File operations library

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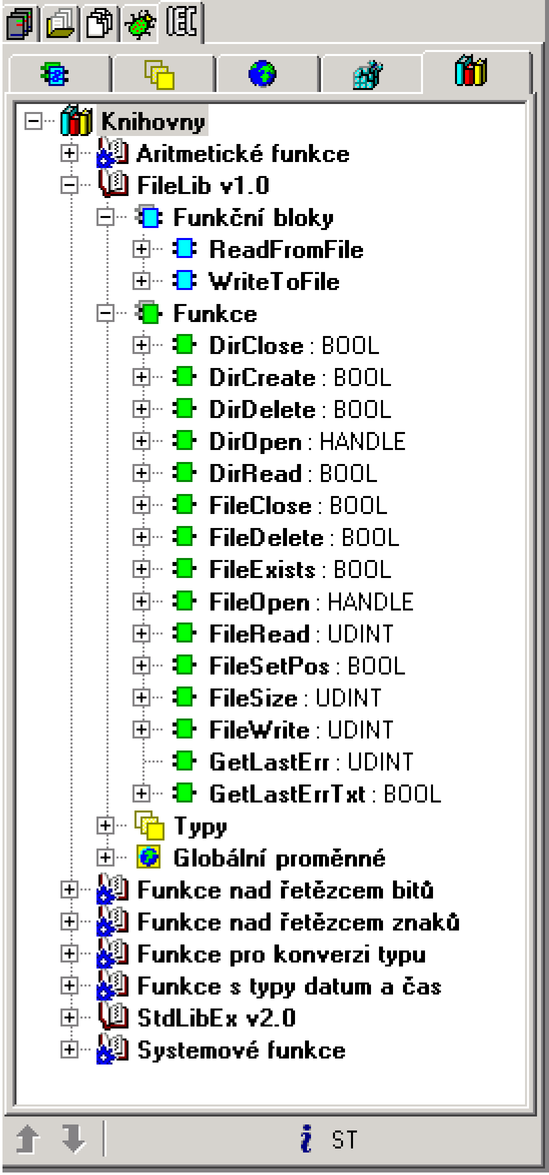
1 INTRODUCTION

The FileLib library contains a set of functions necessary for file operations. This library can be used for controlled systems equipped with file system.

The FileLib library contains basic (low-level) functions for file and directory operations, further, necessary data types and constants and last, function blocks for file reading and file entry. Function blocks use basic file functions and breakdown reading or file entry rather onto more cycles so, that the time consuption of these operations is optimalized.

The following picture shows the FileLib library structure within the Mosaic environment.



If we want to use FileLib library functions in the PLC aplication program, we must firstly add this library to the project. The library is supplied as a part of Mosaic environment instalation as from the version 2.6.0. The PLC central unit of the system must have the file operation support implemented.

Directories structure

The root directory for file operations within the PLC system is called ROOT. The system programmer can work only with such files and directories that are located in the ROOT directory. Other files and directories are not accessable from the PLC program. Therefore, the ROOT directory is the work directory for the PLC programmer.

File names

The file system supports file names in DOS 8.3 conversion. The file name consists of the file name itself (max. of 8 characters) and an appendix (max. of 3 characters). These two parts are separated by a dot. It is not possible to use punctuation characters, spaces and characters " * "," ? " in file names. The national alphabet characters are not supported in file names. Capital and small letters are not distinguished. Substitutional characters (e. g. *.*).

File path

The file path is a specification of a file location on the disc with regard to the ROOT directory. Therefore, the path contains names of directories where the file is saved. Same rules apply for names of directories within the path as for file name. Individual directory names within the path are divided by the slash sign „/“. The PLC file system supports absolute paths only. Relative paths nor even change of the work directory are not supported.

The maximum file name lenght inclusive of the path is limited by 65 characters (see the constant *MAX_PATH*).

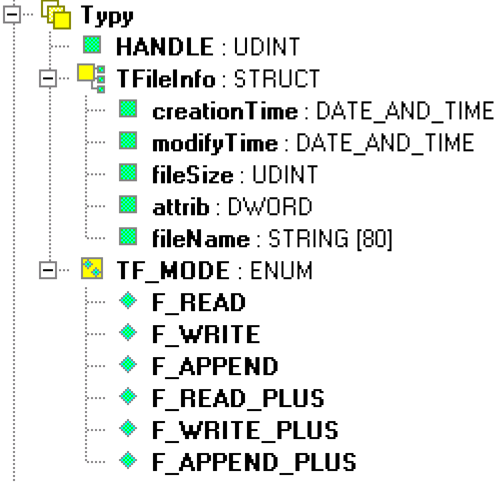
File visibility for the PLC web server

The PLC web server uses as a ROOT directory ROOT/WWW. If files should be accessible via the web interchange, they must be saved within this way (e. g. in the directory ROOT/WWW/DATA).

Details on supported file system type are shown in the description of relevant PLC central units.

2 DATA TYPES

In the FileLib library are following data types defined:

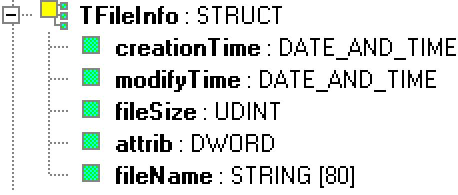


2.1 HANDLE type

HANDLE is a data type derived from the basic UDINT type and is used for a file identifier. Each open file has its identifier assigned that is used for file reading operations, file entry, file closing etc.

2.2 TfileInfo type

TFileInfo is a structure that is returned by the *DirOpen* and *DirRead* function and that contains file information.

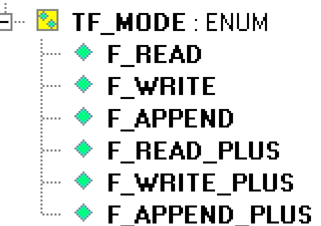


Meaning of individual items of the *TFileInfo* structure is as follows:

- *creationTime* date and time of file creation
- *modifyTime* date and time of the last file modification
- *fileSize* file size in bytes
- *attrib* file attributes
- *fileName* file name

2.3 TF_MODE type

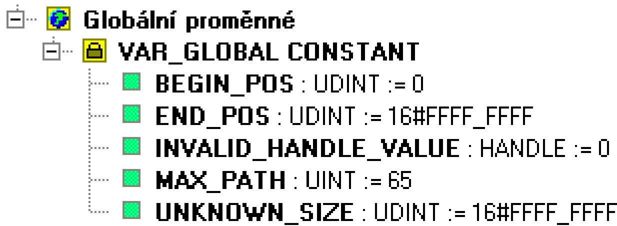
TF_MODE is an enumerational type that is used for constants defining the way of opening of the *FileOpen* function set.



