MPRL_Template_T) );

   process_locks->Template_Size = sizeof( _MPRL_Template_T );

   matprlk( process_locks, NULL );


 /*--------------------------------------------------------------------*/
 /* Use the 'Expanded Number of Entries' field from the template to    */
 /* determine the number of object locks the job is holding.           */
 /*--------------------------------------------------------------------*/

   printf("Number of objects that have locks owned by this job/process:");
   printf("%d \n\n", process_locks->Num_Entry_Exp );

 /*--------------------------------------------------------------------*/
 /* Now that we know exactly how many locks are held by this job, we   */
 /* can allocate enough space to accommodate the variable-length       */
 /* portion of the template and call 'matprlk' again to have it fill   */
 /* in all of the information, including the "lock descriptor"         */
 /* information for each lock.                                         */
 /*--------------------------------------------------------------------*/

   new_size = sizeof(_MPRL_Template_T)   +
            ( process_locks->Num_Entry_Exp * sizeof(_LOCK_Descript_T ) );

   process_locks = (_MPRL_Template_T *) realloc( process_locks, new_size );

   process_locks->Template_Size =  new_size;

   matprlk( process_locks, NULL );
```

```
   printf("This job/process holds locks to the objects pointed to  \n");
   printf("by the following pointers: \n" );

   for ( lock_count = 0;
         lock_count  < process_locks->Num_Entry_Exp;
         lock_count++ )  {

      printf("Object %3d: pointed to by: %p \n",
              lock_count+1, process_locks->Locks [ lock_count ] );
   }
}
```

Output

```
Number of objects that have locks owned by this job/process:    18

This job/process holds locks to the objects pointed to
by the following pointers:
Object   1: pointed to by: SYP:8100 :0401QUSRSYS :0:1247
Object   2: pointed to by: SYP:8100 :0401QSYS2 :0:1247
Object   3: pointed to by: SYP:8100 :0401QHLPSYS :0:1247
Object   4: pointed to by: SYP:8100 :0401QADM :0:1247
Object   5: pointed to by: SYP:8100 :04c1QTEMP     :0:1247
Object   6: pointed to by: SYP:8100 :0401QSYS :0:1247
Object   7: pointed to by: SYP:8100 :0801VISCA :0:1247
Object   8: pointed to by: SYP:8100 :0401QPDA :0:1247
Object   9: pointed to by: SYP:0000 :18a0QJOBMSGQ :0:1247
Object  10: pointed to by: SYP:8100 :1001QPADEV0003 :0:1247
Object  11: pointed to by: SYP:0401QSYS :1916MAIN :0:1247
Object  12: pointed to by: SYP:8100 :0401SALMI :0:1247
Object  13: pointed to by: SYP:0000 :19dfQMH MESSAGE QUEUE LOCK OBJECT :0:1247
Object  14: pointed to by: SYP:0401QSYS :1901QDUI80 :0:1247
Object  15: pointed to by: SYP:8100 :0401QGPL :0:1247
Object  16: pointed to by: SPP:0401MYLIB :0a02MYUSRQ :0:0:1247
Object  17: pointed to by: SYP:0401QSYS :1901QSN80 :0:1247
Object  18: pointed to by: SYP:0401QPDA :1901QDUODSPF :0:1247
```

Materialize Queue Attributes (MATQAT)

Format

```
#include <QSYSINC/MIH/MATQAT>

void matqat (_MQAT_Template_T *receiver,
             _SYSPTR queue);
```

Description

The matqat function materializes the attributes of the specified queue.

Parameters

receiver (input/output)

Pointer to the receiver template.

queue (input)

Pointer to the queue whose attributes are to be materialized.

Notes on Usage

- The builtin function _MATQAT also provides access to the MI instruction.

Example

This example illustrates the use of the matqat function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   User Queues <QSYSINC/MIH/MATQAT>                  */
/*                                                                    */
/* Function:        matqat  (Materialize Queue Attribute)             */
/*                                                                    */
/* Description:     Materialize the "attributes" of the User Queue    */
/*                  into a "template" (structure) and output some of  */
/*                  the returned information to the screen.           */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/MATQAT>
#include <QSYSINC/MIH/RSLVSP>
#include <stdio.h>


_MQAT_Template_T    queue_attributes;   /* The receiver template for   */
                                        /* 'matqat'.                   */

_SYSPTR             queue_ptr;          /* Pointer to the user queue.  */


int main(void) {
                                        /* Get a pointer to the *USRQ. */
  queue_ptr = rslvsp( _Usrq, "MYUSRQ", "MYLIB", _AUTH_ALL );

/*--------------------------------------------------------------------*/
/* Materialize the attributes of the user queue and output some of    */
/* them to the screen.                                                */
/*--------------------------------------------------------------------*/
```

```
  queue_attributes.Template_Size = sizeof( _MQAT_Template_T );

  matqat( &queue_attributes, queue_ptr );


  printf("Number of entries currently on the queue:   %d\n",
          queue_attributes.Num_Msgs );

  printf("Initial number of entries allowed:          %d\n",
          queue_attributes.Max_Msgs );

  printf("Additional number of entries allowed:       %d\n",
          queue_attributes.Extension);

  printf("Maximum size of any particular entry:       %d\n",
          queue_attributes.Max_Size );
}
```

Output

```
Number of entries currently on the queue:   3
Initial number of entries allowed:          10
Additional number of entries allowed:       50
Maximum size of any particular entry:       75
```

Materialize Queue Messages (MATQMSG)

Format

```
#include <QSYSINC/MIH/MATQMSG>

void matqmsg (_MQMS_Template_T *receiver
              _SYSPTR queue,
              char selection,
              int max_key,
              int max_msg,
              _SPCPTR key);
```

Description

The matqmsg function materializes selected messages on a queue. The number of messages materialized and the amount of key and message text materialized for each message are controlled through the function's parameters.

Parameters

receiver (input/output)
Pointer to the receiver template where the materialized message and attributes will be placed. This template must be 16-byte aligned.

queue (input)
Pointer to the queue.

selection (input)
The message selection criteria. Constants for the allowable values are defined in the header file.

max_key (input)
The number of key bytes to materialize. It must be a multiple of 16.

max_msg (input)
The number of message text bytes to materialize. It must be a multiple of 16.

key (input)
Pointer to the message key. This must be a null-terminated string or consist of exactly 256 bytes.

Notes on Usage

- The builtin function _MATQMSG provides access to the MI instruction.

Example

This example illustrates the use of the matqmsg function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   User Queues <QSYSINC/MIH/MATQMSG>                 */
/*                                                                    */
/* Function:        matqmsg  (Materialize Queue Messages)             */
/*                                                                    */
/* Description:     Materialize selected messages from a user queue.  */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/MATQMSG>
#include <QSYSINC/MIH/RSLVSP>
#include <stdio.h>
#include <string.h>
#include <stdlib.h>
#include <stddef.h>
                                       /* The pointer to the receiver */
_MQMS_Template_T *queue_messages;      /* template for 'matqmsg'.     */

char             *this_message_data;   /* Pointer used to loop        */
                                       /* through each message.       */

_SYSPTR           queue_ptr;           /* Pointer to the user queue.  */

                                       /* Loop counter for looping    */
int               message,             /* through each message.       */

                  key_length = 0,      /* Not materializing by key so */
                                       /* set the key length to 0.    */

                                       /* Even though the message size*/
                  message_length = 80, /* is 75, this value must be a */
                                       /* multiple of 16, so use 80.  */

                                       /* Number of bytes needed for  */
                  new_size;            /* both the fixed and variable */
                                       /* portion of the template.    */

char             *key = " ";           /* Not a keyed User Queue so   */
                                       /* this key will not be used.  */

int main(void) {
                                       /* Get a pointer to the *USRQ. */
   queue_ptr = rslvsp( _Usrq, "MYUSRQ", "MYLIB", _AUTH_ALL );

 /*--------------------------------------------------------------------*/
 /* Allocate just enough space for the fixed portion of the receiver   */
 /* template.  Then call 'matqmsg' to fill in the template with        */
 /* information about all of the messages on the queue.                */
 /*--------------------------------------------------------------------*/

   queue_messages = (_MQMS_Template_T *)
                    malloc( sizeof( _MQMS_Template_T )  );

   queue_messages->Template_Size = sizeof( _MQMS_Template_T );
```

```
  matqmsg( queue_messages, queue_ptr, _MQMS_ALL,
           key_length, message_length, key );


  printf("Number of messages materialized:  %d\n",
          queue_messages->Mat_Msgs );

  printf("Number of messages on the queue:  %d\n",
          queue_messages->Num_Msgs );

  printf("Maximum message size:             %d\n",
          queue_messages->Max_Size );


/*--------------------------------------------------------------------*/
/* Now that we know exactly how many messages there are, we can       */
/* allocate enough space to accomodate the variable-length portion    */
/* of the template providing us with information about each message.  */
/* Since this is a "fixed-message-length" user queue, we know the     */
/* size of each "message" will be the fixed size + the number of      */
/* bytes required for the other fields in  _MQMS_Data_T.              */
/*--------------------------------------------------------------------*/


  new_size = sizeof(_MQMS_Template_T)   +
             ( queue_messages->Num_Msgs *
              ( sizeof(_MQMS_Data_T) + queue_messages->Max_Size )
             );


  queue_messages = (_MQMS_Template_T *)
                   realloc( queue_messages, new_size );

  queue_messages->Template_Size = new_size;

  matqmsg( queue_messages, queue_ptr, _MQMS_ALL,
           key_length, message_length, key );


/*--------------------------------------------------------------------*/
/* Output each message that was returned to us in the storage area    */
/* pointed to by 'queue_messages'.  'Message_Data' is the first byte  */
/* of the first message structure (_MQMS_Data_T). 'this_message_data' */
/* pointer will be used to access the actual message in this          */
/* structure.  The pointer is then moved through all of the           */
/* subsequent message data structures to access the queued messages.  */
/* Since the _MQMS_Data_T structure only has one byte for the message */
/* we have to add the length of the message to reset the pointer to   */
/* the next message data structure.  Even though the message length   */
/* is 75 bytes, we have to round up to a 16-byte boundary, so we use  */
/* 80 as the message length.  To get to the next message in the next  */
/* message data structure, we also need to add the offset at which    */
/* the 'Message' member is defined within the _MQMS_Data_T structure. */
/*--------------------------------------------------------------------*/

  this_message_data =  &(queue_messages->Message_Data) +
                       offsetof( _MQMS_Data_T, Message );
```

```
   for ( message=0;   message < queue_messages->Mat_Msgs;  message++ ) {

      printf("Message %3d: %.75s\n", message+1, this_message_data );

      this_message_data +=  80 + offsetof( _MQMS_Data_T, Message );

  }
}
```

Output

```
Number of messages materialized:  2
Number of messages on the queue:  2
Maximum message size:             75
Message   1: This is the first message being entered.
Message   2: This is the second message being entered.
```

Materialize Resource Management Data (MATRMD)

Format

```
#include <QSYSINC/MIH/MATRMD>

void matrmd (_MATRMD_Template_T *receiver,
             _SPCPTR control);
```

Description

The matrmd function materializes the resource management data.

Parameters

receiver (input/output)

Pointer to the receiver template where the resource management data will be materialized.

control (input)

Pointer to the 8-byte character control data. This argument identifies the type of information to be materialized.

Notes on Usage

- A macro version is available.
- The builtin function _MATRMD also provides access to the MI instruction.

Example

This example illustrates the use of the matrmd function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Resource Management Data(RMD) <QSYSINC/MIH/MATRMD> */
/*                                                                    */
/* Function:        matrmd    (Materialize Process RMD )              */
/*                                                                    */
/* Description:     This simple example illustrates the use of        */
/*                  'matrmd' to get the number of Auxillary Storage   */
/*                  Pools (ASPs) and the number of Allocated Auxillary */
/*                  Units attached to the AS/400 on which this program */
/*                  is run.                                           */
/*                                                                    */
/*--------------------------------------------------------------------*/
#include <QSYSINC/MIH/MATRMD>
#include <stdio.h>
#include <stdlib.h>

                                        /* Pointer to the receiver     */
_MATRMD_Template_T   *RMD_template;     /* template for 'matrmd'.      */

                                        /* The control option that tells*/
char                  control[ 8 ];     /* 'matrmd' what information   */
                                        /* should be returned.         */


int main(void) {
```

```
 /*--------------------------------------------------------------------*/
 /* Call 'matrmd' to get the number of Auxillary Storage Pools (ASPs)  */
 /* and the number of allocated auxillary storage units.  This         */
 /* information is contained in the first 32 bytes of the template     */
 /* so there is no need to materialize the whole thing.                */
 /*--------------------------------------------------------------------*/

   control[ 0 ] = _MATRMD_AUX_STORAGE;

   RMD_template = ( _MATRMD_Template_T * ) malloc( 32 );

   RMD_template->Template_Size = 32;

   matrmd( RMD_template, control );


   printf("Number of Auxillary Storage Pools (ASPs):    %3d \n",
           RMD_template->_MATRMD_Data.Aux_Storage.Num_ASP );

   printf("Number of Allocated Auxillary Storage Units: %3d \n",
           RMD_template->_MATRMD_Data.Aux_Storage.Num_Alloc_Aux );
}
```

Output

```
Number of Auxiliary Storage Pools (ASPs):      1
Number of Allocated Auxiliary Storage Units:   8
```

Materialize Space Attributes (MATS)

Format

```
#include <QSYSINC/MIH/MATS>

void mats (_SPC_Template_T *receiver
           _SYSPTR space_object);
```

Description

The mats function materializes the current attributes of the space object into the receiver template.

Parameters

receiver (input/output)

Pointer to the template where the attributes of the space object are materialized.

space_object (input)

Pointer to the space object whose attributes are to be materialized.

Notes on Usage

- The builtin function _MATS also provides access to the MI instruction.

Example

This example illustrates the use of the mats function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Space Management      <QSYSINC/MIH/MATS>          */
/*                                                                    */
/* Function:        mats     (Materialize Space Attributes)           */
/*                                                                    */
/* Description:     This example uses 'mats' to materialize the       */
/*                  size of a space object. (Note that the size is    */
/*                  always at least as large as requested and a power */
/*                  of two.)                                          */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <stdio.h>
#include <QSYSINC/MIH/MATS>
#include <QSYSINC/MIH/RSLVSP>
#include <QSYSINC/H/QUSCRTUS>

#define CREATION_SIZE  65500

int main(void)

{
   _SPC_Template_T space_t;
   _SYSPTR         ptr_to_space;
   int             error_code = 0;

   QUSCRTUS("MYSPACE   QTEMP     ",
            "MYSPACE   ",
            CREATION_SIZE,
            "\0",
            "*ALL      ",
            "MYSPACE example for Programmer's Reference        ",
            "*YES      ",
            &error_code);

   ptr_to_space = rslvsp(_Usrspc, "MYSPACE", "QTEMP", _AUTH_OBJ_MGMT);

   space_t.TmpSize = sizeof(_SPC_Template_T);

   mats(&space_t, ptr_to_space);

   printf("The actual size of MYSPACE is %d bytes\n", space_t.Size);
}
```

Output

```
The actual size of MYSPACE is 65536 bytes
```

Materialize Selected Locks (MATSELLK)

Format

```
#include <QSYSINC/MIH/MATSELLK>

void matsellk (_MSLL_Template_T *receiver,
               _ANYPTR pointer);
```

Description

The matsellk function materializes the locks held by the process issuing this instruction for the object or space location specified.

Parameters

receiver (input/output)

Pointer to the receiver template where the materialized locks will be returned.

pointer (input)

Pointer to the system object or space location whose locks are to be materialized. The argument must be a system pointer or a space pointer.

Notes on Usage

- The builtin function _MATSELLK also provides access to the MI instruction.

Example

This example illustrates the use of the matsellk function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Locks   <QSYSINC/MIH/MATSELLK>                    */
/*                                                                    */
/* Function:        matsellk   (Materialize Selected Locks)           */
/*                                                                    */
/* Description:     Use the CL ALCOBJ (Allocate Object) command to    */
/*                  place a lock on some object.  Very much like      */
/*                  the 'mataol' and 'matobjlk' examples, 'matsellk'  */
/*                  will be used to verify the lock.                  */
/*                                                                    */
/*--------------------------------------------------------------------*/
#include <QSYSINC/MIH/MATSELLK>
#include <QSYSINC/MIH/RSLVSP>
#include <stdio.h>
#include <stdlib.h>

                                       /* The receiver template for    */
_MSLL_Template_T     allocated_locks;  /* 'matsellk'.                  */

_SYSPTR              some_object;      /* The object being locked.     */


int main(void) {
                                       /* Get a pointer to the object. */
 some_object = rslvsp( _Usrq, "MYUSRQ", "MYLIB", _AUTH_ALL );
```

```
/*--------------------------------------------------------------------*/
/* Use the CL ALCOBJ command to place a lock on the user queue (this  */
/* could also be done with the 'lock' function).  'matobjlk' is then  */
/* used to materialize all of the object locks held for the queue.    */
/*--------------------------------------------------------------------*/

  system( "ALCOBJ OBJ((MYLIB/MYUSRQ *USRQ *EXCL)) ");

  allocated_locks.Template_Size = sizeof( _MSLL_Template_T );

  matsellk( &allocated_locks, some_object );


/*--------------------------------------------------------------------*/
/* In order to verify that the Exclusive lock was placed on the       */
/* object, we can look at the bit pattern returned by 'matsellk'.     */
/* The 'Cum_Lock_Status' field in the template is the bit pattern      */
/* that represents the "Current Cumulative Locks" and the fifth bit   */
/* (bit 4) of this field represents the Lock-Exclusive-No-Read (LENR) */
/* lock.  By using the bitwise AND (&) operator, we can determine if  */
/* the bit is set by ANDing it with the provided bit mask, _LENR_LOCK */
/* (which is defined in <milock.h> as hex 08 - bit pattern 0000 1000).*/
/*--------------------------------------------------------------------*/


  if ( allocated_locks.Cum_Lock_Status  & _LENR_LOCK ) {

       printf("There is an Exclusive-No-Read lock on the object \n");
  }
  else
       printf("Error.  An Exclusive-No-Read lock is not held on the object.\n");

}
```

Output

```
There is an Exclusive-No-Read lock on the object.
```

Materialize System Object (MATSOBJ)

Format

```
#include <QSYSINC/MIH/MATSOBJ>

void matsobj (_MSOB_Template_T *receiver,
              _SYSPTR object);
```

Description

The matsobj function materializes the identity and size of a system object.

