The MSP430 Flash Programmer

Multi-FPA API-DLL User's Guide

for the USB-MSP430-FPA and MSP-FET430UIF Adapters

Software version 4.5

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* ***Consult the dealer or an experienced radio/TV technician for help.***

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Table of Contents

1. Introduction

The **FlashPro430** (**USB-MSP430-FPA**) or **TI's MSP-FET430UIF** adapter can be remotely controlled from other software applications (Visual C++, Visual Basic etc.) via a DLL library. The Multi-FPA - allows to remotely control simultaneously up to sixteen Flash Programming Adapters (USB-MSP430-FPAs) significantly reducing programming speed in production. When the MSP-FET430UIF adapter is used then the only one adapter can be connected.

Figure 1.1 shows the connections between PC and up to sixteen programming adapters. The FPAs can be connected to PC USB ports directly or via USB-HUB. Direct connection to the PC is faster but if the PC does not have required number of USB ports, then USB-HUB can be used. The USB-HUB should be fast, otherwise speed degradation can be noticed. When the USB hub is used, then the D-Link's Model No: **DUB-H7, P/N BDUBH7..A2** USB 2.0 HUB is recommended.

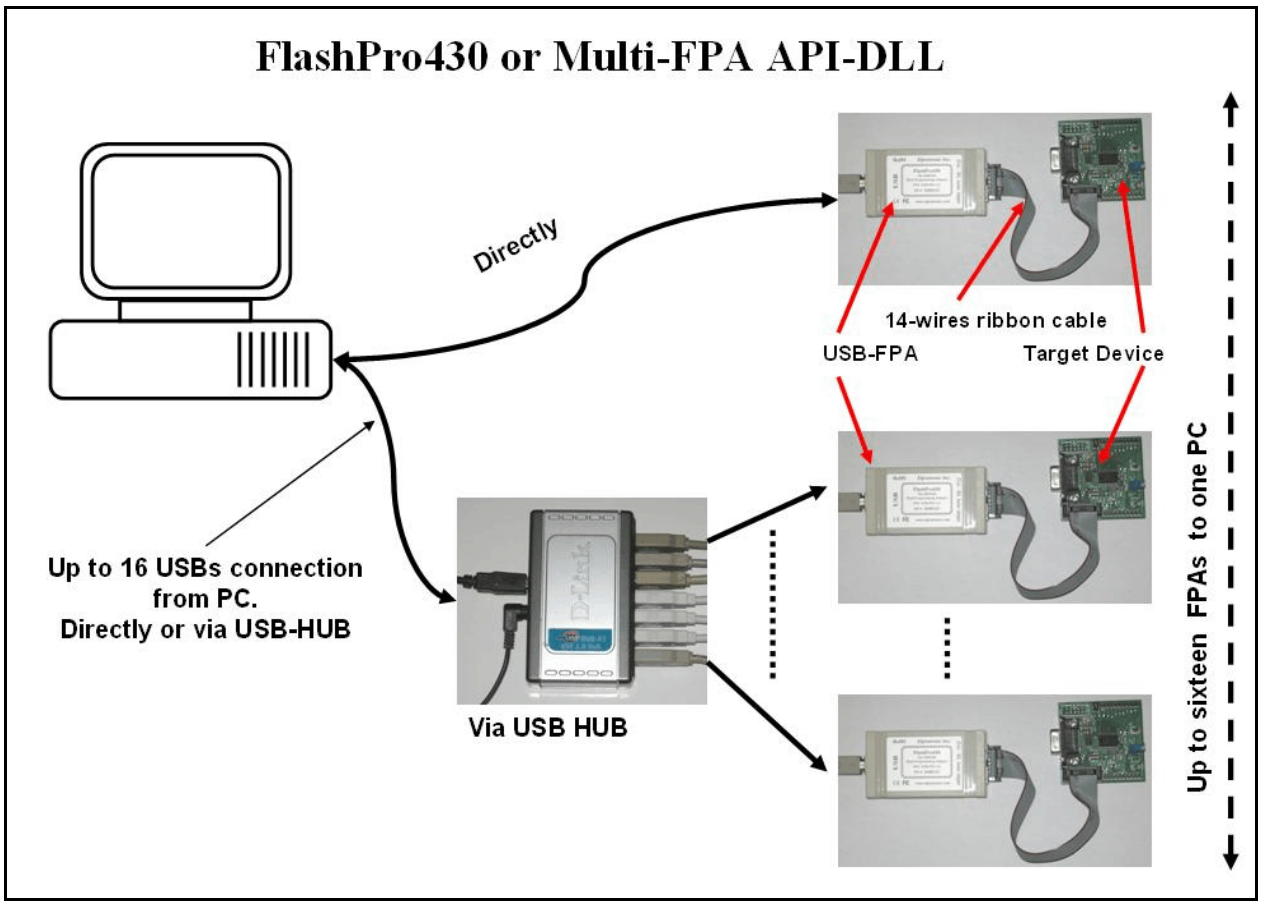
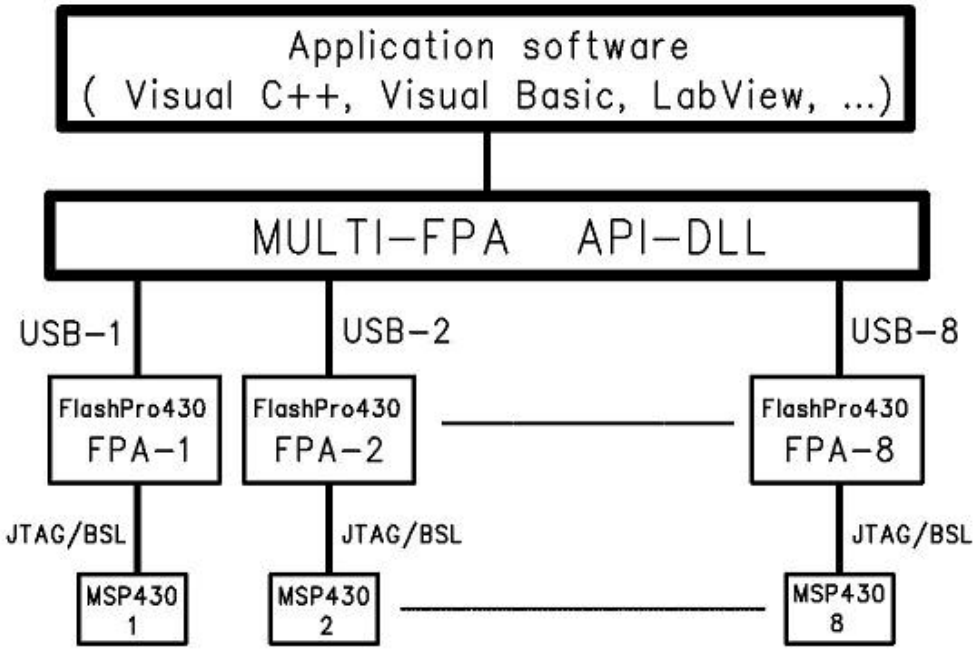