Meaning of individual items of the enumeration, see function description FileOpen.

3 CONSTANTS

In the FileLib library the following constants are described:



3.1 BEGIN_POS constant

The *BEGIN_POS* constant is of an UDINT type and is used as a parameter of *FileSetPos* function in the case when we want to set reading or entry from the file beginning. The constant has a value of 0.

3.2 END_POS constant

The *END_POS* constant is of an UDINT type and is used as a paramter of the *FileSetPos* function in the case when we want to set reading or entry from the file end. The constant has a value of 16#FFFF_FFFF.

3.3 INVALID_HANDLE_VALUE constant

The *INVALID_HANDLE_VALUE* constant is of a HANDLE type and is used as a restoration value of *FileOpen* or rather *DirOpen* function in the case when the file or rather the directory failed to open. The constant has a value of 0 and means an invalid file identifier.

3.4 MAX_PATH constant

The *MAX_PATH* constant is of an UINT type and indicates the maximum possible lenght of file or directory name (path included). The constant has a value of 65.

3.5 UNKNOWN_SIZE constant

The *UNKNOWN_SIZE* constant is of an UDINT type and is used as a restoration value of *FileSize* function in the case when the file size could not be identified. The constant has a value of 16#FFFF_FFFF.

4 FILE OPERATIONS FUNCTION

The FileLib library contains following functions for file operations:

- *FileOpen* file opening
- *FileRead* file reading
- *FileWrite* file entry
- *FileClose* file closing
- *FileExists* file existence inquiry
- *FileSize* file size inquiry
- *FileDelete* file deleting
- *FileSetPos* file position setting

For directory operations the FileLib library contains following functions:

- *DirOpen* directory opening
- *DirRead* directory reading
- *DirClose* directory closing
- *DirCreate* directory creation
- *DirDelete* directory deleting

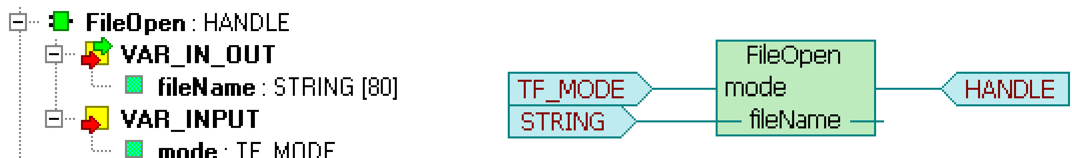
Other group of functions is functions enabling the specification of an error caused by and during file operations:

- *GetLastErr* last error code inquiry
- *GetLastErrTxt* error code transfer to the text report

And finally, funstion enabling disk information inquiry is available:

- *DiskInfo* disk size and disc free space inquiry

4.1 FileOpen function



FileOpen function opens the file specified by a variable *fileName.* The *mode* variable then states the required way of file access.

FileOpen function returns the identifier of the open file. If the file opening fails, this function restore the invalid identifier (INVALID_HANDLE_VALUE).

Variable description :

	Variable	*Type*	*Signification*	
VAR_IN_OUT				
	fileName	STRING	File name including the path	
VAR_INPUT				
	mode	TF_MODE	File access type	
			F_READ	Open file for reading, the file must exist
			F_WRITE	Open file for entry data will be entered from the file beginning if the file does not exist, function establish a new file if the file exists, the file content is deleted
			F_APPEND	Open file for entry data will be entered to the file end if the file does not exist, function establish a new file if the file exists, data will be added at the file end
FileOpen				
	Resto-ration value	HANDLE	Open file identifier If the file opening fails, the invalid identifier is restored (INVALID_HANDLE_VALUE)	

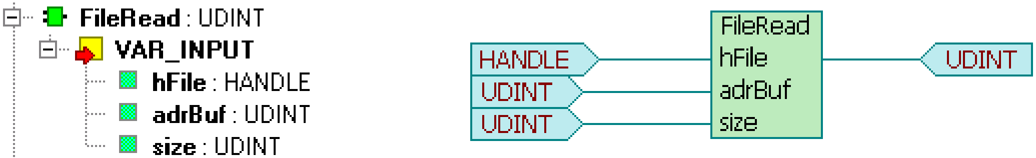
Example of the program with the FileOpen function call:

```
PROGRAM ExampleFileOpen
  VAR
    path         : STRING := 'DATA/';
    name         : STRING := 'log.txt';
    hf           : HANDLE;                // file handle
  END_VAR
  VAR_TEMP
    result       : BOOL;
    fullFileName : STRING;
  END_VAR

  fullFileName := path + name;
  hf := FileOpen(fileName := fullFileName, mode := F_READ);
  IF hf <> INVALID_HANDLE_VALUE THEN
    result := FileClose( hFile := hf);
  END_IF;

END_PROGRAM
```

4.2 FileRead function



The **FileRead** function load a certain number of characters and save them to the PLC memory. The file is specified by the *hFile* variable. The variable, where the loaded data will be saved to, is specified in *adrBuf*. And finally, the *size* variable states how many characters will be read from the file.

The **FileRead** function restores the number of really loaded characters.

Variable description :

	Variable	*Type*	*Signification*
VAR_INPUT			
	hFile	HANDLE	File identifier
	adrBuf	UDINT	Variable address where file character will be loaded to
	size	UDINT	Number of characters that should be loaded
FileRead			
	Návratová hodnota	UDINT	The number of really loaded characters

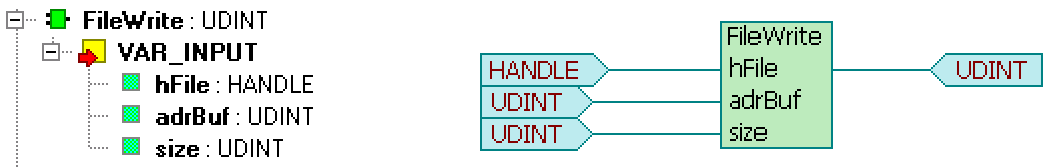
Example of the program with the FileRead function call :

```
PROGRAM ExampleFileRead
  VAR
    path    : STRING := 'DATA/';
    name    : STRING := 'log.txt';
    hf      : HANDLE;                    // file handle
    buffer  : STRING[200];
    lenght  : UDINT;
  END_VAR
  VAR_TEMP
    result       : BOOL;
    fullFileName : STRING;
  END_VAR

  fullFileName := path + name;
  hf := FileOpen(fileName := fullFileName, mode := F_READ);
  IF hf <> INVALID_HANDLE_VALUE THEN
    lenght := FileRead( hFile  := hf,
                        adrBuf := PTR_TO_UDINT( ADR(buffer)),
                        size   := 100);
    result := FileClose( hFile := hf);
  END_IF;
```

```
END_PROGRAM
```

4.3 FileWrite function



The **FileWrite** function copies the PLC variable content to the file. The file is specified by the *hFile* variable. The variable, where data will be copied from, is specified in *adrBuf*. And finally, the *size* variable states how many characters will be entered to the file.