Parameters

receiver (input/output)

Pointer to the receiver template.

object (input)

Pointer to the system object whose attributes are to be materialized.

Notes on Usage

- The builtin function _MATSOBJ also provides access to the MI instruction.

Example

This example illustrates the use of the matsobj function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Machine Observation   <QSYSINC/MIH/MATSOBJ>       */
/*                                                                    */
/* Function:        matsobj  (Materialize System Object)              */
/*                                                                    */
/* Description:     This example uses 'matsobj' to determine if       */
/*                  program SAMPLE is an ILE program.                 */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/MATSOBJ>
#include <stdio.h>
#include <stdlib.h>

#pragma linkage (SAMPLE, OS)
void SAMPLE(void);

int main(void) {
   _MSOB_Template_T msob_template;

   /* Create an ILE C program called SAMPLE. */
   system("CRTBNDC QTEMP/SAMPLE QCLE/QACSRC");

   msob_template.Template_Size = sizeof(_MSOB_Template_T);
   matsobj(&msob_template, SAMPLE);

   /* Is SAMPLE an ILE program?                              */
   printf("SAMPLE is an %s program\n",
          (msob_template.Pgm_Type ? "ILE" : "OPM"));
}
```

Output

```
SAMPLE is an ILE program
```

Materialize Time-of-Day Clock (MATTOD)

Format

```
#include <QSYSINC/MIH/MATTOD>

void mattod (_MI_Time time_of_day);
```

Description

The mattod function materializes the time of day clock.

Parameters

time_of_day (output)

An 8-byte character array into which the time-of-day clock is materialized.

Notes on Usage

- A macro version is available.
- The builtin function _MATTOD also provides access to the MI instruction.

Example

This example illustrates the use of the mattod function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Machine Interface   <QSYSINC/MIH/MATTOD>          */
/*                                                                    */
/* Function:        mattod   (Materialize Time-Of-Day)                */
/*                                                                    */
/* Description:     Use the 'mattod' MI function to get the current   */
/*                  MI Time-Of-Day (TOD) value.  The function returns */
/*                  an 8-byte value represented by the type _MI_Time  */
/*                  (defined in <milib.h>) which represents a large   */
/*                  "counter" in which bit 41 (starting at offset 0)  */
/*                  is incremented approximately once every           */
/*                  millisecond (1/1000th of a second).  The TOD is   */
/*                  returned by several MI functions and is also used */
/*                  (as input) by other MI functions.                 */
/*                                                                    */
/*--------------------------------------------------------------------*/
#include <QSYSINC/MIH/MATTOD>
#include <stdio.h>

_MI_Time    time_of_day;

int         byte;                       /* Counter for looping through */
                                        /* each byte of the _MI_Time.  */
int main(void) {

 /*--------------------------------------------------------------------*/
 /* Materialize the time of day clock and output it to the screen.     */
 /* Since _MI_Time is an 8-byte character array, we have to loop       */
 /* through each byte and display it as a hexadecimal number.          */
 /*--------------------------------------------------------------------*/

   mattod( time_of_day );


   printf("Time of Day returned by 'mattod' in the _MI_Time format:   ");

   for ( byte=0; byte < sizeof(_MI_Time);  byte++)
      printf("%2.2X", time_of_day[ byte ]  );

   printf("\n");

}
```

Output

```
Time of Day returned by 'mattod' in the _MI_Time format:   748D3E7FEB400017
```

Machine Interface Time (MITIME)

Format

```
#include <QSYSINC/MIH/MICOMMON>
_MI_TIME *mitime (_MI_Time *receiver, int hours,
int minutes, int seconds, int hundredths);
```

Description

The mitime function takes, as parameters, hours, minutes, seconds, and hundredths of seconds, and converts them to the AS/400 system value for time which has the data type _MI_Time. Many of the MI library functions use this _MI_Time data type.

Parameters

receiver(output)
Pointer to an 8-byte character array which is to receive the system value for the specified time.

hours(input)
The number of hours to be converted to the system value for time.

minutes(input)
The number of minutes to be converted to the system value for time.

seconds(input)
The number of seconds to be converted to the system value for time.

hundredths(input)
The number of 1/100 seconds to be converted to the system value for time.

Notes on Usage

- The maximum system time that can be input to mitime is such that the total number of hours, minutes, seconds and hundredths of seconds specified must not exceed (UINT_MAX * 1024 / 1,000,000) seconds which is about 50 days. If this value is exceeded, the results from mitime are undefined.

Example

This example illustrates the use of the mitime function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Job Information  <QSYSINC/MIH/MICOMMON>           */
/*                                                                    */
/* Function:        mitime   (convert time to AS/400 system value     */
/*                            for time)                               */
/* Description:      Use the 'mitime' MI function to convert          */
/*                   specific values for the components of time to    */
/*                   the AS/400 system value for time. Then use the   */
/*                   formatted _MI_Time value to suspend or make      */
/*                   the job go to sleep for the specified amount     */
/*                   of time.                                         */
/*                                                                    */
/*--------------------------------------------------------------------*/
#include <QSYSINC/MIH/MICOMMON>
#include <QSYSINC/MIH/WAITTIME>
#include <stdio.h>


_MI_Time        time_to_wait;          /* The amount of time to wait.  */

int             hours      =  0,       /* Time components used to      */
                minutes    =  0,       /* create an _MI_Time value     */
                seconds    = 15,       /* that can be passed to the    */
                hundredths =  0;       /* 'waittime' function          */

short           wait_option;

int main(void) {

 /*--------------------------------------------------------------------*/
 /* Format an 'mitime' value to represent the amount of time to wait.  */
 /* When 'waittime' is called, the job that is running this program    */
 /* will be suspended.                                                 */
 /*--------------------------------------------------------------------*/

   mitime( &time_to_wait, hours, minutes, seconds, hundredths );

                                      /* Tells the system to use normal */
   wait_option = _WAIT_NORMAL;        /* handling of a suspended job.   */


   waittime( &time_to_wait, wait_option );
}
```

Output

```
** no output **
```

Modify Automatic Storage Allocation (MODASA)

Format

```
#include <QSYSINC/MIH/MODASA>

_SPCPTR modasa (unsigned int size);
```

Description

The modasa function extends the size of the automatic storage frame (ASF) assigned to the invocation of the currently executing program. The function returns the address of the first byte of the ASF extension. This extension might not be contiguous with the original allocation.

Parameters

size (input)

The size of the adjustment. This value must be greater than 0.

Notes on Usage

- A macro version is available.
- The builtin function _MODASA also provides access to the MI instruction.
- The _MODASA builtin is non-resumable following an exception.
- If an attempt is made to resume execution without first changing the resume point, an MCH2204 is signalled.

Example

This example illustrates the use of the modasa function.

```
/*------------------------------------------------------------------*/
/*                                                                  */
/* Example Group:   Program Execution   <QSYSINC/MIH/MODASA>        */
/*                                                                  */
/* Function:        modasa   (Modify Automatic Storage Area)        */
/*                                                                  */
/* Description:     This simple example shows how the automatic     */
/*                  storage frame (ASF) can be extended.            */
/*                                                                  */
/*------------------------------------------------------------------*/
#include <QSYSINC/MIH/MODASA>
#include <string.h>

                                        /* The size by which to extend  */
int        additional_bytes = 2000;     /* the automatic storage frame. */

char      *ptr;                         /* A pointer that will be set   */
                                        /* to the location of the first */
                                        /* byte of the extended area.   */
int main(void) {

  ptr = modasa( additional_bytes );

  strcpy( ptr, "Some string" );

}
```

Output

```
** no screen output **
```

Modify Independent Index (MODINX)

Format

```
#include <QSYSINC/MIH/MODINX>

void modinx (_SYSPTR index_obj,
             char mod_option);
```

Description

The modinx function modifies the selected attributes of the independent index.

Parameters

index_obj (input)

Pointer to the independent index object whose attributes are to be modified.

mod_option (input)

The modification option. The valid values are:

0 = No immediate update

1 = Immediate update

Notes on Usage

- The builtin function _MODINX also provides access to the MI instruction.

Example

This example illustrates the use of the modinx function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   User Indexes   <QSYSINC/MIH/MODINX>               */
/*                                                                    */
/* Function:        modinx     (Modify Index)                         */
/*                                                                    */
/* Description:     This example illustrates the use of the Modify    */
/*                  User Index function. The only attribute of the    */
/*                  index that can be selected for modification is    */
/*                  the "immediate update" attribute.  If this bit    */
/*                  is set, the user index object is written to       */
/*                  auxiliary storage on any change to the entries    */
/*                  in the user index.                                */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/MODINX>
#include <QSYSINC/MIH/RSLVSP>
#include <QSYSINC/MIH/MATINXAT>
#include <stdio.h>
#include <string.h>

_IIX_Template_T     index_template;

_SYSPTR             index_ptr;      /* Pointer to the user index      */


 /* The index attributes returned by 'matinxat' will be copied into   */
 /* the following structure of bit-fields so that the single bit we   */
```

```
 /* want to check is readily available by name.                        */

struct index_attributes {
  int entry_type     : 1;          /* Fixed or Variable-length entries*/
  int when_updated   : 1;          /* Whether or not Immediate Update */
  int insert_type    : 1;          /* Keyed or Sequential inserts ?   */
  int type_of_data   : 1;          /* Contain pointers or not ?       */
  int optimize       : 1;          /* Optimized for Random/Sequential */
  int reserved       : 3;          /* 3 bits unused                   */
} index_attributes;

#define IMMEDIATE_UPDATE     1
#define NO_IMMEDIATE_UPDATE  0

int main(void) {
                                   /* Get a pointer to the *USRIDX.   */
  index_ptr = rslvsp( _Usridx, "MYUSRIDX", "MYLIB", _AUTH_ALL );

 /*-------------------------------------------------------------------*/
 /* Materialize the index attributes and store the "attribute"        */
 /* settings (8-bits).  Check the "immediate update" bit (the second  */
 /* bit-field in the structure as shown in the 'index_attributes'     */
 /* structure above) and turn it on to represent the "immediate update"*/
 /* option if it is not already set.                                  */
 /*-------------------------------------------------------------------*/

   index_template.Template_Size = sizeof( _IIX_Template_T );

   matinxat( &index_template, index_ptr );


 /* Copy the 1-byte attribute field into a structure of bit-fields so  */
 /* we can isolate the "immediate update" flag by name (rather than    */
 /* using the logical AND (&) operator with a bit mask).               */

  memcpy( &index_attributes, &index_template.Attributes, 1 );


  if ( index_attributes.when_updated  !=  IMMEDIATE_UPDATE ) {

                                     /* Since the user index did not */
                                     /* have the "immediate update"  */
                                     /* attribute, modify it.        */
     modinx( index_ptr, IMMEDIATE_UPDATE );

     printf("The user index attributes were modified so that any   \n");
     printf("update (eg: entry inserts or removals) will cause the \n");
     printf("index to be written to auxiliary storage.             \n");
  }
  else {
     printf("The user index already had the 'immediate update' \n");
     printf("option set on. \n");
  }
}
```

Output

The user index attributes were modified so that any update (e.g. entry inserts or removals) will cause the index to be written to auxiliary storage.

Modify Space Attributes (MODS)

Format

```
#include <QSYSINC/MIH/MODS>

void mods (_SYSPTR space_object,
           int size);
```

Description

The mods function modifies the size of the space associated with the system object. The current allocation of the space is extended or truncated accordingly to match as closely as possible the specified size. The modified space size will be at least the size specified.

Parameters

space_object (input)

Pointer to the system object whose associated space size is to be modified.

size (input)

Size in bytes to which the space size is to be modified.

Notes on Usage

- The functions mods and mods2 provide equivalent semantics as the MODS MI instruction.
- The builtin function _MODS also provides access to the MI instruction.

Example

This example illustrates the use of the mods function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Space Management      <QSYSINC/MIH/MODS>          */
/*                                                                    */
/* Function:        mods     (Modify Space Attributes)                */
/*                                                                    */
/* Description:     This example uses 'mods' to increase the size     */
/*                  of a space object.                                */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <stdio.h>
#include <QSYSINC/MIH/MODS>
#include <QSYSINC/MIH/MATS>
#include <QSYSINC/MIH/RSLVSP>
#include <QSYSINC/H/QUSCRTUS>
#include <QSYSINC/H/QUSEC>

#define  INCREMENT  4096
#define  CREATION_SIZE  65500

int main(void)

{
   _SPC_Template_T space_t;
   _SYSPTR         ptr_to_space;
   Qus_EC_t        error_code;

   QUSCRTUS("MYSPACE   QTEMP     ",
            "MYSPACE   ",
            CREATION_SIZE,
            "\0",
            "*ALL      ",
            "MYSPACE example for Programmer's Reference        ",
            "*YES      ",
            &error_code);

   ptr_to_space = rslvsp(_Usrspc, "MYSPACE", "QTEMP", _AUTH_OBJ_MGMT);

   space_t.TmpSize = sizeof(_SPC_Template_T);

   mats(&space_t, ptr_to_space);

   printf("The current size of MYSPACE is %d bytes\n", space_t.Size);

   mods(ptr_to_space, INCREMENT + space_t.Size);

   mats(&space_t, ptr_to_space);

   printf("The new larger size of MYSPACE is %d bytes\n", space_t.Size);
}
```

Output

```
The current size of MYSPACE is 65536 bytes
The new larger size of MYSPACE is 69632 bytes
```

Modify Space Attributes - Long Form with Template (MODS2)

Format

```
#include <QSYSINC/MIH/MODS>

void mods2 (_SYSPTR space_object,
            _SPC_MOD_T *space_t);
```

Description

The mods2 function modifies the attributes of the space associated with the system object.

Parameters

space_object (input)

Pointer to the system object whose associated space attributes are to be modified.

space_t (input)

Pointer to the space modification template that contains a selection of space attribute values to be used to modify the attributes of the space.

Notes on Usage

- The functions mods and mods2 provide equivalent semantics as the MODS MI instruction.
- The builtin function _MODS2 also provides access to the MI instruction.

Example

This example illustrates the use of the mods2 function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Space Management      <QSYSINC/MIH/MODS>          */
/*                                                                    */
/* Function:        mods2    (Modify Space Attributes)                */
/*                                                                    */
/* Description:     This example uses 'mods2' to re-initialize the    */
/*                  space to blanks.                                  */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <string.h>
#include <QSYSINC/MIH/MODS>
#include <QSYSINC/MIH/RSLVSP>
#include <QSYSINC/H/QUSCRTUS>
#include <QSYSINC/H/QUSEC>

#define  CREATION_SIZE 65500

int main(void)

{
   _SPC_MOD_T      mod_t;
   _SYSPTR         ptr_to_space;
   Qus_EC_t        error_code;

   QUSCRTUS("MYSPACE   QTEMP     ",
            "MYSPACE   ",
            CREATION_SIZE,
            "\0",
            "*ALL      ",
            "MYSPACE example for Programmer's Reference        ",
            "*YES      ",
            &error_code);

   /* Resolve to existing space               */
   ptr_to_space = rslvsp(_Usrspc, "MYSPACE", "QTEMP", _AUTH_OBJ_MGMT);

   memset(&mod_t, 0, sizeof(_SPC_MOD_T));

   /* Re-initialize the space to blanks       */
   mod_t.Modify_Init_Val = 1;
   mod_t.Re_Init_Space   = 1;
   mod_t.InitCh          = 0x40;

   mods2(ptr_to_space, &mod_t);

}
```

Output

```
** no screen output **
```

Resolve System Pointer (RSLVSP)

Format

```
#include <QSYSINC/MIH/RSLVSP>

_SYSPTR rslvsp (_OBJ_TYPE_T obj_type,
                _OBJ_NAME obj_name,
                _LIB_NAME lib_name,
                _REQ_AUTH auth);
```

Description

The rslvsp function locates an object identified by a symbolic address and stores the object's addressability in a system pointer. The symbolic address consists of the object type, object name, and library. The system pointer returned by the function points to the first object encountered with the designated type/subtype code, object name, and library without regard to the authorization currently available to the process.