The **FileWrite** function restores the number of really entered characters.

Variable description :

	Variable	*Type*	*Signification*
VAR_INPUT			
	hFile	HANDLE	File identifier
	adrBuf	UDINT	Variable address w ch content will be entered to the file
	size	UDINT	The number of cha cters entered
FileWrite			
	Návratová hodnota	UDINT	The number of rea entered characters

Example of the program with the FileWrite function call :

```
PROGRAM ExampleFileWrite
  VAR
    start   : BOOL;
    fname   : STRING := 'DATA/log.txt';
    hf      : HANDLE;                   // file handle
    buffer  : STRING[200];
    lenght  : UDINT;
  END_VAR
  VAR_TEMP
    result        : BOOL;
  END_VAR

  IF start THEN
    start := FALSE;
    buffer := 'Hello world!';
    hf := FileOpen(fileName := fname, mode := F_WRITE);
    IF hf <> INVALID_HANDLE_VALUE THEN
      lenght := FileWrite( hFile  := hf,
                           adrBuf := PTR_TO_UDINT( ADR(buffer)),
                           size   := len( buffer));
      result := FileClose( hFile := hf);
    END_IF;
```

```
  END_IF;
END_PROGRAM
```

4.4 FileClose function

The **FileClose** function close the file specified by the *hFile* variable. All internal buffers for entry are prior to the file closing entered to the file. After the file closing, it is not possible to read from or entry to the file. The file identifier cease to be connected with the file.

The **FileClose** funstion restor the value TRUE, providing the file was closed successfuly. Otherwise, it restores the value FALSE. The cause of a possible error can be found using function **GetLastErr**.

Variable description :

	Variable	*Type*	*Signification*
VAR_INPUT			
	hFile	HANDLE	File identifier
FileClose			
	Návratová hodnota	BOOL	TRUE if the file is closed successfuly, FALSE in other cases

Example of the program with the **FileClose** function call:

```
PROGRAM ExampleFileClose
  VAR
    path          : STRING := 'DATA/';
    name          : STRING := 'log.txt';
    hf            : HANDLE;                 // file handle
  END_VAR
  VAR_TEMP
    result        : BOOL;
    fullFileName  : STRING;
  END_VAR

  fullFileName := path + name;
  hf := FileOpen(fileName := fullFileName, mode := F_READ);
  IF hf <> INVALID_HANDLE_VALUE THEN
    result := FileClose( hFile := hf);
  END_IF;

END_PROGRAM
```

4.5 FileExists function

The **FileExists** function tests if the file specified by the *fileName* variable exists.

The **FileExists** function restore TRUE when the file exists. If the file search fails, this function restore FALSE.

Variable description :

	Variable	*Type*	*Signification*
VAR_IN_OUT			
	fileName	STRING	File name includin he path
FileExists			
	Návratová hodnota	BOOL	TRUE if the file e ts, FALSE in other cases

Example of the program with the FileExists function call :

```
PROGRAM ExampleFileExist
  VAR
    fname   : STRING;
    del     : BOOL;
  END_VAR

  IF NOT del THEN
    fname := 'DATA/log.txt';
    IF FileExists( fileName := fname) THEN
      del := FileDelete( fileName := fname);
    END_IF;
  END_IF;
END_PROGRAM
```

4.6 FileSize function

The **FileSize** function finds the file size specified by the variable *hFile*.

The **FileSize** function restores file size in bytes. If an error occures during the file size evaluation, this function restores UKNOWN_SIZE. The cause of a possible error can be found using function **GetLastErr**.

Variable description :

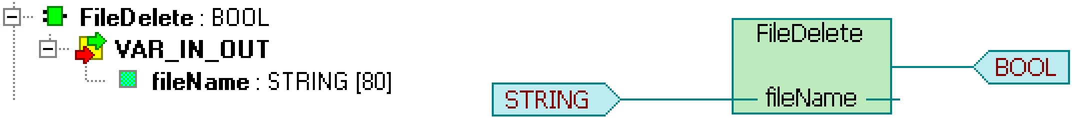
	Variable	*Type*	*Signification*
VAR_INPUT			
	hFile	HANDLE	File identifier
FileSize			
	Restoration value	UDINT	File size UKNOWN_SIZE, i.e. 16#FFFF_FFFF is restored when error occures

Example of the program with the FileSize function call :

```
PROGRAM ExampleFileSize
  VAR
    fname   : STRING;
    hf      : HANDLE;
    lenght  : UDINT;
    result  : BOOL;
  END_VAR

  fname := 'DATA/log.txt';
  hf := FileOpen(fileName := fname, mode := F_READ);
  IF hf <> INVALID_HANDLE_VALUE THEN
    lenght := FileSize(hFile := hf);
    result := FileClose( hFile := hf);
    result := result AND lenght <> UNKNOWN_SIZE;
  END_IF;
END_PROGRAM
```

4.7 FileDelete function



The **FileDelete** function delete the file specified by the variable *fileName.*
This function can be used for directory deleting, too. To ensure succesful directory deleting, it is necessary to ensure that the directory is empty

The **FileDelete** function restores TRUE providing the file is deleted succesfuly. Otherwise, function restores FALSE. The cause of a possible error can be found using function **GetLastErr**.

Popis proměnných :

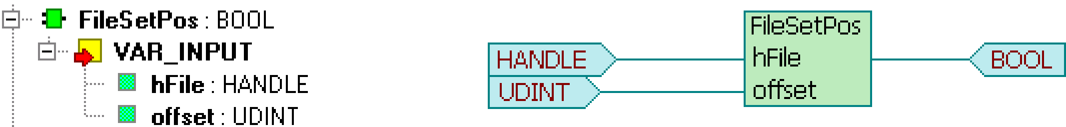
	Proměnná	***Typ***	***Význam***
VAR_IN_OUT			
	fileName	STRING	Jméno souboru vč ě cesty
FileDelete			
	Návratová hodnota	BOOL	TRUE pokud je so or smazán, FALSE v ostatních případech

Example of the program with the FileDelete function call :

```
PROGRAM ExampleFileDelete
  VAR
    fname   : STRING;
    del     : BOOL;
  END_VAR

  IF NOT del THEN
    fname := 'DATA/log.txt';
    IF FileExists( fileName := fname) THEN
      del := FileDelete( fileName := fname);
    END_IF;
  END_IF;
END_PROGRAM
```

4.8 FileSetPos function



The **FileSetPos** function enables to set the position for the file reading or rathe for the file entry. The file is specified by the variable *hFile*. The required position in the file is stated by the variable *offset*.