Parameters

obj_type (input)

A member of the enumerated list of object types. The enumeration is supplied in the <milib.h> header file.

obj_name (input)

A null terminated string specifying the name of the object.

lib_name (input)

A null terminated string specifying the name of the library where the object is stored. You can specify either a specific name for the library, or the character string "*LIBL" (or an empty string), which indicates that the current library list is to be searched to find the library where the object is stored.

auth (input)

Constructed from supplied bit mask macros in the <milib.h> header file. Programs executing in user-domain may not assign authority in the resulting system pointer. The value in *auth* is ignored; authority is set to the not set state. Otherwise, the object authority states are set as specified by *auth.*

Notes on Usage

- The function will first resolve to the library. If successful, a resolve to the object is made.
- The builtin functions _RSLVSP1 through _RSLVSP8 also provide access to the MI instruction.

Example

This example illustrates the use of the rslvsp function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Pointer/Name Resolution Addressing                */
/*                  <QSYSINC/MIH/RSLVSP>                              */
/*                                                                    */
/* Function:        rslvsp   (Resolve System Pointer)                 */
/*                                                                    */
/* Description:     This example uses 'rslvsp' to obtain a pointer    */
/*                  to program 'MYPGM' in *LIBL.                      */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/RSLVSP>
#include <QSYSINC/MIH/MATPTR>
#include <stdio.h>

int main(void) {

  _SYSPTR           pgm_ptr;
  _MPTR_Template_T  mpt;

  /* Resolve to program MYPGM in the current library list */

  pgm_ptr = rslvsp(_Program,  "MYPGM", "*LIBL", _AUTH_OBJ_MGMT);

  /* Materialize the program pointer                      */

  mpt.Obj_Ptr.Template_Size = sizeof(_OBJPTR_T);
  matptr(&mpt, pgm_ptr);

  printf("Object name : %.10s\n", mpt.Obj_Ptr.Object_ID.Name);
  printf("Library     : %.10s\n", mpt.Obj_Ptr.Library_ID.Name);
  printf("Type        : %x\n", mpt.Obj_Ptr.Ptr_Type);
  printf("Authority   : %u\n",
          mpt.Obj_Ptr.Auth_Or_Off.Ptr_Authorization);
}
```

Output

```
Object name : MYPGM
Library     : QTEMP
Type        : 1
Authority   : 0
```

Retrieve Computational Attributes (RETCA)

Format

```
#include <QSYSINC/MIH/RETCA>

unsigned int retca (unsigned int mask);
```

Description

The retca builtin retrieves from the machine and returns the 4-byte value containing the selected computational attributes.

Parameters

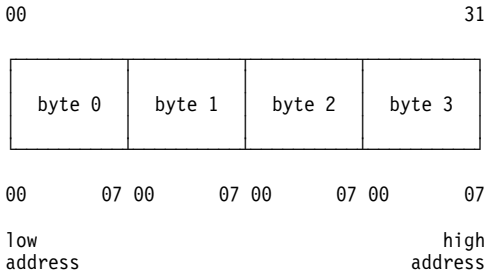
mask (input)

Selection mask specifying which floating-point computational attributes are to be retrieved from the machine. The mask, which must be a literal, is constructed by OR'ing together a combination of the following least significant bits of the 4-byte mask.

Mask Bit	Portion of Computational attributes value to load from the machine
x'08'	Load the Exception Mask byte
x'04'	Reserved (binary 0)
x'02'	Load the Exception Occurrence byte
x'01'	Load the Rounding Mode byte

For the format of the computational attributes returned by this builtin see the layout of the computation attribute bytes in Figure 1 on page 209.

The format of the 4-byte computational attributes is:



- Byte 0: Exception Mask

  0 = disabled (exception is masked)
  1 = enabled (exception is unmasked)

Bits	Meaning
0-1	Reserved (binary zero)
2	Floating-point Overflow
3	Floating-point Underflow
4	Floating-point Zero Divide
5	Floating-point Inexact Result
6	Floating-point Invalid Operand
7	Reserved (binary zero)

- Byte 1: Reserved (binary zero)
- Byte 2: Exception Occurrence

  0 = exception has not occurred
  1 = exception has occurred

Bits	Meaning
0-1	Reserved (binary zero)
2	Floating-point Overflow
3	Floating-point Underflow
4	Floating-point Zero Divide
5	Floating-point Inexact Result
6	Floating-point Invalid Operand
7	Reserved (binary zero)

- Byte 3: Computational Mode

Bits	Meaning	
0	Reserved (binary zero)	
1-2	Rounding Mode	
	00	Round towards positive infinity
	01	Round towards negative infinity
	10	Round towards zero
	11	Round to nearest
3-7	Reserved (binary zero)	

Figure 1. Layout of the computational attribute bytes

Notes on Usage

- retca is available as a macro only.

Example

This example illustrates the use of the retca macro.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Computation and Branching  <QSYSINC/MIH/RETCA>     */
/*                                                                    */
/* Function:        retca    (Retrieve Computational Attributes)      */
/*                                                                    */
/* Description:     This example uses 'retca' to retrieve the         */
/*                  "rounding mode" portion of the computational      */
/*                  attributes.                                       */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/RETCA>
#include <stdio.h>

#define POSITIVE_INFINITY 0x00
#define NEGATIVE_INFINITY 0x20
#define ZERO              0x40
#define NEAREST           0x60

int main(void) {

 unsigned    rounding_mode;

 rounding_mode = retca(_SRCA_ROUNDING_MODE);

 switch (rounding_mode) {
   case  POSITIVE_INFINITY:
       printf("The current setting is round towards positive infinity\n");
       break;
   case  NEGATIVE_INFINITY:
       printf("The current setting is round towards negative infinity\n");
       break;
   case  ZERO:
       printf("The current setting is round towards zero\n");
       break;
   case  NEAREST:
       printf("The current setting is round towards nearest\n");
       break;
   default:
       printf("Error: unrecognized setting\n");
 }
}
```

Output

```
The current setting is round towards nearest
```

Remove Independent Index Entry (RMVINXEN)

Format

```
#include <QSYSINC/MIH/RMVINXEN>

_SPCPTR rmvinxen (_SPCPTR receiver,
                  _SYSPTR index_obj,
                  _IIX_Opt_List_T *option_list,
                  _SPCPTR search_arg);
```

Description

The rmvinxen function removes the specified index entries from the independent index and returns these in the receiver. A pointer to the receiver is returned by the function.

Parameters

receiver (input/output)

Pointer to the buffer to receive the removed entry or entries. A NULL is not supported for this parameter.

index_obj (input)

Pointer to the independent index object from which the entry or entries are to be removed.

option_list (input)

Pointer to the option list template. This template contains additional information on the entry or entries to be removed.

search_arg (input)

Pointer to the search argument(s).

Notes on Usage

- The builtin functions _RMVINXEN1 and _RMVINXEN2 also provide access to the MI instruction.

Example

This example illustrates the use of the rmvinxen function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   User Indexes   <QSYSINC/MIH/RMVINXEN>             */
/*                                                                    */
/* Function:        rmvinxen   (Remove Index Entry)                   */
/*                                                                    */
/* Description:     This example illustrates how the 'rmvinxen'       */
/*                  function can be used to remove a particular       */
/*                  entry from a user index.  The entry being         */
/*                  removed, will be found using the customer         */
/*                  number key.  Upon removal from the user index,    */
/*                  the entry will be displayed to the screen.        */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/RMVINXEN>
#include <QSYSINC/MIH/RSLVSP>
#include <stdio.h>

typedef struct Customer_Entry  {       /* The format/layout of each    */
   int   customer_number;              /* entry on the user index.     */
   char  last_name[ 50 ];
   char  first_name[ 40 ];
   char  phone_number[9];              /* Using phone format: 555-5555 */
} Customer_Entry;

                                       /* Template used for setting    */
_IIX_Opt_List_T   remove_option;       /* options for the "remove".    */
                                       /* Also used as the receiver    */
                                       /* for any returned data.       */

_SYSPTR           index_ptr;           /* Pointer to the user index.   */


                                       /* Buffer to receive any entry  */
Customer_Entry     removed_customer;   /* that matches our criteria.   */

                                       /* Our criterion is to remove   */
int                which_customer      /* the entry that has this      */
                    = 9999999;         /* customer number.             */

int main(void) {

                                       /* Get a pointer to the *USRIDX */
 index_ptr = rslvsp( _Usridx, "MYUSRIDX", "MYLIB", _AUTH_ALL );


 remove_option.Rule = _FIND_EQUALS;    /* Find a customer number that  */
                                       /* matches the specified one.   */

 remove_option.Arg_Length              /* The customer search "key"    */
              = sizeof( int );         /* is an integer.               */
```

```
                                        /* Maximum number of entries    */
                                        /* to return that match the     */
 remove_option.Occ_Count = 1;           /* criterion.  In this case,    */
                                        /* we want to find the one      */
                                        /* unique entry that has the    */
                                        /* particular customer number.  */

 /*-------------------------------------------------------------------*/
 /* Remove the entry for this particular customer if it exists in the  */
 /* user index.  If the entry was successfully removed, output the     */
 /* entry to the screen.                                               */
 /*-------------------------------------------------------------------*/

  rmvinxen( &removed_customer, index_ptr, &remove_option,
            &which_customer);


  if (  remove_option.Ret_Count == 0 )  {

      printf("Could not remove the entry for customer number: %d \n",
              which_customer );
      printf("since the entry could not be found in the user index.\n");
  }

  else {                              /* an entry was found and removed */

    printf("The removed entry for customer number %d was:\n",
            which_customer );

    printf("Customer Name:  %s %s \n", removed_customer.first_name,
                                       removed_customer.last_name   );

    printf("Phone Number:   %s \n",    removed_customer.phone_number );

  }
}
```

Output

```
The removed entry for customer number 9999999 was:
Customer Name:  John Smith
Phone Number:   555-5555
```

Scan with Control (SCANWC)

Format

```
#include <QSYSINC/MIH/SCANWC>

int scanwc (char *base-locator,
            _SCWC_Control_T *controls,
            char options);
```

Description

The scanwc function scans a base string of single or double-byte characters for occurrences of a character value satisfying the criteria in the *controls* and *options* parameters.

The scanwc function returns -1 if the scan is unsuccessful. Otherwise, scanwc returns a value which is the offset of the character which terminated the scan relative to the base string.

On return from the scan, the base locator is still pointing to the first character in the base string. This behavior is different from the SCANWC MI which updates the base locator.

Parameters

source (input)
Pointer to the base string to scan.

controls (input/output)
Pointer to the controls template which specifies additional information to be used to control the scan.

options (input)
The option indicators.

Notes on Usage

- This is a compatibility function to provide the same semantics as the SCANWC MI instruction.
- There is no equivalent to the escape target operand of the SCANWC MI provided on this interface.

Exceptions

If arguments 1 and 2 do not point to valid storage locations, an MCH3601 or an MCH0601 exception will be signalled.

If any of the input parameters are not valid, an MCH3601 or MCH0601 may be signalled.

Other exceptions possible from this function are:

MCH0602 - Boundary alignment
MCH0801 - Parameter Reference Violation
MCH3402 - Object Destroyed
MCH3602 - Pointer Type Invalid
MCH6801 - Object Domain Violation

Example

This example illustrates the use of the scanwc function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Computation and Branching  <QSYSINC/MIH/SCANWC>    */
/*                                                                    */
/* Function:        scanwc      (Scan With Control)                   */
/*                                                                    */
/* Description:     This example uses 'scanwc' to scan the single-    */
/*                  byte base string for a character to which 'k'     */
/*                  is 'greater than or equal'.                       */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/SCANWC>
#include <string.h>
#include <stdio.h>

int main(void) {


 char             base[]= "This is the base string";
 _SCWC_Control_T  t;
 int              offset;
 char             options;

 memset(&t, 0, sizeof(t));
 t.Start_Scan = 1;
 t.Comp_Char[1] = 'k';
 t.Base_Length = sizeof(base);

 offset = scanwc(base, &t,_SCWC_NONMIXED_GREATER | _SCWC_NONMIXED_EQUAL);

 printf("The scan was stopped at character %c, offset %d\n",
         base[offset], offset);

}
```

Output

```
The scan was stopped at character h, offset 1
```

Set Access State (SETACST)

Format

```
#include <QSYSINC/MIH/SETACST>

void setacst (_ANYPTR object,
              char state_code,
              int pool_id,
              int space_length);
```

Description

The setacst function specifies the access state (which specifies the desired speed of access) that the issuing process has for a set of objects or sub-object elements in the execution interval following the execution of the function.

The specification of an access state for an object momentarily preempts the machine's normal management of an object.

Parameters

object (input)
The pointer to object.

state_code (output)
The access state code.

pool_id (input)
The access pool ID.

space_length (input)
The space length.

Notes on Usage

- The setacst function performs a single object Set Access State only. You must use the _SETACST builtin to perform a multiple object Set Access State.
- For access states 0x10 and 0x18, the operational object size is returned through the template. The template is used on the builtin version only. For this reason, it is recommended that the _SETACST builtin be used for access states 0x10 and 0x18.
- A macro version is available.

Example

This example illustrates the use of the setacst function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Resource Management Data(RMD) <QSYSINC/MIH/SETACST>*/
/*                                                                    */
/* Function:        setacst   (Set Access State)                      */
/*                                                                    */
/* Description:     This example uses 'setacst' to "bring" an object  */
/*                  into main memory asynchronously in order to       */
/*                  improve the access time to the object (rather     */
/*                  than have it "page-faulted" into main memory if   */
/*                  it's not already there).  It is not necessary to  */
/*                  explicitly have the object brought into memory    */
/*                  since the system will ensure that the object is   */
/*                  in main memory when it is used.  In some cases,   */
/*                  explicitly moving objects into main memory can    */
/*                  reduce page faulting and improve performance.     */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/SETACST>
#include <QSYSINC/MIH/RSLVSP>
#include <stdio.h>

_SYSPTR      some_object;             /* The object that is being put  */
                                      /* into main memory.             */

int          pool,                    /* Main memory storage pool in   */
                                      /* which to put the object.      */

             size;                    /* Number of bytes of the object */
                                      /* to be moved into main memory. */

int main(void) {

                                      /* Get a pointer to the object.  */
 some_object = rslvsp( _Usrq, "MYUSRQ", "MYLIB", _AUTH_ALL );

 /*-------------------------------------------------------------------*/
 /* Have the first 64K bytes (arbitrary value for this example) of    */
 /* the object brought into main memory asynchronously (moved in by   */
 /* a "background" task, so this process/job is not necessarily       */
 /* suspended - unlike a synchronous "bring").                        */
 /*-------------------------------------------------------------------*/

   size = 65536;
                                      /* 0 specifies to use the pool   */
   pool = 0;                          /* in which the job running this */
                                      /* program is using.             */

   setacst( some_object, _SETACST_ASYNCH_REQ, pool, size );

}
```

Output

```
** no screen output **
```

Set Bit in String (SETBTS)

Format

```
#include <QSYSINC/MIH/SETBTS>

void setbts (_SPCPTR bit_string,
             unsigned int bit_offset);
```

Description

The setbts function sets *bit_string* as indicated by *bit_offset*.

Parameters

bit_string (input)

A pointer to *bit_string* with the bits numbered left to right from 0 to the total number of bits in the string minus 1.

bit_offset (input)

Indicates which bit of *bit_string* is to be set, with an offset of zero indicating the leftmost bit of the leftmost byte of *bit_string*. This value must be less than 64k.

Notes on Usage

- If the selected bit is beyond the end of the string, or the value of *bit_offset* is greater than or equal to 64k, the result of the operation is undefined.
- A macro version is available.
- The builtin function _SETBTS also provides access to the MI instruction.

Exceptions

In some circumstances, if the selected bit is beyond the end of allocated storage, an MCH3203 exception may be signalled.

Example

This example illustrates the use of the setbts function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Computation and Branching  <QSYSINC/MIH/SETBTS>   */
/*                                                                    */
/* Function:        setbts   (Set Bit in String)                      */
/*                                                                    */
/* Description:     This example uses 'setbts', 'tstbts', and         */
/*                  'clrbts' to set, test, and clear the 17th bit     */
/*                  in the bit string.                                */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/SETBTS>
#include <QSYSINC/MIH/TSTBTS>
#include <QSYSINC/MIH/CLRBTS>
#include <stdio.h>

#define  FALSE 0
#define  TRUE  !FALSE

int main(void) {

  unsigned bit_string = 0;
  unsigned offset = 17;
  unsigned flag = FALSE;

  setbts(&bit_string, offset);

  flag = tstbts(&bit_string, offset);

  if (flag)
    printf("The %u'th bit has been set\n", offset);

  clrbts(&bit_string, offset);

  flag = tstbts(&bit_string, offset);

  if (!flag)
    printf("The %u'th bit has been cleared\n", offset);

}
```

Output

```
The 17'th bit has been set
The 17'th bit has been cleared
```

Set Computational Attributes (SETCA)

Format

```
#include <QSYSINC/MIH/SETCA>

    void setca (unsigned int new_value,
                unsigned int mask);
```

Description

The setca builtin sets the computational attributes selected and stores them into the machine.

Parameters

new_value(input)

The value which is to be used to update the machine computational attributes.

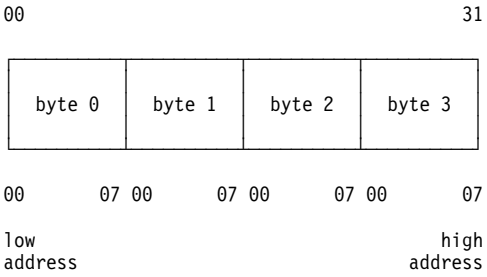
mask(input)

Selection mask specifying which floating-point computational attributes are to be set in the machine. The mask, which must be a literal, is constructed by ORing together a combination of the following least significant bits of the 4-byte mask.

Mask Bit	Portion of Computational attributes value to store in the machine
x'08'	Store the Exception Mask byte
x'04'	Reserved (binary 0)
x'02'	Store the Exception Occurrence byte
x'01'	Store the Rounding Mode byte

For the format of the computational attributes returned by this builtin see the layout of the computation attribute bytes in Figure 2 on page 222.

The format of the 4-byte computational attributes is:



- Byte 0: Exception Mask

  0 = disabled (exception is masked)
  1 = enabled (exception is unmasked)

Bits	Meaning
0-1	Reserved (binary zero)
2	Floating-point Overflow
3	Floating-point Underflow
4	Floating-point Zero Divide
5	Floating-point Inexact Result
6	Floating-point Invalid Operand
7	Reserved (binary zero)

- Byte 1: Reserved (binary zero)
- Byte 2: Exception Occurrence

  0 = exception has not occurred
  1 = exception has occurred

Bits	Meaning
0-1	Reserved (binary zero)
2	Floating-point Overflow
3	Floating-point Underflow
4	Floating-point Zero Divide
5	Floating-point Inexact Result
6	Floating-point Invalid Operand
7	Reserved (binary zero)

- Byte 3: Computational Mode

Bits	Meaning	
0	Reserved (binary zero)	
1-2	Rounding Mode	
	00	Round towards positive infinity
	01	Round towards negative infinity
	10	Round towards zero
	11	Round to nearest
3-7	Reserved (binary zero)	

Figure 2. Computational attributes

Notes on Usage

- setca is available as a macro only.
- When setca is used to change the computational attributes, it is the programmer's responsibility to save the prior attributes and to restore these on abnormal/normal termination.

Example

This example illustrates the use of the setca macro.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Computation and Branching  <QSYSINC/MIH/SETCA>     */
/*                                                                    */
/* Function:        setca    (Set Computational Attributes)           */
/*                                                                    */
/* Description:     This example uses 'setca' to temporarily mask     */
/*                  the floating point overflow, underflow, and       */
/*                  zero divide exceptions. Please Note: it is the    */
/*                  responsibility of the programmer to save and      */
/*                  restore any prior attribute settings.             */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/SETCA>
#include <QSYSINC/MIH/RETCA>
#include <except.h>

#define  NEW_ATTRIBUTES 0x02000000  /* Mask the following exceptions: */
                                    /*   floating point overflow      */
                                    /*   floating point underflow     */
                                    /*   floating point zero divide   */
                                    /*   floating point inexact result*/


static void cancel_handler (_CNL_Hndlr_Parms_T *parms) {

  /* Restore the saved exception mask attributes passed to the        */
  /* handler through the communications area.                         */

  setca (*(unsigned *)parms->Com_Area, _SRCA_EXCEPTION_MASK);
}


int main(void) {

  volatile unsigned int old_attributes;

  /* Save the prior exception mask attributes.                        */

  old_attributes = retca(_SRCA_EXCEPTION_MASK);

  /* Set the new exception mask attributes.                            */

  setca(NEW_ATTRIBUTES, _SRCA_EXCEPTION_MASK);

  /* Set up a cancel handler to restore prior exception mask          */
  /* attributes in the event of a cancellation.                       */

  #pragma cancel_handler(cancel_handler, old_attributes)

  /* Floating point computations using new attributes would go here...*/

  /* Restore the saved exception mask attributes.                     */
```

```
  setca(old_attributes, _SRCA_EXCEPTION_MASK);

}
```

Output

```
** no screen output **
```

Set System Pointer from Pointer (SETSPFP)

Format

```
#include <QSYSINC/MIH/SETSPFP>

_SYSPTR setspfp (_ANYPTR pointer);
```

Description

The setspfp function returns a system pointer to the system object addressed by *pointer*.

If *pointer* is a system pointer, then a system pointer addressing the same object is returned containing the same authority as the input pointer.

If *pointer* is a space pointer, then a system pointer addressing the system object that contains the associated space addressed by *pointer* is returned.

Parameters

pointer (input)

A space pointer or system pointer.

Notes on Usage

- A macro version is available.
- The builtin function _SETSPFP also provides access to the MI instruction.

Exceptions

If the pointer argument is not set, an MCH3601 is signalled. If the pointer argument is not a space pointer, system pointer, or an open pointer containing a space pointer or system pointer, an MCH3602, and an MCH3601 are signalled.

Example

This example illustrates the use of the setspfp function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Space Object Addressing    <QSYSINC/MIH/SETSPFP>  */
/*                                                                    */
/* Function:        setspfp   (Set System Pointer from Pointer)       */
/*                                                                    */
/* Description:     This example uses 'setspfp' to return a system    */
/*                  pointer to the object addressed by both a         */
/*                  space pointer and a system pointer.               */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/SETSPFP>
#include <QSYSINC/MIH/RSLVSP>
#include <stdio.h>

#include <QSYSINC/H/QUSCRTUS>
#include <QSYSINC/H/QUSPTRUS>

#define CREATION_SIZE  65536

int main(void) {
   _SPCPTR         myspace_spp;
   _SYSPTR         myspace_sysp, sysp;
   int             error_code = 0;

   QUSCRTUS("MYSPACE   QTEMP     ",  /* Create user space            */
            "MYSPACE   ",
            CREATION_SIZE,
            "\0",
            "*ALL      ",
            "MYSPACE example for Programmer's Reference        ",
            "*YES      ",
            &error_code);

   QUSPTRUS("MYSPACE   QTEMP     ",  /* Retrieve pointer to user space */
             &myspace_spp);

  /* Case 1: source pointer is a space  pointer  */

  myspace_sysp = rslvsp(_Usrspc, "MYSPACE", "QTEMP", _AUTH_OBJ_MGMT);
  sysp = setspfp(myspace_spp);

  if (sysp != myspace_sysp)
    printf("Case 1 : the pointers are not equal\n");
  else
    printf("Case 1 : the pointers are equal\n");

  /* Case 2: source pointer is a system pointer  */

  sysp = setspfp(myspace_sysp);

  if (sysp != myspace_sysp)
    printf("Case 2 : the pointers are not equal\n");
  else
```

```
    printf("Case 2 : the pointers are equal\n");

}
```

Output

```
Case 1 : the pointers are equal
Case 2 : the pointers are equal
```

Set Space Pointer from Pointer (SETSPPFP)

Format

```
#include <QSYSINC/MIH/SETSPPFP>

_SPCPTR setsppfp (_ANYPTR pointer);
```

Description

The setsppfp function returns the address of a space object from the source pointer specified.

If the source pointer is a space pointer, the pointer returned is set to the address of the leftmost byte of the storage location addressed by the source pointer.

If the source pointer is a system pointer, the pointer returned is set to address the first byte of the space contained in the system object addressed by the system pointer.

Parameters

pointer (input)

A space pointer or system pointer.

Notes on Usage

- A macro version is available.
- The builtin function _SETSPPFP also provides access to the MI instruction.

Exceptions

If the source pointer is not set, an MCH3601 is signalled. If the pointer is not a space pointer, system pointer, or an open pointer containing a space pointer or system pointer, an MCH3602 is signalled.

Example

This example illustrates the use of the setsppfp function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Space Object Addressing    <QSYSINC/MIH/SETSPPFP> */
/*                                                                    */
/* Function:        setsppfp   (Set Space Pointer from Pointer)       */
/*                                                                    */
/* Description:     This example uses 'setsppfp' to obtain a pointer  */
/*                  to the leftmost byte of the space addressed by    */
/*                  both a space pointer and a system pointer.        */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/SETSPPFP>
#include <QSYSINC/MIH/RSLVSP>
#include <string.h>
#include <stdio.h>

#include <QSYSINC/H/QUSCRTUS>
#include <QSYSINC/H/QUSPTRUS>

#define CREATION_SIZE  65536

int main(void) {
   _SPCPTR         myspace_spp, sp;
   _SYSPTR         myspace_sysp;
   int             error_code = 0;

   QUSCRTUS("MYSPACE   QTEMP     ",  /* Create user space            */
            "MYSPACE   ",
            CREATION_SIZE,
            "\0",
            "*ALL      ",
            "MYSPACE example for Programmer's Reference        ",
            "*YES      ",
            &error_code);

   QUSPTRUS("MYSPACE   QTEMP     ",  /* Retrieve pointer to user space */
             &myspace_spp);

  /* Case 1: source pointer is a space pointer   */

  sp = setsppfp(myspace_spp);

  if (sp != myspace_spp)
    printf("Case 1 : the pointers are not equal\n");
  else
    printf("Case 1 : the pointers are equal\n");

  /* Case 2: source pointer is a system pointer  */

  myspace_sysp = rslvsp(_Usrspc, "MYSPACE", "QTEMP", _AUTH_OBJ_MGMT);

  sp = setsppfp(myspace_sysp);

  if (sp != myspace_spp)
```

```
    printf("Case 2 : the pointers are not equal\n");
  else
    printf("Case 2 : the pointers are equal\n");
}
```

Output

```
Case 1 : the pointers are equal
Case 2 : the pointers are equal
```

Set Space Pointer Offset (SETSPPO)

Format

```
#include <QSYSINC/MIH/SETSPPO>

_SPCPTR setsppo (_SPCPTR pointer,
                 int offset);
```

Description

The setsppo function takes the value of *offset* and assigns it to the offset portion *pointer*. The resulting pointer is returned by the function.

Parameters

pointer (input)

The space pointer whose offset is to be set.

offset (input)

The space pointer offset value.

Notes on Usage

- The resulting space pointer continues to address the same space object.
- *pointer* is left unchanged.

Exception

If the pointer argument is not set, or the offset argument is not valid (too large, or negative), an MCH3601 is signalled.

Example

This example illustrates the use of the setsppo function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Space Object Addressing    <QSYSINC/MIH/SETSPPO>  */
/*                                                                    */
/* Function:        setsppo    (Set Space Pointer Offset)             */
/*                                                                    */
/* Description:     This example uses 'setsppo' to set the offset     */
/*                  portion of a space pointer.                       */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <stdio.h>
#include <QSYSINC/MIH/SETSPPO>
#include <QSYSINC/MIH/STSPPO>

int main(void) {
  int buffer[50];

  _SPCPTR  sp1 = buffer + 25, sp2 = buffer;

  sp2 = setsppo(sp2, stsppo(sp1));
  if (sp1 != sp2)
     printf("Error: the pointers are not equal\n");
  else
     printf("The pointers are equal\n");
}
```

Output

```
The pointers are equal
```

Store Space Pointer Offset (STSPPO)

Format

```
#include <QSYSINC/MIH/STSPPO>

int stsppo (_SPCPTR pointer);
```

Description

The stsppo function returns the offset value of *pointer*.

Parameters

pointer (input)

Space pointer to extract offset from

Exceptions

If the pointer argument is not set, an MCH3601 is signalled.

Example

This example illustrates the use of the stsppo function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Space Object Addressing    <QSYSINC/MIH/STSPPO>   */
/*                                                                    */
/* Function:        stsppo     (Store Space Pointer Offset)           */
/*                                                                    */
/* Description:     This example uses 'stsppo' to return the offset   */
/*                  value of a space pointer.                         */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <stdio.h>
#include <QSYSINC/MIH/STSPPO>

#define OFFSET  25

int main(void) {
  int buffer[50], offset1, offset2;

  _SPCPTR  sp1 = buffer + OFFSET, sp2 = buffer;

  offset1 = stsppo(sp1);
  offset2 = stsppo(sp2);
  printf("offset1 - offset2 = %d bytes\n", offset1 - offset2);
}
```

Output

```
offset1 - offset2 = 100 bytes
```

Test Authority (TESTAU)

Format

```
#include <QSYSINC/MIH/TESTAU>

short testau (_SYSPTR object,
              short offset,
              short req_auth);
```

Description

The testau function returns information on the object authorities and/or ownership rights currently available to the process for the object specified. The operation is performed relative to the invocation whose offset is specified.

Parameters

object (input)

Pointer to the system object for which authority is to be tested.

offset (input)

Identifies an invocation relative to the current at which the authority verification is to be performed.

req_auth (input)

Indicates the required authority and/or ownership rights to be tested and returned by the function (if currently available to the process).

Notes on Usage

- The builtin function _TESTAU1 or _TESTAU2 also provides access to the MI instruction.

Example

This example illustrates the use of the testau function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Authorizations    <QSYSINC/MIH/TESTAU>            */
/*                                                                    */
/* Function:        testau    (Test Authorization)                    */
/*                                                                    */
/* Description:     This example shows how 'testau' can be used to    */
/*                  determine what kind of authority the job in which */
/*                  this program runs in, has to some object.  This   */
/*                  example determines whether the job can delete or  */
/*                  update a particular program object (QCMD *PGM     */
/*                  in QSYS).                                         */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/TESTAU>
#include <QSYSINC/MIH/RSLVSP>
#include <stdio.h>
                                        /* Pointer to the object that  */
_SYSPTR      some_object;               /* will be tested for certain  */
                                        /* authority.                  */
```

```
short       test_authority,           /* Authority being checked.    */

            return_authority,         /* Actual authority this job   */
                                      /* has to the object.          */

            relative_invocation;

int main(void) {

                                      /* Get a pointer to the object */
                                      /* that is being tested.       */
   some_object = rslvsp( _Program, "QCMD", "QSYS", _AUTH_NONE );

 /*--------------------------------------------------------------------*/
 /* 'testau' will be used to check if the job that is running this     */
 /* program has both delete and update authority to the object.        */
 /*--------------------------------------------------------------------*/

   test_authority = _AUTH_DELETE | _AUTH_UPDATE;

   relative_invocation = 0;           /* Use the current invocation. */


   return_authority = testau( some_object, relative_invocation,
                              test_authority );


 /*--------------------------------------------------------------------*/
 /* If the actual authority does not match the authority we were       */
 /* testing for, then output this information to the screen.           */
 /*--------------------------------------------------------------------*/

   if ( return_authority != test_authority ) {

        printf("This job/process does not have Delete or Update\n");
        printf("authority to the QSYS/QCMD program. \n");
   }
}
```

Output

```
This job/process does not have Delete or Update
authority to the QSYS/QCMD program.
```

Trim Length (TRIML)

Format

```
#include <QSYSINC/MIH/TRIML>

int triml (char *string,
           char trim_char);
```

Description

The triml function returns the length of *string* after *trim_char* has been trimmed from the end.

trim_char is trimmed from the end of *string* as follows: if the rightmost (last) character of *string* is equal to the character specified by *trim_char*, the length of the trimmed *string* is reduced by 1. This operation continues until the rightmost character is no longer equal to *trim_char* or the trimmed length is zero.

string is not changed by this function.

Parameters

string (input)
The source string.

trim_char (input)
The trim character.

Notes on Usage

- The triml function operates on null-terminated strings.
- This is a compatibility function to provide the same semantics as the TRIML MI instruction.

Exceptions

If invalid input values are passed to the function, an MCH3601 and MCH0601 exception may be signalled.

Other exceptions possible from this function are:

MCH0602 - Boundary alignment
MCH0801 - Parameter Reference Violation
MCH3402 - Object Destroyed
MCH3602 - Pointer Type Invalid
MCH6801 - Object Domain Violation

Example

This example illustrates the use of the triml function.

```
/*------------------------------------------------------------------------*/
/*                                                                        */
/* Example Group:   Computation and Branching  <QSYSINC/MIH/TRIML>    */
/*                                                                        */
/* Function:        triml    (Trim Length)                            */
/*                                                                        */
/* Description:     This example uses 'triml' to return the length    */
/*                  of the string after the trim character '!' has    */
/*                  been removed.                                     */
/*                                                                        */
/*------------------------------------------------------------------------*/

#include <QSYSINC/MIH/TRIML>
#include <string.h>
#include <stdio.h>

int main(void) {

 char      trim_str[] = "String with lots of punctuation!!!!!!!!!!";
 int       trim_len;

 trim_len = triml(trim_str, '!');
 printf("The length of the untrimmed string is %d\n", strlen(trim_str));
 printf("The length of the trimmed string is %d\n", trim_len);

}
```

Output

```
The length of the untrimmed string is 42
The length of the trimmed string is 31
```

Test Bit in String (TSTBTS)

Format

```
#include <QSYSINC/MIH/TSTBTS>

int tstbts (_SPCPTR bit_string,
            unsigned int bit_offset);
```

Description

The tstbts function tests the bit in *bit_string*, as indicated by *bit_offset*, to determine if the bit is set or not set. The tstbts function returns a nonzero value if the selected bit is set; otherwise zero is returned.