The **FileSetPos** function restores TRUE providing that the required position was set succesfuly. Otherwise, it restores FALSE. The cause of a possible error can be found using function **GetLastErr**.

Variable description :

	Variable	*Type*	*Signification*	
VAR_INPUT				
	hFile	HANDLE	File identifier	
	offset	UDINT	Position in the file	
			0 or BEGIN_POS	File beginning
			0 > offset > END_POS	Position set
			16#FFFF_FFFF or END_POS	File end
FileSetPos				
	Resto-ration value	BOOL	Restores TRUE if : required position in the file is set Otherwise FALSE is restored	

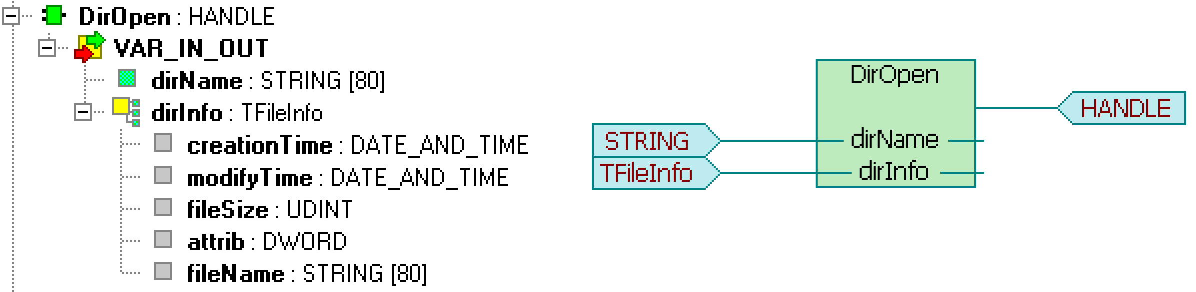
Example of the program with the FileSetPos function call:

```
PROGRAM ExampleFileSetPos
  VAR
    path    : STRING := 'DATA/';
    name    : STRING := 'log.txt';
    hf      : HANDLE;                // file handle
    buffer  : STRING[200];
    lenght  : UDINT;
  END_VAR
  VAR_TEMP
    result        : BOOL;
    fullFileName  : STRING;
  END_VAR

  fullFileName := path + name;
  hf := FileOpen(fileName := fullFileName, mode := F_READ);
  IF hf <> INVALID_HANDLE_VALUE THEN
    IF FileSetPos( hFile := hf, offset := 10) THEN
```

```
      lenght := FileRead( hFile  := hf,
                          adrBuf := PTR_TO_UDINT( ADR(buffer)),
                          size   := 100);
      result := FileClose( hFile := hf);
    END_IF;
  END_IF;
END_PROGRAM
```

4.9 DirOpen function



The **DirOpen** function opens the directory specified by the variable *dirName.* Then it finds information about the first file in the directory and enter these information in to the *dirInfo*. Information on other files in the directory can be found using function DirRead.

The **DirOpen** function restore the open directory identifier. If the directory opening fails, function restores an invalid identifier (INVALID_HANDLE_VALUE).

Variable description:

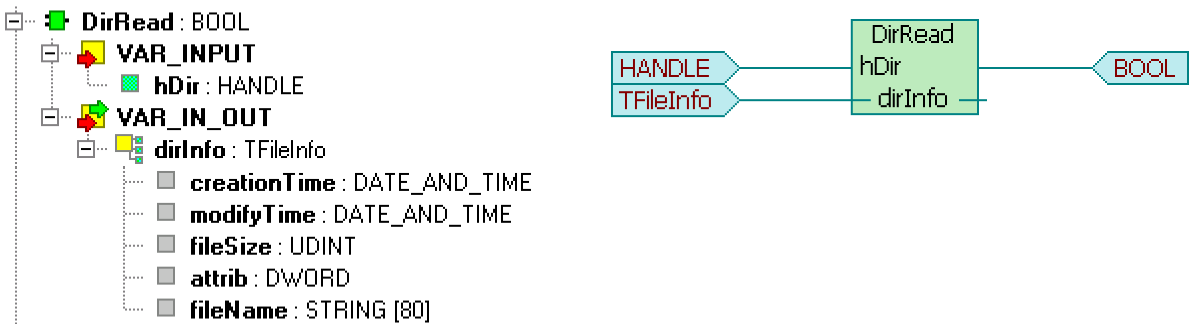
	Variable	***Type***	***Signification***
VAR_IN_OUT			
	dirName	STRING	Directory name including the path
	dirInfo	TFileInfo	Structure with information on the first file
	.creationTime	DT	Date and time of the file creation
	.modifyTime	DT	Date and time of the last file modification
	.fileSize	UDINT	File size
	.attrib	DWORD	File attributes
	.fileName	STRING	File name
DirOpen			
	Restoration value	HANDLE	Open directory identifier. If the opening fails, the invalid identifier is restored (INVALID_HANDLE_VALUE)

Example of the program with the DirOpen function call:

```
PROGRAM ExampleDirOpen
  VAR
    dn     : STRING := 'DATA/';      // dir name
    hd     : HANDLE;                 // dir handle
    fi     : TFileInfo;
    result : BOOL;
  END_VAR

  hd := DirOpen(dirName := dn, dirInfo := fi);
  IF hd <> INVALID_HANDLE_VALUE THEN
    result := DirClose(hDir := hd);
  END_IF;
END_PROGRAM
```

4.10 DirRead function



The **DirRead** function finds information about other file in the directory and enter this information in to the variable *dirInfo*. The directory is specified by a variable *dirHandle*. Before this function call, the directory must be open via the function DirOpen.

The **DirRead** function restores TRUE providing that the operation was successful. Otherwise, the FALSE value is restored.