Parameters

bit_string (input)

Pointer to *bit_string* with the bits numbered left to right from 0 to the total number of bits in the string minus 1.

bit_offset (input)

Indicates which bit of *bit_string* is to be tested with an offset of 0 indicating the leftmost bit of the leftmost byte of *bit_string*. This value must be less than 64k.

Notes on Usage

- If the selected bit is beyond the end of the string, or the value of *bit_offset* is greater than or equal to 64k, the result of the operation is undefined.
- A macro version is available.
- The builtin function _TSTBTS also provides access to the MI instruction.

Exceptions

In some circumstances, if the selected bit is beyond the end of allocated storage, an MCH3203 exception may be signalled.

Example

This example illustrates the use of the tstbts function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Computation and Branching  <QSYSINC/MIH/TSTBTS>   */
/*                                                                    */
/* Function:        tstbts   (Test Bit in String)                     */
/*                                                                    */
/* Description:     This example uses 'setbts', 'tstbts', and         */
/*                  'clrbts' to set, test, and clear the 17th bit     */
/*                  in the bit string.                                */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/TSTBTS>
#include <QSYSINC/MIH/SETBTS>
#include <QSYSINC/MIH/CLRBTS>
#include <stdio.h>

#define  FALSE 0
#define  TRUE  !FALSE

int main(void) {

  unsigned bit_string = 0;
  unsigned offset = 17;
  unsigned flag = FALSE;

  setbts(&bit_string, offset);

  flag = tstbts(&bit_string, offset);

  if (flag)
    printf("The %u'th bit has been set\n", offset);

  clrbts(&bit_string, offset);

  flag = tstbts(&bit_string, offset);

  if (!flag)
    printf("The %u'th bit has been cleared\n", offset);

}
```

Output

```
The 17'th bit has been set
The 17'th bit has been cleared
```

Unlock Object (UNLOCK)

Format

```
#include <QSYSINC/MIH/UNLOCK>

void unlock (_SYSPTR object,
             char unlock_option,
             char lock_state);
```

Description

The unlock function releases a single lock for the system object specified.

Parameters

object (input)

Pointer to the system object to be unlocked.

unlock_option (input)

The unlock option specifies if locks are to be released or outstanding lock requests are to be cancelled.

lock_state (input)

The lock state to unlock.

Notes on Usage

- The lock entry will always be marked as active by the unlock function. So, for the function version it is not necessary to OR the lock state with _LOCK_ENTRY_ACTIVE.
- The builtin function _UNLOCK and macro Unlock also provide access to the MI instruction.

Example

This example illustrates the use of the unlock function.

```
/*------------------------------------------------------------------*/
/*                                                                  */
/* Example Group:   Locks   <QSYSINC/MIH/UNLOCK>                    */
/*                                                                  */
/* Function:        unlock    (Unlock Object)                       */
/*                                                                  */
/* Description:     This example illustrates the use of the 'unlock'   */
/*                  function.  The 'lock' function will first be used  */
/*                  to place a Shared Read (LSRD) lock on the object   */
/*                  (a user queue in this example).  The CL DSPJOB     */
/*                  command will then be used to display all of the    */
/*                  locks held by the job/process that runs this       */
/*                  program.  After using the 'unlock' function to     */
/*                  remove the lock, DSPJOB is used again to allow     */
/*                  the user to verify that the lock was removed.      */
/*                                                                  */
/*------------------------------------------------------------------*/

#include <QSYSINC/MIH/UNLOCK>
#include <QSYSINC/MIH/RSLVSP>
#include <QSYSINC/MIH/LOCK>
#include <stdio.h>
#include <stdlib.h>

_SYSPTR      some_object;              /* The object being locked.     */

_MI_Time     timeout;                  /* Amount of time to wait for   */
                                       /* the lock to be placed.       */


int          hours       =  0,         /* Time components used to      */
             minutes     =  0,         /* create an _MI_Time value     */
             seconds     = 20,         /* that can be passed to the    */
             hundredths  =  0;         /* 'lock' function.             */


int main(void) {

                                       /* Get a pointer to the object  */
  some_object = rslvsp( _Usrq, "MYUSRQ", "MYLIB", _AUTH_ALL );

 /*------------------------------------------------------------------*/
 /* Format an 'mitime' value to represent the timeout to be used by    */
 /* the 'lock' function when trying to obtain a Shared-Read (LSRD)     */
 /* lock on the object. If the lock request cannot be satisfied in the */
 /* specified amount of time, then an exception will be raised.  The   */
 /* CL DSPJOB command is called to display all of the object locks     */
 /* owned by the job/process that runs this program.                   */
 /*------------------------------------------------------------------*/

   mitime( &timeout, hours, minutes, seconds, hundredths );

   lock( some_object, timeout, _LSRD_LOCK );

   system( "DSPJOB OPTION(*JOBLCK)" );
```

```
 /*--------------------------------------------------------------------*/
 /* Now the 'unlock' function is used to remove the LSRD lock and the  */
 /* object locks for the job are displayed again.                      */
 /*--------------------------------------------------------------------*/

   unlock( some_object, _UNLOCK_SPECIFIC, _LSRD_LOCK );

   system( "DSPJOB OPTION(*JOBLCK)" );
}
```

Output

```
                              Display Job Locks
                                                          System:   TORAS4YL
Job:   OMXNA3S4       User:   VISCA          Number:   009616

Job status:   ACTIVE

Type options, press Enter.
  5=Display job member locks
                                   Object                          Member
Opt    Object        Library       Type         Lock       Status   Locks
       MAIN          QSYS          *MENU        *SHRNUP     HELD
                                                *SHRNUP     HELD
       MYUSRQ        MYLIB         *USRQ        *SHRRD      HELD
       OMXNA3S4      QSYS          *DEVD        *EXCLRD     HELD
                                                *EXCLRD     HELD
                                                *EXCLRD     HELD
                                                *EXCLRD     HELD
       QADM          QSYS          *LIB         *SHRRD      HELD
                                                                  More...
F3=Exit   F5=Refresh   F10=Display job record locks   F12=Cancel


                              Display Job Locks
                                                          System:   TORAS4YL
Job:   OMXNA3S4       User:   VISCA          Number:   009616

Job status:   ACTIVE

Type options, press Enter.
  5=Display job member locks
                                   Object                          Member
Opt    Object        Library       Type         Lock       Status   Locks
       MAIN          QSYS          *MENU        *SHRNUP     HELD
                                                *SHRNUP     HELD
       OMXNA3S4      QSYS          *DEVD        *EXCLRD     HELD
                                                *EXCLRD     HELD
                                                *EXCLRD     HELD
                                                *EXCLRD     HELD
       QADM          QSYS          *LIB         *SHRRD      HELD
                                                                  More...
F3=Exit   F5=Refresh   F10=Display job record locks   F12=Cancel
```

Unlock Space Location (UNLOCKSL)

Format

```
#include <QSYSINC/MIH/UNLOCKSL>

void unlocksl (_SPCPTR location,
               char lock_state);
```

Description

The unlocksl function removes a single lock type from the space location.

Parameters

location (input)

Pointer to the space location to be unlocked.

lock_state (input)

The lock state to unlock.

Notes on Usage

- The builtin functions _UNLOCKSL1 and _UNLOCKSL2 also provide access to the MI instruction.
- The _UNLOCKSL2 builtin supports multiple space location unlock requests.

Example

This example illustrates the use of the unlocksl function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Locks   <QSYSINC/MIH/UNLOCKSL>                    */
/*                                                                    */
/* Function:        unlocksl  (Unlock Space Location)                 */
/*                                                                    */
/* Description:     Place an Exclusive-No-Read (LENR) on a particular */
/*                  byte (space location) of some object (a user      */
/*                  queue in this example).  This type of lock is     */
/*                  "symbolic" in that it does not prevent the space  */
/*                  location from being referenced or updated.        */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/UNLOCKSL>
#include <QSYSINC/MIH/RSLVSP>
#include <QSYSINC/MIH/LOCKSL>
#include <QSYSINC/MIH/SETSPPFP>
#include <QSYSINC/MIH/MATOBJLK>
#include <stdio.h>

                                       /* The object from which some  */
_SYSPTR              some_object;      /* byte (space) location will  */
                                       /* locked.                     */

_SPCPTR              some_byte;        /* The pointer to the location */
                                       /* that is being locked.       */

                                       /* The receiver template used  */
_MOBJL_Template_T    allocated_locks;  /* by 'matobjlk'.              */


int main(void) {

                                       /* Get a pointer to the object */
  some_object = rslvsp( _Usrq, "MYUSRQ", "MYLIB", _AUTH_ALL );

                                       /* Set a space pointer from    */
                                       /* the system pointer.         */
  some_byte = setsppfp( some_object );

 /*-------------------------------------------------------------------*/
 /* Request the Exclusive-No-Read (LENR) lock on the space location.  */
 /* A default timeout called the "Process Default Timeout" is used as */
 /* the timeout value.  If the lock request is not satisfied in that  */
 /* time, an exception is raised.                                     */
 /*-------------------------------------------------------------------*/

  locksl( some_byte, _LENR_LOCK );
```

```
/*--------------------------------------------------------------------*/
/* In order to verify that the Exclusive lock was placed on the space */
/* location (byte), we can look at the bit pattern returned by        */
/* 'matobjlk' in the 'Lock_Alloc' field of the template. The fifth    */
/* bit (bit 4) of this field represents the Lock-Exclusive-No-Read    */
/* (LENR) lock.  By using the bitwise AND (&) operator, we can        */
/* determine if the bit is set by ANDing it with the provided bit     */
/* mask, _LENR_LOCK (which happens to be defined in <milock.h> as     */
/* hex 08 which is bit pattern 0000 1000).                            */
/*--------------------------------------------------------------------*/

  allocated_locks.Template_Size = sizeof( _MOBJL_Template_T );

  matobjlk( &allocated_locks, some_byte );


  if ( allocated_locks.Lock_Alloc  &   _LENR_LOCK ) {

      printf("There is an Exclusive-No-Read lock on the space  \n");
      printf("location with address: %p \n\n", some_byte  );

    /* For illustration purposes, we will now remove the lock we  */
    /* just placed on the space location and use 'matobjlk' again */
    /* to verify that it gets removed.                            */

      printf("The lock will now be removed... \n");

      unlocksl( some_byte, _LENR_LOCK );

      matobjlk( &allocated_locks, some_byte );

                                    /* If the LENR bit is still set */
      if ( allocated_locks.Lock_Alloc  &   _LENR_LOCK )

           printf("Error.  The LENR lock still exists.\n");
      else
           printf("The LENR lock was removed.\n");
  }
}
```

Output

```
There is an Exclusive-No-Read lock on the space
location with address: SPP:0401MYLIB :0a02MYUSRQ :0:0:d35
The lock will now be removed...
The LENR lock was removed.
```

Wait on Time (WAITTIME)

Format

```
#include <QSYSINC/MIH/WAITTIME>

void waittime (_MI_Time *wait_interval,
               short options);
```

Description

The waittime function causes the current process to be placed in a wait state for the amount of time specified by the wait interval in accordance with the specified wait options.

Parameters

wait_interval (input)

Pointer to an 8-byte time interval prepared using the mitime function.

options (input)

The wait options.

Notes on Usage

- The builtin function _WAITTIME also provides access to the MI instruction.

Example

This example illustrates the use of the waittime function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Processes      <QSYSINC/MIH/WAITTIME>             */
/*                                                                    */
/* Function:        waittime    (wait or sleep for a specified time)  */
/*                                                                    */
/* Description:     This example shows how you can suspend or make    */
/*                  your job go to sleep for a specified amount of    */
/*                  time.  This is similar to the CL DLYJOB (delay    */
/*                  job) command.                                     */
/*                                                                    */
/*--------------------------------------------------------------------*/
#include <QSYSINC/MIH/WAITTIME>
#include <stdio.h>


_MI_Time        time_to_wait;          /* The amount of time to wait.  */

int             hours      =  0,       /* Time components used to      */
                minutes    =  0,       /* create an _MI_Time value     */
                seconds    = 15,       /* that can be passed to the    */
                hundredths =  0;       /* 'waittime' function          */

short           wait_option;

int main(void) {

 /*--------------------------------------------------------------------*/
 /* Format an 'mitime' value to represent the amount of time to wait.  */
 /* When 'waittime' is called, the job that is running this program    */
 /* will be suspended.                                                 */
 /*--------------------------------------------------------------------*/

   mitime( &time_to_wait, hours, minutes, seconds, hundredths );

                                     /* Tells the system to use normal */
   wait_option = _WAIT_NORMAL;       /* handling of a suspended job.   */


   waittime( &time_to_wait, wait_option );
}
```

```
** no output **
```

Transfer Object Lock (XFRLOCK)

Format

```
#include <QSYSINC/MIH/XFRLOCK>

void xfrlock (_SYSPTR process,
              _SYSPTR object,
              char lock_state_to_transfer);
```

Description

The xfrlock function allocates a single lock to the receiving process. Upon completion of the transfer request, the current process no longer holds the transferred lock.

Parameters

process (input)
Pointer to the receiving process control space.

object (input)
Pointer to the system object whose lock is to be transferred.

lock_state_to_transfer (input)
Identifies the lock state to be transferred to the receiving process.

Notes on Usage

- The lock entry will always be marked as active by the xfrlock function. So, for the function version, it is not necessary to OR the lock state with _LOCK_ENTRY_ACTIVE.
- The builtin function _XFRLOCK, which supports multiple lock transfer requests, also provides access to the MI instruction.

Example

This example illustrates the use of the xfrlock function.

```
/*--------------------------------------------------------------------*/
/*                                                                    */
/* Example Group:   Locks   <QSYSINC/MIH/XFRLOCK>                     */
/*                                                                    */
/* Function:        xfrlock    (Transfer Object Lock)                 */
/*                                                                    */
/* Description:     This example shows how the job/process in which   */
/*                  this program is run can obtain an object lock     */
/*                  and then transfer it to another job.   In order   */
/*                  to transfer the lock, the Process Control Space   */
/*                  (PCS) of the other job/process needs to be known. */
/*                                                                    */
/*                  One way to accomplish this would be for an ILE    */
/*                  C/400 program running in another job to use the   */
/*                  'matpratr' (materialize process attributes)       */
/*                  function to obtain the PCS pointer.  This pointer */
/*                  could then be put into a User Space or onto a     */
/*                  User Queue.  This program would then have to      */
/*                  resolve to the User Space or User Queue and get   */
/*                  the PCS pointer.  The pointer could then be copied*/
/*                  into the 'to_PCS' variable defined in this program*/
/*                  to pass to the 'xfrlock' function.                */
/*                                                                    */
/*                  In order to not complicate this example too much, */
/*                  the 'to_PCS' variable will be filled in with the  */
/*                  Process Control Space of the job/process that     */
/*                  runs this program.  This effectively means that   */
/*                  the lock is not being transferred to another      */
/*                  job, but this example should still illustrate the */
/*                  use of the 'xfrlock' function.                    */
/*                                                                    */
/*--------------------------------------------------------------------*/

#include <QSYSINC/MIH/XFRLOCK>
#include <QSYSINC/MIH/RSLVSP>
#include <QSYSINC/MIH/LOCK>
#include <QSYSINC/MIH/MATPRATR>
#include <stdlib.h>

_SYSPTR           some_object;          /* The object being locked.    */

_SYSPTR           to_PCS;               /* Process Control Space (PCS) */
                                        /* (job) that the lock will be */
                                        /* transferred to.             */

_MI_Time          timeout;              /* The amount of time to wait  */
                                        /* for the lock to be placed.  */

int               hours      = 0,       /* Time components used to     */
                  minutes    = 0,       /* create an _MI_Time value    */
                  seconds    = 3,       /* that can be passed to the   */
                  hundredths = 0;       /* 'lock' function             */

                                        /* The receiver template for   */
_MPRT_Template_T  process_attributes;   /* the call to 'matpratr' to   */
```

```
                                        /* get the PCS pointer.       */

int main(void) {

                                        /* Get a pointer to the object.*/
   some_object = rslvsp( _Usrq, "MYUSRQ", "MYLIB", _AUTH_ALL );

 /*--------------------------------------------------------------------*/
 /* Format an 'mitime' value to represent the timeout to be used by    */
 /* the 'lock' function when trying to obtain an Exclusive-No-Read     */
 /* (LENR) lock on the object. If the lock request cannot be satisfied */
 /* in the specified amount of time, then an exception will be raised. */
 /* The CL DSPJOB command is called to display all of the object locks */
 /* owned by the job/process that runs this program.                   */
 /*--------------------------------------------------------------------*/

  mitime( &timeout, hours, minutes, seconds, hundredths );

  lock( some_object, timeout, _LENR_LOCK );

  system( "DSPJOB OPTION(*JOBLCK)" );

 /*--------------------------------------------------------------------*/
 /* Obtain the PCS of the job/process that is running this program     */
 /* by using the Materialize Process Attributes function with the      */
 /* PCS selection option.                                              */
 /*--------------------------------------------------------------------*/

    process_attributes.Ptr_Attr3.Template_Size = sizeof( _MPRT_PTR_T );

    matpratr( &process_attributes, NULL, _MPRT_CTRL_SPC );

    to_PCS = process_attributes.Ptr_Attr3.Mptr_Ptr;