Variable description :

	Variable	***Type***	***Signification***
VAR_INPUT			
	dirHandle	HANDLE	Directory identifier
VAR_IN_OUT			
	dirInfo	TFileInfo	The structure with information on other file in the directory
	.creationTime	DT	Date and time of file creation
	.modifyTime	DT	Date and time of the last file modification
	.fileSize	UDINT	File size
	.attrib	DWORD	File attributes
	.fileName	STRING	File name
DirRead			
	Restoration value	BOOL	TRUE if the operation was successful, FALSE in othe cases

Example of the program with the DirRead function call:

```
TYPE
  T_FILE_INFO :
    STRUCT
      name : STRING[12];          // DOS name 8.3
      len  : UDINT;               // file length
    END_STRUCT;
END_TYPE

VAR_GLOBAL
  dirList : ARRAY[0..31] OF T_FILE_INFO;
END_VAR

PROGRAM ExampleDirRead
  VAR
    dn     : STRING := 'DATA/';   // dir name
    hd     : HANDLE;              // dir handle
    di     : TFileInfo;           // dir info
    count  : USINT;               // number of files
    done   : BOOL;
    err    : BOOL;
    open   : BOOL;
    result : BOOL;
  END_VAR

  IF NOT done THEN
    IF NOT open THEN
      hd := DirOpen( dirName := dn, dirInfo := di);
      IF hd <> INVALID_HANDLE_VALUE THEN
        count := 1; open := TRUE;
        dirList[0].name := di.fileName;
        dirList[0].len  := di.fileSize;
      ELSE
        count := 0; err := TRUE; done := TRUE;
      END_IF;
    ELSE
      IF DirRead( hDir := hd, dirInfo := di) THEN
        dirList[count].name := di.fileName;
        dirList[count].len  := di.fileSize;
        count := count + 1;
      ELSE
        done := TRUE; err := FALSE; open := FALSE;
        result := DirClose( hDir := hd);
      END_IF;
    END_IF;
  END_IF;
END_PROGRAM
```

4.11 DirClose function

The **DirClose** function close the directory specified by the variable *hDir*. After the directory was closed, it is not possible to read from it using the funciton ReadDir. The directory identifier will cease to be connected to the file.

The **DirClose** function restores the value TRUE if the directory was closed successfuly. Otherwise, it restores the value FALSE. The cause of a possible error can be found using the function **GetLastErr**.

Variable description :

	Variable	*Type*	*Signification*
VAR_INPUT			
	hFile	HANDLE	File identifier
DirClose			
	Resto-ration value	BOOL	TRUE if the directory was closed successfuly, FALSE in other cases

Example of the program with the DirClose function call:

```
PROGRAM ExampleDirClose
  VAR
    dn      : STRING := 'DATA/';      // dir name
    hd      : HANDLE;                 // dir handle
    fi      : TFileInfo;
    result  : BOOL;
  END_VAR

  hd := DirOpen(dirName := dn, dirInfo := fi);
  IF hd <> INVALID_HANDLE_VALUE THEN
    result := DirClose(hDir := hd);
  END_IF;
END_PROGRAM
```

4.12 DirCreate function

The **DirCreate** function creates the directory specified by the *dirName* variable.

The **DirCreate** function restores the value TRUE providing that the directory was created successfuly. Otherwise, the value FALSE is restored. The cause of the possible error can be found using the function **GetLastErr**.

Variable description :

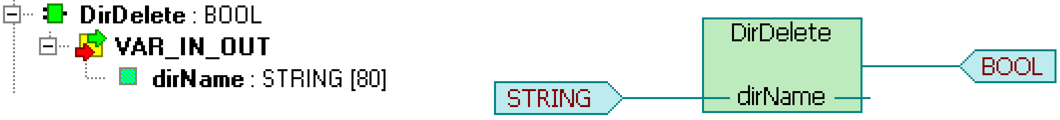
	Variable	*Type*	*Signification*
VAR_IN_OUT			
	dirName	STRING	File name includin he path
DirCreate			
	Resto-ration value	BOOL	TRUE if the direct y was created successfuly, FALSE in other cases

Example of the program with the DirCreate function call:

```
PROGRAM ExampleDirCreate
  VAR
    dn      : STRING := 'NEW/';        // dir name
    result : BOOL;                     // dir exists
  END_VAR

  IF NOT FileExists( fileName := dn) THEN
    result := DirCreate( dirName := dn);
  ELSE
    result := TRUE;
  END_IF;
END_PROGRAM
```

4.13 DirDelete function



The **DirDelete** function deletes the directory specified by the variable *dirName*. To ensure a successful directory deleting, it is necessary that the directory is empty (it should not contain any files).

The **DirDelete** function restores TRUE if the directory is deleted successfuly. Otherwise, FALSE is restored. The cause of the possible error can be found using the function **GetLastErr**.

Variable description :

	Variable	*Type*	*Signification*
VAR_IN_OUT			
	fileName	STRING	Directory name in[illegible]ding the path
DirDelete			
	Restoration value	BOOL	TRUE if the direct[illegible]y is deleted, FALSE in other cases

Example of the program with the DirDelete function call:

```
PROGRAM ExampleDirDelete
  VAR
    dn     : STRING := 'NEW/';       // dir name
    fi     : TFileInfo;
    dh     : HANDLE;
    result : BOOL;
  END_VAR

  IF FileExists( fileName := dn) THEN
    dh := DirOpen( dirName := dn, dirInfo := fi);
    IF dh = INVALID_HANDLE_VALUE THEN
      // directory is empty
      result := DirDelete( dirName := dn);
    ELSE
      // directory is not empty
      // it means we can't delete dir
      result := DirClose(hDir := dh);
    END_IF;
  END_IF;
END_PROGRAM
```

4.14 GetLastErr function

The **GetLastErr** function restores the code of the last error identified arrisen during the file operation. This code can be used as a parameter of function GetLastErrTxt which then returns the text description of the error.

Variable description:

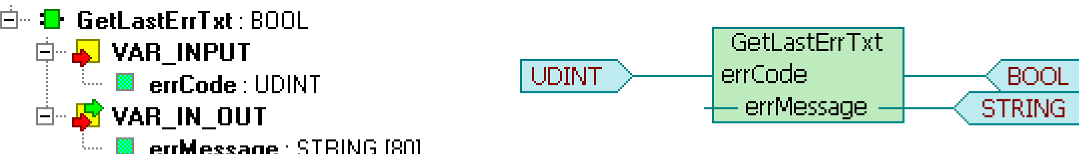
	Variable	*Type*	*Signification*
GetLastErr			
	Resto-ration value	UDINT	The code of the last error within the file operation

Example of the program with the GetLastErr function call:

```
PROGRAM ExampleGetLastErr
  VAR
    fname    : STRING;
    error    : UDINT;
    errTxt   : STRING;
    valid    : BOOL;
  END_VAR

  fname := 'DATA/log.txt';
  IF NOT FileExists( fileName := fname) THEN
    error := GetLastErr();
    valid := GetLastErrTxt(errCode := error, errMessage := errTxt);
  END_IF;
END_PROGRAM
```

4.15 GetLastErrTxt function



The **GetLastErrTxt** function enters the text description of an error in to the variable *errMessage*. The text description of an error corresponds to the error code that is specified by the variable *errCode*.

The **GetLastErrTxt** function restores TRUE if a text description of an error exists in comply with the set code. Otherwise, it restoresí FALSE.