 /*--------------------------------------------------------------------*/
 /* Now transfer the LENR lock on the object to the other job.  DSPJOB */
 /* will be used again to allow the user to verify that the lock       */
 /* disappears from this job.  Since this example does not really      */
 /* transfer the lock to another job, the lock will still appear on    */
 /* the Display Job Locks display.                                     */
 /*--------------------------------------------------------------------*/

   xfrlock( to_PCS, some_object, _LENR_LOCK );

   system( "DSPJOB OPTION(*JOBLCK)" );

}
```

Output

```
                              Display Job Locks
                                                              System:   TORAS4YL
Job:   OMXNA3S4       User:   VISCA          Number:   009616

Job status:   ACTIVE

Type options, press Enter.
  5=Display job member locks
                                    Object                              Member
Opt    Object        Library        Type         Lock        Status     Locks
       MAIN          QSYS           *MENU        *SHRNUP      HELD
                                                 *SHRNUP      HELD
       MYUSRQ        MYLIB          *USRQ        *EXCL        HELD
       OMXNA3S4      QSYS           *DEVD        *EXCLRD      HELD
                                                 *EXCLRD      HELD
       QADM          QSYS           *LIB         *SHRRD       HELD
                                                                       More...
F3=Exit   F5=Refresh   F10=Display job record locks   F12=Cancel


                              Display Job Locks
                                                              System:   TORAS4YL
Job:   OMXNA3S4       User:   VISCA          Number:   009616

Job status:   ACTIVE

Type options, press Enter.
  5=Display job member locks
                                    Object                              Member
Opt    Object        Library        Type         Lock        Status     Locks
       MAIN          QSYS           *MENU        *SHRNUP      HELD
                                                 *SHRNUP      HELD
       MYUSRQ        MYLIB          *USRQ        *EXCL        HELD
       OMXNA3S4      QSYS           *DEVD        *EXCLRD      HELD
                                                 *EXCLRD      HELD
       QADM          QSYS           *LIB         *SHRRD       HELD
                                                                       More...
F3=Exit   F5=Refresh   F10=Display job record locks   F12=Cancel
```

Translate with Table (XLATEWT)

Format

```
#include <QSYSINC/MIH/XLATEWT>

void xlatewt (char *receiver,
              const char *source,
              const char *table);
```

Description

The xlatewt function translates the source characters under control of the translate table and places the translated characters into the receiver. The operation begins with the leftmost character of the source and proceeds character-by-character, left-to-right, until all source characters have been translated.

Parameters

rcvr_string (input/output)
Pointer to the receiver location to receive the translated string. The resulting string will be null-terminated.

src_string (input)
The source string.

table (input)
Pointer to the translation table. Must be exactly 256 bytes in length. This table specifies the translated values for the 256 possible byte values. Results are undefined if the table provided is less than 256 bytes.

Notes on Usage

- The xlatewt function operates on null-terminated strings.
- This is a compatibility function with the same semantics as the XLATEWT MI instruction.
- The length of the string to translate must be between 0 and 16 773 104.
- The builtin function _XLATEB also provides access to the MI instruction. _XLATEB does the translation in place.

Exceptions

If any of the input parameters are invalid, an MCH3601 or MCH0601 exception may be signalled.

Other exceptions possible from this function are:

MCH0602 - Boundary alignment
MCH0801 - Parameter Reference Violation
MCH3402 - Object Destroyed
MCH3602 - Pointer Type Invalid
MCH6801 - Object Domain Violation

Example

This example illustrates the use of the xlatewt function.

```
/*------------------------------------------------------------------------*/
/*                                                                        */
/* Example Group:   Computation and Branching  <QSYSINC/MIH/XLATEWT>  */
/*                                                                        */
/* Function:        xlatewt   (Translate with Table)                  */
/*                                                                        */
/* Description:     This example uses 'xlatewt' and a simple          */
/*                  'case folding' translate table to change the      */
/*                  input string to uppercase.                        */
/*                                                                        */
/*------------------------------------------------------------------------*/

#include <QSYSINC/MIH/XLATEWT>
#include <string.h>
#include <stdio.h>

#define SIZE  100

char xtable[256] = {
/*  0      1      2      3      4      5      6      7               */
/*  8      9      A      B      C      D      E      F               */
 '\0',   0,     0,     0,     0,     0,     0,     0,       /* 00-07 */
  0,     0,     0,     0,     0,     0,     0,     0,       /* 08-0F */
  0,     0,     0,     0,     0,     0,     0,     0,       /* 10-17 */
  0,     0,     0,     0,     0,     0,     0,     0,       /* 18-1F */
  0,     0,     0,     0,     0,     0,     0,     0,       /* 20-27 */
  0,     0,     0,     0,     0,     0,     0,     0,       /* 28-2F */
  0,     0,     0,     0,     0,     0,     0,     0,       /* 30-37 */
  0,     0,     0,     0,     0,     0,     0,     0,       /* 38-3F */
  ' ',   0,     0,     0,     0,     0,     0,     0,       /* 40-47 */
  0,     0,     0,     0,     0,     0,     0,     0,       /* 48-4F */
  0,     0,     0,     0,     0,     0,     0,     0,       /* 50-57 */
  0,     0,     0,     0,     0,     0,     0,     0,       /* 58-5F */
  0,     0,     0,     0,     0,     0,     0,     0,       /* 60-67 */
  0,     0,     0,     0,     0,     0,     0,     0,       /* 68-6F */
  0,     0,     0,     0,     0,     0,     0,     0,       /* 70-77 */
  0,     0,     0,     0,     0,     0,     0,     0,       /* 78-7F */
  0,     'A',   'B',   'C',   'D',   'E',   'F',   'G',     /* 80-87 */
  'H',   'I',   0,     0,     0,     0,     0,     0,       /* 88-8F */
  0,     'J',   'K',   'L',   'M',   'N',   'O',   'P',     /* 90-97 */
  'Q',   'R',   0,     0,     0,     0,     0,     0,       /* 98-9F */
  0,     0,     'S',   'T',   'U',   'V',   'W',   'X',     /* A0-A7 */
  'Y',   'Z',   0,     0,     0,     0,     0,     0,       /* A8-AF */
  0,     0,     0,     0,     0,     0,     0,     0,       /* B0-B7 */
  0,     0,     0,     0,     0,     0,     0,     0,       /* B8-BF */
  0,     0,     0,     0,     0,     0,     0,     0,       /* C0-C7 */
  0,     0,     0,     0,     0,     0,     0,     0,       /* C8-CF */
  0,     0,     0,     0,     0,     0,     0,     0,       /* 00-07 */
  0,     0,     0,     0,     0,     0,     0,     0,       /* 08-0F */
  0,     0,     0,     0,     0,     0,     0,     0,       /* E0-E7 */
  0,     0,     0,     0,     0,     0,     0,     0,       /* E8-EF */
  0,     0,     0,     0,     0,     0,     0,     0,       /* F0-F7 */
  0,     0,     0,     0,     0,     0,     0,     0,       /* F8-FF */
  };
```

```
int main(void) {

  char    source[SIZE] = "good day";
  char    receiver[SIZE];

  xlatewt(receiver, source, xtable);
  printf("The translated string is %s\n", receiver);

}
```

Output

```
The translated string is GOOD DAY
```

Appendix: Reference Summary

Table 1 briefly describes the MI functions. For each instruction the function prototype and description is provided.

The prototype for the associated builtin is also provided if it is identical to that of the function. The table also provides the prototypes for builtins which do not have a function interface.

The interface type of each function is also identified. The possible interface types are:

Type	Description
Function	Provides access to the MI instruction or performs an equivalent function.
Builtin	Provides access to the MI instruction.

The naming convention for the ILE C/400 MI library functions is as follows:

- Function names are all lowercase characters, for example, matinvat.
- Builtin names are in uppercase with an initial underscore character, for example, _MATS.

Table 1 (Page 1 of 18). Machine Interface Instructions

Instruction	C Function Prototype	Description
ATIEXIT	#include <mipgexec.h> **Function** `int atiexit (_OS_func_t *exit_handler, void *parm)`	Establish an invocation exit handler by copying pointers *exit_handler* and *parm* to internal buffers.

CDD	#include <QSYSINC/MIH/MIDTTM>
	Function
	`void cdd (_SPCPTR date_duration, _SPCPTRCN date1, _SPCPTRCN date2, _INST_Template_T2 *inst_t);`
	Builtin
	`void _CDD (_SPCPTR date_duration, _SPCPTRCN date1, _SPCPTRCN date2, _INST_Template_T2 *inst_t);`
		The date specified by *date2* is subtracted from the date specified by *date1* and the value of the result is placed in *date_duration*.

CLRBTS	#include <QSYSINC/MIH/CLRBTS>
	Function
	`void clrbts (_SPCPTR bit_string, unsigned int bit_offset);`
	Builtin
	`void _CLRBTS (_SPCPTR bit_string, unsigned int bit_offset);`
		Clear the bit in *bit_string* corresponding to *bit_offset*.

CMPPSPAD	#include <QSYSINC/MIH/CMPPSPAD> **Function** `int cmppspad (_SPCPTR space1, _SPCPTR space2);`	Compares space addressability of *space1* and *space2*.

Table 1 (Page 2 of 18). Machine Interface Instructions

Instruction	C Function Prototype	Description

CMPPTRA	#include <QSYSINC/MIH/CMPPTRA>
	Function
	`int cmpptra (_ANYPTR pointer1,`
	`_ANYPTR pointer2);`
	Builtin
	`int _CMPPTRA (_ANYPTR pointer1,`
	`_ANYPTR pointer2);`
		The objects addressed by *pointer1 and pointer2* are compared to determine if they are addressing the same object.

CMPPTRT	#include <QSYSINC/MIH/CMPPTRT>
	Function
	`int cmpptrt (_ANYPTR pointer,`
	`char type);`
	Builtin
	`int _CMPPTRT (char type,`
	`_ANYPTR pointer);`
		Compares the pointer type of *pointer* with the character *type*.

CPRDATA	#include <QSYSINC/MIH/CPRDATA>
	Function
	`int cprdata (_SPCPTR result,`
	`int result_length,`
	`_SPCPTRCN source,`
	`int src_length);`
	Builtin
	`void _CPRDATA (_CPRD_Template_T *cprd_t);`
		Compresses user data of specified length.

CRTMTX	#include <QSYSINC/MIH/CRTMTX>
	Builtin
	`int _CRTMTX (_Mutex_T *,`
	`_Mutex_Create_T *);`
		Creates a mutex.

CTD	#include <QSYSINC/MIH/MIDTTM>
	Function
	`void ctd (_SPCPTR time_duration,`
	`_SPCPTRCN time1,`
	`_SPCPTRCN time2,`
	`_INST_Template_T2 *inst_t);`
	Builtin
	`void _CTD (_SPCPTR time_duration,`
	`_SPCPTRCN time1,`
	`_SPCPTRCN time2,`
	`_INST_Template_T2 *inst_t);`
		The time specified by *time2*, is subtracted from the time specified by *time1* and the value of the result is placed in *time_duration*.

CTSD	#include <QSYSINC/MIH/MIDTTM>
	Function
	`void ctsd (_SPCPTR timestamp_duration,`
	`_SPCPTRCN timestamp1,`
	`_SPCPTRCN timestamp2,`
	`_INST_Template_T2 *inst_t);`
	Builtin
	`void _CTSD (_SPCPTR timestamp_duration,`
	`_SPCPTRCN timestamp1,`
	`_SPCPTRCN timestamp2,`
	`_INST_Template_T2 *inst_t);`
		The timestamp specified by *timestamp2*, is subtracted from the timestamp specified by *timestamp1* and the result is placed in *timestamp_duration*.

Table 1 (Page 3 of 18). Machine Interface Instructions

Instruction	C Function Prototype	Description

CVTBC	#include <QSYSINC/MIH/CVTBC>
	Function
	`int cvtbc (_SPCPTR receiver, unsigned int rcvr_length, _CVTBC_Control_T *controls, _SPCPTRCN source, unsigned int src_length);`
	Builtin
	`void _CVTBC (_SPCPTR receiver, unsigned int rcvr_length, _CVTBC_Control_T *controls, _SPCPTRCN source, unsigned int src_length, int *return_code);`
	Return Code
	Value **Meaning**
	-1 Completed Record
	0 Source Exhausted
	1 Truncated Record
		Converts *source* from the BSC compressed format to character, under control of *controls*, and places the result into *receiver*.

CVTCB	#include <QSYSINC/MIH/CVTCB>
	Function
	`int cvtcb (_SPCPTR receiver, unsigned int rcvr_length, _CVTCB_Control_T *controls, _SPCPTRCN source, unsigned int src_length);`
	Builtin
	`void _CVTCB (_SPCPTR receiver, unsigned int rcvr_length, _CVTCB_Control_T *controls, _SPCPTRCN source, unsigned int src_length, int *return_code);`
	Return Code
	Value **Meaning**
	-1 Receiver Overrun
	0 Source Exhausted
		Converts *source* from character to the BSC compressed format, under control of *controls*, and places the result into *receiver*.

CVTCH	#include <QSYSINC/MIH/CVTCH> **Function** `void cvtch (_SPCPTR receiver, _SPCPTRCN source, int size);`	Each 8-bit character of *source* is converted to a 4-bit hex digit and placed in *receiver*.

CVTCM	#include <QSYSINC/MIH/CVTCM>
	Function
	`int cvtcm (_SPCPTR receiver, unsigned int rcvr_length, _CVTCM_Control_T *controls, _SPCPTRCN source, unsigned int src_length);`
	Builtin
	`void _CVTCM (_SPCPTR receiver, unsigned int rcvr_length, _CVTCM_Control_T *controls, _SPCPTRCN source, unsigned int src_length, int *return_code);`
	Return Code
	Value **Meaning**
	-1 Receiver Overrun
	0 Source Exhausted
		Converts *source* from character format to MRJE compressed format under control of *controls*, and places the results in *receiver*.

Table 1 (Page 4 of 18). Machine Interface Instructions

Instruction	C Function Prototype	Description

CVTCS	#include <QSYSINC/MIH/CVTCS>
	Function
	`int cvtcs (_SPCPTR receiver,`
	`unsigned int rcvr_length,`
	`_CVTCS_Control_T *controls,`
	`_SPCPTRCN source,`
	`unsigned int src_length);`
	Builtin
	`void _CVTCS (_SPCPTR receiver,`
	`unsigned int rcvr_length,`
	`_CVTCS_Control_T *controls,`
	`_SPCPTRCN source,`
	`unsigned int src_length,`
	`int *return_code);`
	Return Code
	Result **Meaning**
	-1 Receiver Overrun
	0 Source Exhausted
		Converts *source* from character to SNA format under control of *controls*, and places the results in *receiver*.

CVTD	#include <QSYSINC/MIH/MIDTTM>
	Function
	`void cvtd (_SPCPTR result_date,`
	`_SPCPTRCN source_date,`
	`_INST_Template_T1 *inst_t);`
	Builtin
	`void _CVTD (_SPCPTR result_date,`
	`_SPCPTRCN source_date,`
	`_INST_Template_T1 *inst_t);`
		The date specified in *source_date* is converted to another calendar external or internal presentation and placed in *result_date*.

CVTEFN	#include <QSYSINC/MIH/CVTEFN>
	Function
	`int cvtefni (_SPCPTRCN source,`
	`unsigned int src_length,`
	`char mask[3]);`
	`double cvtefnd (_SPCPTRCN source,`
	`unsigned int src_length,`
	`char mask[3]);`
	Builtin
	`void _CVTEFN (_SPCPTR receiver,`
	`_DPA_Template_T *rcvr_descr,`
	`_SPCPTRCN source,`
	`unsigned int *src_length,`
	`_SPCPTR mask);`
	or
	`void _CVTEFN1(_SPCPTR receiver,`
	`_DPA_Template_T *rcvr_descr,`
	`_SPCPTRCN source,`
	`unsigned int *src_length,`
	`_SPCPTR mask);`
	or
	`void _CVTEFN2(_SPCPTR receiver,`
	`_DPA_Template_T *rcvr_descr,`
	`_SPCPTRCN source,`
	`unsigned int *src_length);`
		Scans a character *source* for a valid decimal number in display format, removes the display character, and places the result in *receiver*.

CVTHC	#include <QSYSINC/MIH/CVTHC>
	Function
	`void cvthc (_SPCPTR receiver,`
	`_SPCPTRCN source,`
	`int size);`
		Each 4-bit hex digit of *source* is converted to an 8-bit character and placed in *receiver*.

Table 1 (Page 5 of 18). Machine Interface Instructions

Instruction	C Function Prototype	Description

CVTMC	#include <QSYSINC/MIH/CVTMC>
	Function
	`int cvtmc (_SPCPTR receiver, unsigned int rcvr_length, _CVTMC_Control_T *controls, _SPCPTRCN source, unsigned int src_length);`
	Builtin
	`void _CVTMC (_SPCPTR receiver, unsigned int rcvr_length, _CVTMC_Control_T *controls, _SPCPTRCN source, unsigned int src_length, int *return_code);`
	Return Code
	Result **Meaning**
	-1 Receiver Overrun
	0 Source Exhausted
		Converts *source* from MRJE compressed format to character format under control of *controls*, and places the results in *receiver*.

CVTSC	#include <QSYSINC/MIH/CVTSC>
	Function
	`int cvtsc (_SPCPTR receiver, unsigned int rcvr_length, _CVTSC_Control_T *controls, _SPCPTRCN source, unsigned int src_length);`
	Builtin
	`void _CVTSC (_SPCPTR receiver, unsigned int rcvr_length, _CVTSC_Control_T *controls, _SPCPTRCN source, unsigned int src_length, int *return_code);`
	Return Code
	Result **Meaning**
	-1 Receiver Overrun
	0 Source Exhausted
	1 Escape Code Encountered
		Converts *source* from SNA format to character format under control of *controls*, and places the results in *receiver*.

CVTT	#include <QSYSINC/MIH/MIDTTM>
	Function
	`void cvtt (_SPCPTR result_time, _SPCPTRCN source_time, _INST_Template_T1 *inst_t);`
	Builtin
	`void _CVTT (_SPCPTR result_time, _SPCPTRCN source_time, _INST_Template_T1 *inst_t);`
		The time specified in *source_time* is converted to another external or internal presentation and placed in *result_time*.

CVTTS	#include <QSYSINC/MIH/MIDTTM>
	Function
	`void cvtts (_SPCPTR result_timestamp, _SPCPTRCN source_timestamp, _INST_Template_T1 *inst_t);`
	Builtin
	`void _CVTTS (_SPCPTR result_timestamp, _SPCPTRCN source_timestamp, _INST_Template_T1 *inst_t);`
		The timestamp specified in *source_timestamp* is converted to another external or internal presentation and placed in *result_timestamp*.

Table 1 (Page 6 of 18). Machine Interface Instructions

Instruction	C Function Prototype	Description

CPYBLA	#include <QSYSINC/MIH/CPYBLA>
	Function
	`void cpybla (_SPCPTR receiver,`
	`_SPCPTRCN source,`
	`int size);`
	Builtin
	`void _CPYBYTES (_SPCPTR receiver,`
	`_SPCPTRCN source,`
	`unsigned int size);`
		Copies *source* to *receiver* (without pad).

CPYBLAP	#include <QSYSINC/MIH/CPYBLAP>
	Function
	`void cpyblap (_SPCPTR receiver,`
	`int rcvr_size,`
	`_SPCPTRCN source,`
	`int src_size,`
	`char pad);`
		Copies *source* to *receiver*. with pad.

CPYHEXNN	#include <QSYSINC/MIH/CPYHEXNN> **Function** `char cpyhexnn (char *dest, char source);`	The numeric hex digit value (rightmost 4 bits) of the byte referred to by *source*, is copied to the numeric hex digit value (rightmost 4 bits) of the leftmost byte of *dest*.
CPYHEXNZ	#include <QSYSINC/MIH/CPYHEXNZ> **Function** `char cpyhexnz (char *dest, char source);`	The numeric hex digit value (rightmost 4 bits) of the byte referred to by *source*, is copied to the zone hex digit value (left-most 4 bits) of the leftmost byte of *dest*.
CPYHEXZN	#include <QSYSINC/MIH/CPYHEXZN> **Function** `char cpyhexzn (char *dest, char source);`	The zone hex digit value (leftmost 4 bits) of the byte referred to by *source*, is copied to the numeric hex digit (rightmost 4 bits) of the leftmost byte referred to by *dest*.
CPYHEXZZ	#include <QSYSINC/MIH/CPYHEXZZ> **Function** `char cpyhexzz (char *dest, char source);`	The zone hex digit value (leftmost 4 bits) of the byte referred to by *source*, is copied to the zone hex digit value (leftmost 4 bits) of the leftmost byte referred to by *dest*.

CPYNV	#include <QSYSINC/MIH/CPYNV>
	Function
	`void cpynv (_NUM_Descr_T rcvr_descr,`
	`_SPCPTR receiver,`
	`_NUM_Descr_T src_descr,`
	`_SPCPTRCN source);`
	Builtin
	`void _LBCPYNV (_SPCPTR receiver,`
	`_DPA_Template_T`
	`*rcvr_attributes,`
	`_SPCPTRCN source,`
	`_DPA_Template_T`
	`*src_attributes);`
	or
	`void _CPYNV (_NUM_Descr_T rcvr_descr,`
	`_SPCPTR receiver,`
	`_NUM_Descr_T src_descr,`
	`const _SPCPTR source);`
		Copies the numeric value of *source* to the numeric value of *receiver*, with appropriate conversions.

Table 1 (Page 7 of 18). Machine Interface Instructions

Instruction	C Function Prototype	Description

DCPDATA	#include <QSYSINC/MIH/DCPDATA>
	Function
	`int dcpdata (_SPCPTR result, int result_length, _SPCPTRCN source);`
	Builtin
	`void _DCPDATA (_DCPD_Template_T *dcpd_t);`
		Decompresses user data of a specified length.

DECD	#include <QSYSINC/MIH/MIDTTM>
	Function
	`void decd (_SPCPTR result_date, _SPCPTRCN source_date, _SPCPTRCN duration, _INST_Template_T3 *inst_t);`
	Builtin
	`void _DECD (_SPCPTR result_date, _SPCPTRCN source_date, _SPCPTRCN duration, _INST_Template_T3 *inst_t);`
		The date specified by *source_date* is decremented by the date duration specified by *duration*. The resulting date is placed in *result_date*.

DECT	#include <QSYSINC/MIH/MIDTTM>
	Function
	`void dect (_SPCPTR result_time, _SPCPTRCN source_time, _SPCPTRCN duration, _INST_Template_T3 *inst_t)`
	Builtin
	`void _DECT (_SPCPTR result_time, _SPCPTRCN source_time, _SPCPTRCN duration, _SPCPTR_Template_T3 *inst_t);`
		The time specified by *source_time* is decremented by the time duration specified by *duration*. The resulting time is placed in *result_time*.

DECTS	#include <QSYSINC/MIH/MIDTTM>
	Function
	`void dects (_SPCPTR result_timestamp, _SPCPTRCN source_timestamp, _SPCPTRCN duration, _INST_Template_T3 *inst_t);`
	Builtin
	`void _DECTS (_SPCPTR result_timestamp, _SPCPTRCN source_timestamp, _SPCPTRCN duration, _INST_Template_T3 *inst_t);`
		The timestamp specified by *source_timestamp* is decremented by the date, time or timestamp duration specified by *duration*. The resulting timestamp is placed in *result_timestamp*.

DESMTX	#include <QSYSINC/MIH/DESMTX> **Builtin** `void _DESMTX (_Mutex_T * _Mutex_Destroy_Opt_T *);`	Destroys a mutex.

DEQ	#include <QSYSINC/MIH/DEQ>
	Function
	`void deq (_DEQ_Msg_Prefix_T *msg_prefix, _SPCPTR message, _SYSPTR queue);`
	Builtin
	`void _DEQWAIT (_DEQ_Msg_Prefix_T *msg_prefix, _SPCPTR message, _SYSPTR *queue);`
		Retrieves a queue message based on the queue type specified during the queue's creation. Process is placed in a wait state.

Table 1 (Page 8 of 18). Machine Interface Instructions

Instruction	C Function Prototype	Description

DEQI	#include <QSYSINC/MIH/DEQI>
	Function
	`int deqi (_DEQ_Msg_Prefix_T *msg_prefix, _SPCPTR message, _SYSPTR queue);`
	Builtin
	`int _DEQ (_DEQ_Msg_Prefix_T *msg_prefix, _SPCPTR message, _SYSPTR *queue);`
	Return Value
	Value **Meaning**
	1 Message Dequeued
	0 Message Not Dequeued
		Retrieves a queue message based on queue type (FIFO, LIFO, or keyed). Process is not placed in a wait state.

EDIT	#include <QSYSINC/MIH/EDIT>
	Function
	`void edit (_SPCPTR receiver, unsigned int rcvr_length, _SPCPTRCN source, _NUM_Descr_T src_descr, _SPCPTR mask, unsigned int mask_length);`
	Builtin
	`void _LBEDIT (_SPCPTR receiver, unsigned int *rcvr_length, _SPCPTRCN source, _DPA_Template_T *src_descr, _SPCPTR mask, unsigned int *mask_length);`
		The value of *source* is transformed under control of *mask* and the result is placed in *receiver*.

EDIT with Packed Decimal Source	#include <QSYSINC/MIH/EDIT>
	Function
	`void edit_packed (_SPCPTR receiver, unsigned int rec_length, SPCPTRCN source, unsigned int src_length, _SPCPTR mask, unsigned int mask_length);`
	Builtin
	`void _EDITPD (_SPCPTR receiver, unsigned int rcvr_length, _SPCPTRCN source, unsigned int src_length, _SPCPTR mask, unsigned int mask_length);`
		The value of the packed decimal *source* is transformed under control of *mask*, and the result is placed in *receiver*.

ENQ	#include <QSYSINC/MIH/ENQ>
	Function
	`void enq (_SYSPTR queue, _ENQ_Msg_Prefix_T *msg_prefix, _SPCPTR message);`
	Builtin
	`void _ENQ (_SYSPTR *system_ptr, _ENQ_Msg_Prefix_T *msg_prefix, _SPCPTR message);`
		A message is enqueued according to the queue type attribute specified during the queue's creation.

ENSOBJ	#include <QSYSINC/MIH/ENSOBJ>
	Function
	`void ensobj (_SYSPTR object);`
	Builtin
	`void _ENSOBJ (_SYSPTR *object);`
		The object specified is protected from volatile storage loss.

Table 1 (Page 9 of 18). Machine Interface Instructions

Instruction	C Function Prototype	Description
EXTREXP	#include <QSYSINC/MIH/EXTREXP> **Function** `int extrexp (double source);`	Extracts the exponent portion of the floating point scalar and returns the value as a 4-byte integer.

FNDINXEN	#include <QSYSINC/MIH/FNDINXEN>
	Function
	`_SPCPTR fndinxen (_SPCPTR receiver,`
	`_SYSPTR index_obj,`
	`_IIX_Opt_List_T`
	`*option_list,`
	`_SPCPTR search_arg);`
	Builtin
	`void _FNDINXEN (_SPCPTR receiver,`
	`_SYSPTR *index_obj,`
	`_IIX_Opt_List_T`
	`*option_list,`
	`_SPCPTR search_arg);`
		Searches *index_obj* according to the search criteria specified in *option_list* and search argument *search_arg*.

FNDRINVN	#include <QSYSINC/MIH/FNDRINVN>
	Function
	`int fndrinvn (_INV_Template_T *inv_t,`
	`int srch_option,`
	`_SPCPTRCN srch_arg,`
	`char compare);`
	Builtin
	`void _FNDRINVN1 (int *rel_inv_number,`
	`_FNDR_Search_Template_T`
	`*srch_t);`
	or
	`void _FNDRINVN2 (int *rel_inv_number,`
	`_INV_Template_T *inv_t,`
	`_FNDR_Search_Template_T`
	`*srch_t);`
		Searches a specified range of invocations until an invocation is found which satisfies the search criteria.

INCD	#include <QSYSINC/MIH/MIDTTM>
	Function
	`void incd (_SPCPTR result_date,`
	`_SPCPTRCN source_date,`
	`_SPCPTRCN duration,`
	`_INST_Template_T3 *inst_t);`
	Builtin
	`void _INCD (_SPCPTR result_date,`
	`_SPCPTR source_date,`
	`_SPCPTR duration,`
	`_INST_Template_T3 *inst_t);`
		The date specified by *source_date* is incremented by the date duration specified by *duration*. The resulting date is placed in *result_date*.

INCT	#include <QSYSINC/MIH/MIDTTM>
	Function
	`void inct (_SPCPTR result_time,`
	`_SPCPTRCN source_time,`
	`_SPCPTRCN duration,`
	`_INST_Template_T3 *inst_t);`
	Builtin
	`void _INCT (_SPCPTR result_time,`
	`_SPCPTRCN source_time,`
	`_SPCPTRCN duration,`
	`_INST_Template_T3 *inst_t);`
		The time specified by *source_time* is incremented by the time duration specified by *duration*. The resulting time is placed in *result_time*.