Variable description :

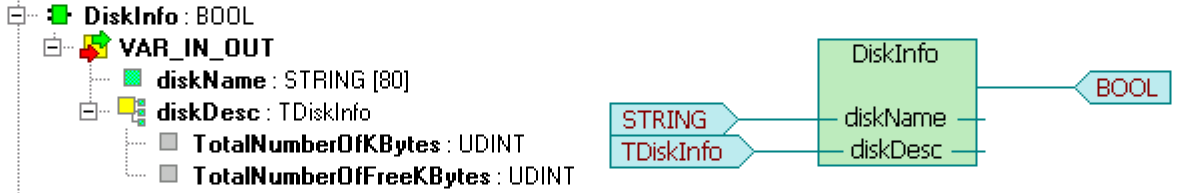
	Variable	*Tye*	*Signification*
VAR_INPUT			
	errCode	UDINT	Error code
VAR_IN_OUT			
	errMessage	STRING	Error text descripti
GetLastErrTxt			
	Restoration value	BOOL	Restores TRUE if : error description exists Otherwise, FALSE is restored

Example of the program with the GetLastErrTxt function call:

```
PROGRAM ExampleGetLastErrTxt
  VAR
    fname    : STRING;
    error    : UDINT;
    errTxt   : STRING;
    valid    : BOOL;
  END_VAR

  fname := 'DATA/log.txt';
  IF NOT FileExists( fileName := fname) THEN
    error := GetLastErr();
    valid := GetLastErrTxt(errCode := error, errMessage := errTxt);
  END_IF;
END_PROGRAM
```

4.16 DiskInfo function



The **DiskInfo** function finds the overall disc size and free space on the disc. The disc name must be stated in the variable diskName. If this variable is empty, the **DiskInfo** function restores information about disc that is set as a default disc (e. g. it is a memory card within Foxtrot systems).

The **DiskInfo** function restores TRUE if information about required disc are found. Otherwise, it restores FALSE.
¨The **DiskInfo** function fill in items *TotalNumberOfKBytes* and *TotalNumberOfFreeKBytes* in the variable *diskDesc*. Both values are in KiloBytes.

Variable description :

	Variable	*Type*	*signification*
VAR_IN_OUT			
	diskName	STRING	Disc name
	diskDesc	TDiskInfo	Disc information
	. *TotalNumberOfKBytes*	UDINT	Total disc size in KB
	. *TotalNumberOfFreeKBytes*	UDINT	Total free space on the disc in KB
DiskInfo			
	Resotration value	BOOL	Restores TRUE if disc information are found. Otherwise, FALSE is restored

Example of the program with the DiskInfo function call:

```
PROGRAM ExampleDiskInfo
  VAR
    disc   : STRING := '';     // default disk
    info   : TDiskInfo;        // info about disk
    result : BOOL;
  END_VAR

  result := DiskInfo(diskName := disc, diskDesc := info);
END_PROGRAM
```

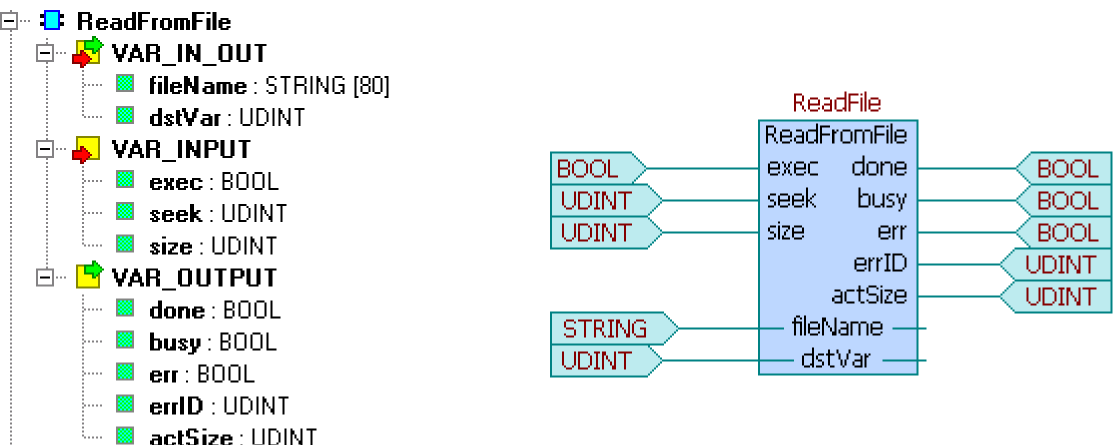
5 FUNCTION BLOCK FOR FILE OPERATIONS

The FileLib library contains following funciton blocks used for file operations:

- *ReadFromFile* file data reading
- *WriteToFile* file data entry

Function blocks use the basic file function and breakdown the reading or rather file entry in to more cycles so, that the time-consumption of these operations is optimalized.

5.1 ReadFromFile function block



The **ReadFromFile** function block reads data from the file and saves them in to the variable in the PLC memory. The file name from which will be read is set by the variable Jméno *fileName*. The variable address, where data will be saved to, is specified by the variable *dstVar*. The reading from the file will be initiated onto the entering edge of the variable *exec*. The variable *seek* states the position from the beginning of the file from which data will be loaded. Data reading will be ceased when all required data are loaded which size is specified by the variable *size* or if the end of the file is reached during the reading.

The **ReadFromFile** function block sets TRUE into the variable *done* in the moment when the last data block is loaded from the file. During the data loading the variable *done* has a value FALSE and the variable *busy* has a value TRUE. The number of actualy loaded bytes is stated in the variable *actSize*. If the reading was faultless, *err* variable has a value FALSE, in case of an error, it has a value TRUE and in the variable *errID* the error code is saved. That can be used as an entering variable of function GetLastErrTxt to obtain the text description of the error occured.

Variable description :

	Variable	***Type***	***Signification***	
VAR_IN_OUT				
	fileName	STRING	File name including the path	
	dstVar	UDINT	Variable address where read data from the file will be saved to	
VAR_INPUT				
	exec	BOOL	Control variable. The entering edge (transittion from the Náběžná FALSE value to the TRUE value) initiate the file reading	
	seek	UDINT	Offset from the beginning of the file which the reading is initiated from	
			0	From the file beginning
			seek <> 0	From the set position

	Variable	*Type*	*Signification*
	size	UDINT	Required size of d read
VAR_OUTPUT			
	done	BOOL	Has a TRUE value the moment of file reading ceasation Otherwise, returns FALSE
	busy	BOOL	Has a TRUE value uring file data reading
	err	BOOL	Error flag within fi reading If the operation was successful it has a FALSE value, otherwise, TRUE.
	errID	UDINT	Error code. If the c ration was successful, errID = 0. In cas of an error, errID <> 0.
	actSize	UDINT	The number of act ly loaded bytes

The following command shows the definition of the function block *ReadFromFile* in the ST language which is described here for the purpose of a detail understanding of this function. The usage of this block shows an example in the following chapter then.

```
FUNCTION_BLOCK ReadFromFile
(* Copy data from file to variable *)
  VAR_IN_OUT
    fileName      : STRING;        // file name
    dstVar        : UDINT;         // destination variable
  END_VAR
  VAR_INPUT
    exec          : BOOL;          // request
    seek          : UDINT;         // data offset in file
    size          : UDINT;         // data length <= size of variable
  END_VAR
  VAR_OUTPUT
    done          : BOOL;          // action is done
    busy          : BOOL;          // action in progress
    err           : BOOL;          // error flag
    errID         : UDINT;         // error number
    actSize       : UDINT;         // really read
  END_VAR
  VAR
    execTrig      : R_TRIG;
    errTrig       : R_TRIG;
    hnd           : HANDLE;
    adrVar        : UDINT;
  END_VAR
  VAR_TEMP
    restSize      : UDINT;
    reqSize       : UDINT;
    read          : UDINT;
  END_VAR

  adrVar := PTR_TO_UDINT( ADR( dstVar));
  execTrig( CLK := exec);

  // open file and seek position
```

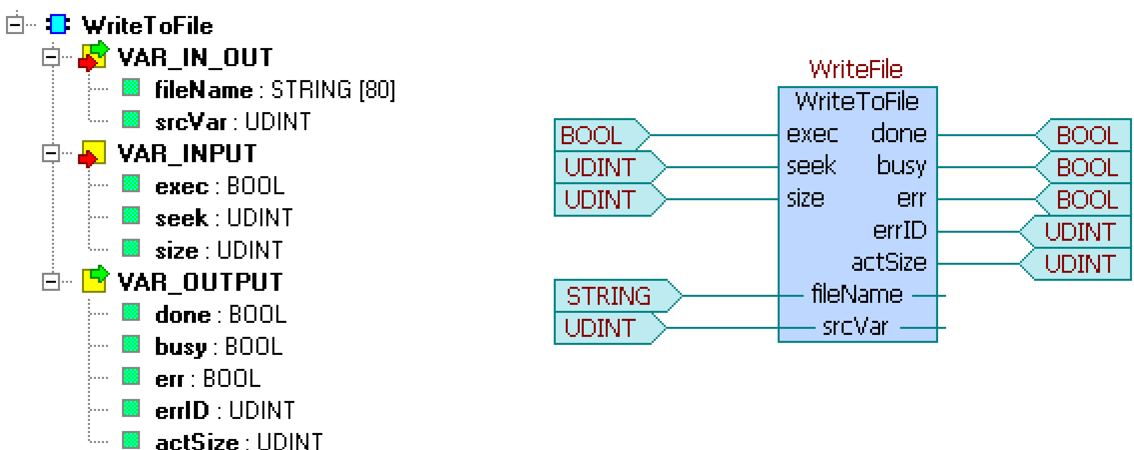
```
  IF execTrig.Q THEN
    busy := TRUE; done := FALSE; err := FALSE; errID := 0; actSize := 0;
    errTrig( CLK := FALSE);
    hnd := FileOpen(fileName := fileName, mode := F_READ);
    IF hnd = INVALID_HANDLE_VALUE THEN
      err := TRUE; busy := FALSE;
    ELSE
      IF seek <> 0 THEN
        IF FileSetPos( hFile := hnd, offset := seek) = FALSE THEN
          err := TRUE; busy := FALSE;
        END_IF;
      END_IF;
    END_IF;
  END_IF;

  // read data from file to variable (one sector per one PLC cycle)
  IF busy THEN
    IF size > actSize THEN
      restSize := size - actSize;
      IF restSize > 512 THEN reqSize := 512;           // more then one sector
                        ELSE reqSize := restSize;      // last sector
      END_IF;
      read := FileRead( hFile := hnd, adrBuf := adrVar + actSize,
                                      size   := reqSize);
      actSize := actSize + read;
      IF read <> reqSize THEN
        busy := FALSE;
        IF read > 0 THEN done := TRUE;          // end of file
                    ELSE err  := TRUE;          // propably any error
        END_IF;
      ELSE
        IF actSize = size THEN
          done := TRUE; busy := FALSE;
        END_IF;
      END_IF;
    ELSE
      done := TRUE;
    END_IF;
  ELSE
    done := done AND exec;
    err  := err  AND exec;
  END_IF;

  // set error code, if any
  errTrig( CLK := err);
  IF errTrig.Q THEN errID := GetLastErr(); END_IF;

  // close file
  IF errTrig.Q OR done THEN
    IF hnd <> INVALID_HANDLE_VALUE THEN
      IF FileClose( hFile := hnd) THEN
        hnd := INVALID_HANDLE_VALUE;
      END_IF;
    END_IF;
  END_IF;
END_FUNCTION_BLOCK
```

5.2 WriteToFile function block



The **WriteToFile** function block enters the content of the PLC variable into the file. The file name where the entry will take place, states the variable *fileName*. If the file does not exist, it will be created. The address of the variable, the content of which will be entered to the file, is specified by the variable src*Var*. The entry to the file will be initiated onto the entering edge of the variable *exec*. The *seek* variable states the position from the file beginning from where data will be entered. The data entry is ceased when all required data which size is stated by the variable *size* are entered..

The **WriteToFile** function block sets TRUE into the variable *done* at the moment when the last data block is entered to the file. During the data entry the variable *done* has a value FALSE and the variable *busy* has a value TRUE. The number of actualy entered bytes is stated by the variable *actSize*. If the file entry was faultless, the *err* variable has a value FALSE. In case of an error occurance it has a value TRUE and in the variable *errID* is saved the error code. This code can be used as an entering variable function GetLastErrTxt to get the text description of the error arrisen.