Table 1 (Page 10 of 18). Machine Interface Instructions

Instruction	C Function Prototype	Description

INCTS	#include <QSYSINC/MIH/MIDTTM>
	Function
	`void incts (_SPCPTR result_timestamp,`
	`_SPCPTRCN source_timestamp,`
	`_SPCPTRCN duration,`
	`_INST_Template_T3 *inst_t);`
	Builtin
	`void _INCTS (_SPCPTR result_timestamp,`
	`_SPCPTRCN source_timestamp,`
	`_SPCPTRCN duration,`
	`_INST_Template_T3 *inst_t);`
		The timestamp specified by *source_timestamp* is incremented by the date, time or timestamp duration specified by *duration*. The resulting timestamp is placed in *result_timestamp*.

INSINXEN	#include <QSYSINC/MIH/INSINXEN>
	Function
	`void insinxen (_SYSPTR index_obj,`
	`_SPCPTR new_entry,`
	`_IIX_Opt_List_T`
	`*option_list);`
	Builtin
	`void _INSINXEN (_SYSPTR *index_obj,`
	`_SPCPTR new_entry,`
	`_IIX_Opt_List_T`
	`*option_list);`
		Inserts one or more new entries into the *index_obj* according to the criteria specified on *option_list*.

LOCK	#include <QSYSINC/MIH/LOCK>
	Function
	`void lock (_SYSPTR object,`
	`MI_Time wait_time,`
	`char lock_state);`
	Builtin
	`void Lock (_LOCK_Template_T *lock_request);`
	or
	`void _LOCK (_LOCK_Template_T *lock_request);`
		Requests the lock(s) for the system object(s) identified be allocated to the issuing process.

LOCKMTX	#include <QSYSINC/MIH/LOCKMTX>
	Builtin
	`void _LOCKMTX (_Mutex_T *,`
	`_Mutex_Lock_T *);`
		Locks a mutex.

LOCKSL	#include <QSYSINC/MIH/LOCKSL>
	Function
	`void locksl (_SPCPTR location,`
	`char lock_state);`
	`void locksl2 (_SPCPTR location,`
	`_MI_Time wait_time,`
	`char lock_state);`
	Builtin
	`void _LOCKSL1 (_SPCPTR *location,`
	`char* lock_state);`
	`void _LOCKSL2 (_LOCKSL_Template_T *`
	`*lock_t);`
		Grants the space location(s) to the issuing process according to the lock request.

MATACTAT	#include <QSYSINC/MIH/MATACTAT>
	Function
	`void matactat (_MTACT_Template_T *receiver,`
	`unsigned int act_mark,`
	`char attr_selection);`
	Builtin
	`void _MATACTAT (_MTACT_Template_T *receiver,`
	`unsigned int *act_mark,`
	`char *attr_selection);`
		Materializes the information selected by *attr_selection* for the program activation specified by *act_mark* and stores it in *receiver*.

Table 1 (Page 11 of 18). Machine Interface Instructions

Instruction	C Function Prototype	Description

MATAGAT	#include <QSYSINC/MIH/MATAGAT>
	Function
	`void matagat (_MAGAT_Template_T *receiver, _SYSPTR access_group);`
	Builtin
	`void _MATAGAT (_MAGAT_Template_T *receiver, _SYSPTR *access_group);`
		Materializes the attributes of *access_group* into *receiver*.

MATAGPAT	#include <QSYSINC/MIH/MATAGPAT>
	Function
	`void matagpat (_MAGP_Template_T *receiver, unsigned int act_grp_mark, char attr_selection);`
	Builtin
	`void _MATAGPAT (_MAGP_Template_T *receiver, unsigned int *act_grp_mark, char *attr_selection);`
		Materializes the information selected by *attr_selection* for activation group *act_grp_mark* and stores it in *receiver*.

MATAOL	#include <QSYSINC/MIH/MATAOL>
	Function
	`void mataol (_MAOL_Template_T *receiver, _ANYPTR pointer);`
	Builtin
	`void _MATAOL (_MAOL_Template_T *receiver, _ANYPTR *pointer);`
		Materializes the current allocated locks on a system object or space location into *receiver*.

MATINVAT	#include <QSYSINC/MIH/MATINVAT>
	Function
	`void matinvat (_SPCPTR receiver, _INV_Template_T *inv_t, int attr_id, int rcvr_length);`
	Builtin
	`void _MATINVAT1 (_SPCPTR receiver, _Select_Template_T *select_t);`
	or
	`void _MATINVAT2 (_SPCPTR receiver, _INV_Template_T *inv_t, _Select_Template_T *select_t);`
		Materializes the attributes of the specified invocation into *receiver*.

MATINXAT	#include <QSYSINC/MIH/MATINXAT>
	Function
	`void matinxat (_IIX_Template_T *receiver, _SYSPTR index_obj);`
	Builtin
	`void _MATINXAT (_IIX_Template_T *receiver, _SYSPTR *index_obj);`
		Materializes the creation attribute and current operational statistics of *index_obj* into *receiver*.

MATMATR	#include <QSYSINC/MIH/MATMATR>
	Function
	`void matmatr (_MMTR_Template_T *receiver, short attr);`
	Builtin
	`void _MATMATR1 (_MMTR_Template_T *receiver, short *attr);`
		Materializes the machines attributes specified by *attr* into *receiver*.

Table 1 (Page 12 of 18). Machine Interface Instructions

Instruction	C Function Prototype	Description

MATMDATA	#include <QSYSINC/MIH/MATMDATA>
	Function
	`void matmdata (_MDATA_Template_T *receiver, short options);`
	Builtin
	`void _MATMDATA (_MDATA_Template *receiver, short options);`
		Materializes the requested machine data into *receiver*.

MATMTX	#include <QSYSINC/MIH/MATMTX> **Builtin** `void _MATMTX (_Mutex_Mat_T *, _Mutex_T *, _Mutex_Mat_Opt_T *);`	Materializes a mutex.

MATOBJLK	#include <QSYSINC/MIH/MATOBJLK>
	Function
	`void matobjlk (_MOBJL_Template_T *receiver, _ANYPTR object);`
	Builtin
	`void _MATOBJLK (_MOBJL_Template_T *receiver, _ANYPTR *object);`
		The current lock status of the object or space location is materialized into *receiver*.

MATPG	#include <QSYSINC/MIH/MATPG>
	Function
	`void matpg (_MATPG_Template_T *receiver, _SYSPTR program);`
	Builtin
	`void _MATPG (_MATPG_Template_T *receiver, _SYSPTR *program);`
		program is materialized into *receiver*.

MATPRMTX	#include <QSYSINC/MIH/MATPRMTX> **Builtin** `void _MATPRMTX (_Mutex_Matpr_T *, _SYSPTR *, _Mutex_Matpr_Opt_T *);`	Materializes process mutex locks.

MATPTR	#include <QSYSINC/MIH/MATPTR>
	Function
	`void matptr (_MPTR_Template_T *receiver, _ANYPTR pointer);`
	Builtin
	`void _MATPTR (_MPTR_Template_T *receiver, _ANYPTR *pointer);`
		The materialized form of *pointer* is returned in *receiver*

MATPTRL	#include <QSYSINC/MIH/MATPTRL>
	Function
	`void matptrl (_MPTL_Template_T *receiver, _SPCPTRCN source, int length);`
	Builtin
	`void _MATPTRL (_MPTL_Template_T *receiver, _SPCPTRCN source, int *length);`
		Finds the pointers in a subset of a space and produces a bit mapping of their relative locations.

MATPRAGP	#include <QSYSINC/MIH/MATPRAGP>
	Function
	`void matpragp (_MPRAG_Template_T *receiver);`
	Builtin
	`void _MATPRAGP (_MPRAG_Template_T *receiver);`
		A list of the activation groups which exist in the current process are returned in *receiver*.

Table 1 (Page 13 of 18). Machine Interface Instructions

Instruction	C Function Prototype	Description

MATPRATR	#include <QSYSINC/MIH/MATPRATR>
	Function
	`void matpratr (_MPRT_Template_T *receiver,`
	`_SYSPTR control_spc,`
	`char options);`
	Builtin
	`void _MATPRATR1 (_MPRT_Template_T *receiver,`
	`char *options);`
	or
	`void _MATPRATR2 (_MPRT_Template_T *receiver,`
	`_SYSPTR *control_spc,`
	`char *options);`
		Materialize attributes of *control_spc* into *receiver* according to the specified options.

MATPRLK	#include <QSYSINC/MIH/MATPRLK>
	Function
	`void matprlk (_MPRL_Template_T *receiver,`
	`_SYSPTR pcs);`
	Builtin
	`void _MATPRLK1 (_MPRL_Template_T *receiver);`
	or
	`void _MATPRLK2 (_MPRL_Template_T *receiver,`
	`_SYSPTR *pcs);`
		The lock status of the process identified by *pcs* is materialized into *receiver*.

MATQAT	#include <QSYSINC/MIH/MATQAT>
	Function
	`void matqat (_MQAT_Template_T *receiver,`
	`_SYSPTR queue);`
	Builtin
	`void _MATQAT (_MQAT_Template_T *receiver,`
	`_SYSPTR *queue);`
		The attributes of the *queue* are materialized into *receiver*

MATQMSG	#include <QSYSINC/MIH/MATQMSG>
	Function
	`void matqmsg (_MQMS_Template_T *receiver,`
	`_SYSPTR queue,`
	`char selection,`
	`int max_key,`
	`int max_msg,`
	`_SPCPTR key);`
	Builtin
	`void _MATQMSG (_MQMS_Template_T *receiver,`
	`_SYSPTR *queue,`
	`_MQMS_Select_T *selection);`
		Materializes selected messages in *queue* into *receiver*.

MATRMD	#include <QSYSINC/MIH/MATRMD>
	Function
	`void matrmd (_MATRMD_Template_T *receiver,`
	`_SPCPTR control);`
	Builtin
	`void _MATRMD (_MATRMD_Template_T *receiver,`
	`_SPCPTR control);`
		The data items requested by *control* are materialized into *receiver*

MATS	#include <QSYSINC/MIH/MATS>
	Function
	`void mats (_SPC_Template_T *receiver,`
	`_SYSPTR space_object);`
	Builtin
	`void _MATS (_SPC_Template_T *receiver,`
	`_SYSPTR *space_object);`
		The current attributes of the space object specified by *space_object* are materialized into *receiver*.

Table 1 (Page 14 of 18). Machine Interface Instructions

Instruction	C Function Prototype	Description

MATSELLK	#include <QSYSINC/MIH/MATSELLK>
	Function
	`void matsellk (_MSLL_Template_T *receiver, _ANYPTR pointer);`
	Builtin
	`void _MATSELLK (_MSLL_Template_T *receiver, _ANYPTR *pointer);`
		Materializes the locks held by the process issuing this instruction for the object or space location specified.

MATSOBJ	#include <QSYSINC/MIH/MATSOBJ>
	Function
	`void matsobj (_MSOB_Template_T *receiver, _SYSPTR object);`
	Builtin
	`void _MATSOBJ (_MSOB_Template_T *receiver, _SYSPTR *object);`
		Materializes the identity and size of a system object addressed by *object* into *receiver*.

MATTOD	#include <QSYSINC/MIH/MATTOD>
	Function
	`void mattod (_MI_Time time_of_day);`
	Builtin
	`void _MATTOD (_MI_Time time_of_day);`
		Materializes the *time_of_day* clock.

MITIME	#include <QSYSINC/MIH/MICOMMON> **Function** `_MI_TIME *mitime (_MI_Time *receiver, int hours, int minutes, int seconds, int hundredths);`	Sets *receiver* to the AS/400 system value for time.

MODASA	#include <QSYSINC/MIH/MODASA>
	Function
	`_SPCPTR modasa (unsigned int size);`
	Builtin
	`_SPCPTR _MODASA (unsigned int size);`
		Extend the current allocation of automatic storage by *size* bytes.

MODINX	#include <QSYSINC/MIH/MODINX>
	Function
	`void modinx (_SYSPTR index_obj, char mod_option);`
	Builtin
	`void _MODINX (_SYSPTR *index_obj, unsigned int *mod_option);`
		Modifies the selected attributes of *index_obj*.

MODS	#include <QSYSINC/MIH/MODS>
	Function
	`void mods (_SYSPTR space_object, int size);`
	Builtin
	`void _MODS1 (_SYSPTR *space_object, int *size);`
		Resize the space associated with *space_object* to *size* bytes.

MODS2	#include <QSYSINC/MIH/MODS2>
	Function
	`void mods2 (_SYSPTR space_object, _SPC_MOD_T *space_t);`
	Builtin
	`void _MODS2 (_SYSPTR *space_object, _SPC_MOD_T *space_t);`
		The attributes of the space associated with *space_object* are modified with the attribute values specified in *space_t*.

Table 1 (Page 15 of 18). Machine Interface Instructions

Instruction	C Function Prototype	Description

RSLVSP	#include <QSYSINC/MIH/RSLVSP>
	Function
	`_SYSPTR rslvsp (_OBJ_TYPE_T obj_type,`
	`_OBJ_NAME obj_name,`
	`_LIB_NAME lib_name,`
	`_REQ_AUTH auth);`
	Builtin
	`void _RSLVSP1 (_SYSPTR *ptr_to_object);`
	or
	`void _RSLVSP2 (_SYSPTR *ptr_to_object,`
	`_RSLV_Template_T`
	`*objid_and_authreq);`
	or
	`void _RSLVSP3 (_SYSPTR *ptr_to_object,`
	`_SYSPTR *library);`
	or
	`void _RSLVSP4 (_SYSPTR *ptr_to_object,`
	`_RSLV_Template_T`
	`*objid_and_authreq,`
	`_SYSPTR *library);`
	or
	`void _RSLVSP5 (_SYSPTR *ptr_to_object,`
	`_REQ_AUTH *auth);`
	or
	`void _RSLVSP6 (_SYSPTR *ptr_to_object,`
	`_RSLV_Template_T`
	`*objid_and_authreq,`
	`_REQ_AUTH *auth);`
	or
	`void _RSLVSP7 (_SYSPTR *ptr_to_object,`
	`_SYSPTR *library,`
	`_REQ_AUTH *auth);`
	or
	`void _RSLVSP8 (_SYSPTR *ptr_to_object,`
	`_RSLV_Template_T`
	`*objid_and_authreq,`
	`_SYSPTR *library,`
	`_REQ_AUTH *auth);`
		Locates an object identified by the object identifier (type, name, and library) and returns the object's addressability in a system pointer.

RETCA	#include <QSYSINC/MIH/RETCA> **Function** `unsigned int retca (unsigned int mask);`	Retrieves from the machine and returns the 4-byte value containing the selected computational attributes.

RMVINXEN	#include <QSYSINC/MIH/RMVINXEN>
	Function
	`_SPCPTR rmvinxen (_SPCPTR receiver,`
	`_SYSPTR index_obj,`
	`_IIX_Opt_List_T`
	`*option_list,`
	`_SPCPTR search_arg);`
	Builtin
	`void _RMVINXEN1 (_SYSPTR *index_obj,`
	`_IIX_Opt_List_T`
	`*option_list,`
	`_SPCPTR search_arg);`
	or
	`void _RMVINXEN2 (_SPCPTR receiver,`
	`_SYSPTR *index_obj,`
	`_IIX_Opt_List_T`
	`*option_list,`
	`_SPCPTR search_arg);`
		The index entries identified by *option_list* and *search_arg* are removed from *index_obj* and returned in *receiver*.

SCANWC	#include <QSYSINC/MIH/SCANWC>
	Function
	`int scanwc (char *source,`
	`_SCWC_Control_T *controls,`
	`char options);`
		The *source* string is scanned for occurrences of a character value satisfying the criteria in *control* and *options*.

Table 1 (Page 16 of 18). Machine Interface Instructions

Instruction	C Function Prototype	Description

SCANX	#include <QSYSINC/MIH/SCANX>
	Builtin
	`int _SCANX(char **source,`
	`_SCWC_Control_T *controls,`
	`int options);`
		The *source* string is scanned for occurrences of a character value satisfying the criteria in *control* and *options*.

SETACST	#include <QSYSINC/MIH/SETACST>
	Function
	`void setacst (_ANYPTR object,`
	`char state_code,`
	`int pool_id,`
	`int space_length);`
	Builtin
	`void Setacst (_SETACST_Template_T`
	`*access_t);`
	or
	`void _SETACST (_SETACST_Template_T`
	`*access_t);`
		Specifies the access state that the issuing process has for a set of objects or subobject elements in the execution interval following the execution of this instruction.

SETBTS	#include <QSYSINC/MIH/SETBTS>
	Function
	`void setbts (_SPCPTR bit_string,`
	`unsigned int bit_offset);`
	Builtin
	`void _SETBTS (_SPCPTR bit_string,`
	`unsigned int bit_offset);`
		Set the bit in *bit_string* corresponding to *bit_offset*.

SETCA	#include <QSYSINC/MIH/SETCA>
	Function
	`void setca (unsigned int new_value,`
	`unsigned int mask);`
		Sets the computation attributes selected and stores them into the machine.

SETSPFP	#include <QSYSINC/MIH/SETSPFP>
	Function
	`_SYSPTR setspfp (_ANYPTR pointer);`
	Builtin
	`_SYSPTR _SETSPFP (_ANYPTR pointer);`
		Returns a system pointer to the system object addressed by *pointer*.

SETSPPFP	#include <QSYSINC/MIH/SETSPPFP>
	Function
	`_SPCPTR setsppfp (_ANYPTR pointer);`
	Builtin
	`_SPCPTR _SETSPPFP (_ANYPTR pointer);`
		Returns addressability to a space object from *pointer*.

SETSPPO	#include <QSYSINC/MIH/SETSPPO>
	Function
	`_SPCPTR setsppo (_SPCPTR pointer,`
	`int offset);`
		The value of the *offset* is assigned to the offset portion of *pointer*.

STSPPO	#include <QSYSINC/MIH/STSPPO> **Function** `int stsppo (_SPCPTR pointer);`	Returns the offset value of *pointer*.

Table 1 (Page 17 of 18). Machine Interface Instructions

Instruction	C Function Prototype	Description

TESTAU	#include <QSYSINC/MIH/TESTAU>
	Function
	`short testau (_SYSPTR obj,`
	`short offset,`
	`short req_auth);`
	Builtin
	`int _TESTAU1 (_ANYPTR *pointer,`
	`short *req_auth);`
	or
	`int _TESTAU2 (short *avail_auth,`
	`_ANYPTR *pointer,`
	`short *req_auth);`
	Return Value
	Value **Meaning**
	1 Authorized
	0 Not Authorized
		Verifies that the object authorities and/or ownership rights specified by *req_auth* are currently available to the process.

TRIML	#include <QSYSINC/MIH/TRIML>
	Function
	`int triml (char *string,`
	`char trim_char);`
		Returns the length of *string* after *trim_char* has been trimmed from the end.

TSTBTS	#include <QSYSINC/MIH/TSTBTS>
	Function
	`int tstbts (_SPCPTR bit_string,`
	`unsigned int bit_offset);`
	Builtin
	`int _TSTBTS (_SPCPTR bit_string,`
	`unsigned int bit_offset);`
		Test the bit in *bit_string* corresponding to *bit_offset*.

UNLOCK	#include <QSYSINC/MIH/UNLOCK>
	Function
	`void unlock (_SYSPTR object,`
	`char unlock_option,`
	`char lock_state);`
	Builtin
	`void Unlock (_LOCK_Template_T`
	`*unlock_request);`
	or
	`void _UNLOCK (_LOCK_Template_T`
	`*unlock_request);`
		Releases the object lock(s) specified.

UNLOCKSL	#include <QSYSINC/MIH/UNLOCKSL>
	Function
	`void unlocksl (_SPCPTR spc_loc,`
	`char lock_state);`
	Builtin
	`void _UNLOCKSL1 (_SPCPTR *spc_loc,`
	`char* lock_state);`
	or
	`void _UNLOCKSL2 (_LOCKSL_Template_T`
	`**lock_t);`
		Releases the lock(s) for the specified space location(s)

WAITTIME	#include <QSYSINC/MIH/WAITTIME>
	Function
	`void waittime (_MI_Time *wait_interval,`
	`short options);`
	Builtin
	`void _WAITTIME (_WAIT_Template_T *wait_t);`
		Causes the process to wait for the time interval specified.

Table 1 (Page 18 of 18). Machine Interface Instructions

Instruction	C Function Prototype	Description

XFRLOCK	#include <QSYSINC/MIH/XFRLOCK>
	Function
	`void xfrlock (_SYSPTR process,`
	`_SYSPTR object,`
	`char lock_state_to_transfer);`
	Builtin
	`void _XFRLOCK (_SYSPTR *receiver,`
	`_LOCK_Template_T *xfer_t);`
		The receiving *process* is allocated the locks designated in *xfer_t*.

XLATEWT	#include <QSYSINC/MIH/XLATEWT>
	Function
	`void xlatewt (char *receiver,`
	`const char *source,`
	`const char *table);`
	Builtin
	`void _XLATEB (_SPCPTR source,`
	`_SPCPTRCN table,`
	`unsigned int length);`
		Translates the source characters under control of the translate table.

Bibliography

For additional information about topics related to ILE C/C++ MI Library Reference refer to the following IBM publications:

- *ILE Concepts*, SC41-4606, explains concepts and terminology pertaining to the Integrated Language Environment (ILE) architecture of the OS/400 licensed program. Topics covered include creating modules, binding, running programs, debugging programs, and handling exceptions.
- *Machine Interface Functional Reference*, SC41-4810 describes the machine interface instruction set. Describes the functions that can be performed by each instruction and also the necessary information to code each instruction.
- *System API Reference*, SC41-4801, provides information for the experienced programmer on how to use the application programming interfaces (APIs) to such OS/400 functions as:
  - Dynamic Screen Manager
  - Files (database, spooled, hierarchical)
  - Message handling
  - National language support
  - Network management
  - Objects
  - Problem management
  - Registration facility
  - Security
  - Software products
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  Includes original program model (OPM), Integrated Language Environment (ILE), and UNIX-type APIs.

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