Variable description :

	Variable	***Type***	***Signification***	
VAR_IN_OUT				
	fileName	STRING	File name including the path	
	srcVar	UDINT	Address of the variable which content will be entered to the file	
VAR_INPUT				
	exec	BOOL	Control variable. Entering edge (transittion from FALSE value to TRUE value) initiates the file entry	
	seek	UDINT	Offset in the file from which the entry is initiated	
			0	From the file beginning
			0 < seek < 16#FFFF_FFFF	From the set position
			16#FFFF_FFFF	Add data to the file end

	Variable	*Type*	*Signification*
	size	UDINT	Required size of d entered
VAR_OUTPUT			
	done	BOOL	Has a TRUE value the moment of the file entry ceasation Otherwise, it returns FALSE
	busy	BOOL	Has a TRUE value uring the entry to the file
	err	BOOL	Error flag during f entry If the operation was successful, it has a FALSE value, otherwise, TRUE.
	errID	UDINT	Error code. If the c ration was successful, errID = 0. In case of an error, errID <> 0.
	actSize	UDINT	Number of actualy ntered bytes

The following command shows the definition of the function block *WriteToFile* in the ST language which is described here for the purpose of a detail understanding of this function. The usage of this block shows an example in the following chapter then.

```
FUNCTION_BLOCK WriteToFile
(*
  Copy data from variable to file.
  If file does not exist new file is created.
  If file exists file content is overwitten.
*)
  VAR_IN_OUT
    fileName      : STRING;        // file name
    srcVar        : UDINT;         // variable address
  END_VAR
  VAR_INPUT
    exec          : BOOL;          // request
    seek          : UDINT;         // data offset in file
    size          : UDINT;         // data length (size of variable)
  END_VAR
  VAR_OUTPUT
    done          : BOOL;          // action is done
    busy          : BOOL;          // action in progress
    err           : BOOL;          // error flag
    errID         : UDINT;         // error number
    actSize       : UDINT;         // really written
  END_VAR
  VAR
    eTrig         : R_TRIG;
    errTrig       : R_TRIG;
    hnd           : HANDLE;
    adrVar        : UDINT;
  END_VAR
  VAR_TEMP
    restSize      : UDINT;
    written       : UDINT;
    reqSize       : UDINT;
    mode          : TF_MODE;
  END_VAR
```

```
  adrVar := PTR_TO_UDINT( ADR( srcVar));
  eTrig(CLK := exec);

  // open file and seek position
  IF eTrig.Q THEN
    busy := TRUE; done := FALSE; err := FALSE; errID := 0; actSize := 0;
    errTrig( CLK := FALSE);
    IF seek = 0 THEN mode := F_WRITE; ELSE mode := F_APPEND; END_IF;
    hnd := FileOpen( fileName := fileName, mode := mode);
    IF hnd = INVALID_HANDLE_VALUE THEN
      err := TRUE; busy := FALSE;
    ELSE
      IF seek <> 0 AND seek <> 16#FFFF_FFFF THEN
        IF FileSetPos( hFile := hnd, offset := seek) = FALSE THEN
          err := TRUE; busy := FALSE;
        END_IF;
      END_IF;
    END_IF;
  END_IF;

  // write data to file to variable (one sector per one PLC cycle)
  IF busy THEN
    IF size > actSize THEN
      restSize := size - actSize;
      IF restSize > 512 THEN reqSize := 512;          // more then one sector
                        ELSE reqSize := restSize;     // last sector
      END_IF;
      written := FileWrite(hFile := hnd, adrBuf := adrVar + actSize,
                                         size   := reqSize);
      actSize := actSize + written;
      IF written <> reqSize THEN
        busy := FALSE; err := TRUE;
      ELSE
        IF actSize = size THEN
          done := TRUE; busy := FALSE;
        END_IF;
      END_IF;
    ELSE
      done := TRUE;
    END_IF;
  ELSE
    done := done AND exec;
    err  := err  AND exec;
  END_IF;

  // set error code, if any
  errTrig( CLK := err);
  IF errTrig.Q THEN errID := GetLastErr(); END_IF;

  // close file
  IF errTrig.Q OR done THEN
    IF hnd <> INVALID_HANDLE_VALUE THEN
      IF FileClose( hFile := hnd) THEN
        hnd := INVALID_HANDLE_VALUE;
      END_IF;
    END_IF;
  END_IF;

END_FUNCTION_BLOCK
```

5.3 The usage of ReadFromFile and WriteToFile function blocks

The following example shows the usage of function blocks ReadFromFile and WriteToFile. The program, in the example, will test after the system restart whether the *DATA* directory exist. If it does not, it will create it. Afterwards, it creates the file *test.txt* in this directory and enters data saved in the variable *record* in to this file. Then, the content of the *test.txt* file is loaded into the variable *copy* that will compare it with the variable *record*. The content of both variables must be identical. So it is a simple test of data entry to the file and their loading for the purpose of the control. The test result is stated by variables *test_OK* and *test_ERR*. The reason of possible difficulties can be then found in the variable *problem*.

```
TYPE
  TRecord : STRUCT
    text  : STRING;
    data  : ARRAY[0..999] of USINT;
  END_STRUCT;
END_TYPE

VAR_GLOBAL
    test_OK   : bool;              // result
    test_ERR  : bool;              // error flag
    record    : TRecord;          // written data
    copy      : TRecord;          // read data
END_VAR


FUNCTION InitRecord : BOOL
  VAR  i : UINT; END_VAR

  record.text := 'Begin of file DATA/test.txt ...';
  FOR i := 0 TO 999 DO  record.data[i] := UINT_TO_USINT(i); END_FOR;
  InitRecord := TRUE;
END_FUNCTION


PROGRAM Test_MMC_card
  VAR
    dir,
    read, init             : BOOL;
    write                  : BOOL;
    fn                     : STRING := 'DATA/test.txt';
    dn                     : STRING := 'DATA/';
    WriteFile              : WriteToFile;
    ReadFile               : ReadFromFile;
    count                  : UINT;
    problem                : STRING := 'No problem';
  END_VAR

  IF NOT init THEN
    init := InitRecord();
    dir := FileExists( fileName := dn);
    IF NOT dir THEN
```

```
      dir := DirCreate(dirName := dn);
      IF NOT dir THEN
        test_ERR := GetLastErrTxt( errCode := GetLastErr(),
                                   errMessage := problem);
      END_IF;
    END_IF;
  END_IF;


 IF dir THEN
    IF NOT WriteFile.err AND NOT ReadFile.err THEN
      IF NOT write THEN
        count := count + 1;
        WriteFile( fileName := fn, srcVar := void( record), exec := true,
                   seek := 0, size := sizeof( record), done => write);
        IF WriteFile.err THEN
          test_ERR := GetLastErrTxt( errCode := WriteFile.errID,
                                     errMessage := problem);
        END_IF;
      END_IF;
      IF write AND NOT read THEN
        count := count + 1;
        ReadFile( fileName := fn, dstVar := void( copy),
                  exec := true, seek := 0,
                  size := sizeof( copy), done => read);
        IF ReadFile.err THEN
          test_ERR := GetLastErrTxt( errCode := ReadFile.errID,
                                     errMessage := problem);
        END_IF;
      END_IF;
    END_IF;

    IF write AND read THEN
      IF record = copy THEN test_OK :=  true; END_IF;
    END_IF;
  END_IF;
END_PROGRAM
```