Figure 1.1

Block diagram of the Multi-FPA application DLL is presented on the Figure 1.2.



Eight Target Devices programmed simultanously
with MULTI-FPA API-DLL

Figure 1.2

To support this new Multi-FPA API-DLL feature, the software package contains seventeen dll files

- the Multi-FPA API-DLL selector
- sixteen standard single FPAs API-DLLs (or one UIF API-DLL)

Figure 1.3 shows the logical connections between these dll files.

The main Multi-FPA file (FPA-selector - MSP430FPA.DLL) allows to transfer API-DLL functions coming from application software to desired single application dll (MSP430FPA1.DLL to MSP430FPA64.DLL or MSPFET430UIF1.DLL).

The MSP430FPA.DLL file is transparent for all API-DLL functions implemented in the single FPA API-DLLs functions. Desired destination FPA can be selected using the function

F_Set_FPA_index(fpa);

where the

fpa = 1 to 64 when only one desired FPA required to be selected

or fpa = 0 when ALL active FPAs should be selected.

The selected FPA index modified by the F_Set_FPA_index(fpa) instruction can be modified at any time. By default, the FPA index is 1 and if only one FPA is used then fpa index does not need to be initialized or modified. When the fpa index 1 to 64 is used, then the result is coming back to application software from the single API-DLL via transparent Multi-FPA dll. When fpa index is 0 (ALL-FPAs) and results are the same from all FPAs, then the same result is passing back to application software. If results are not the same, then the Multi-FPA dll is returning back value -1

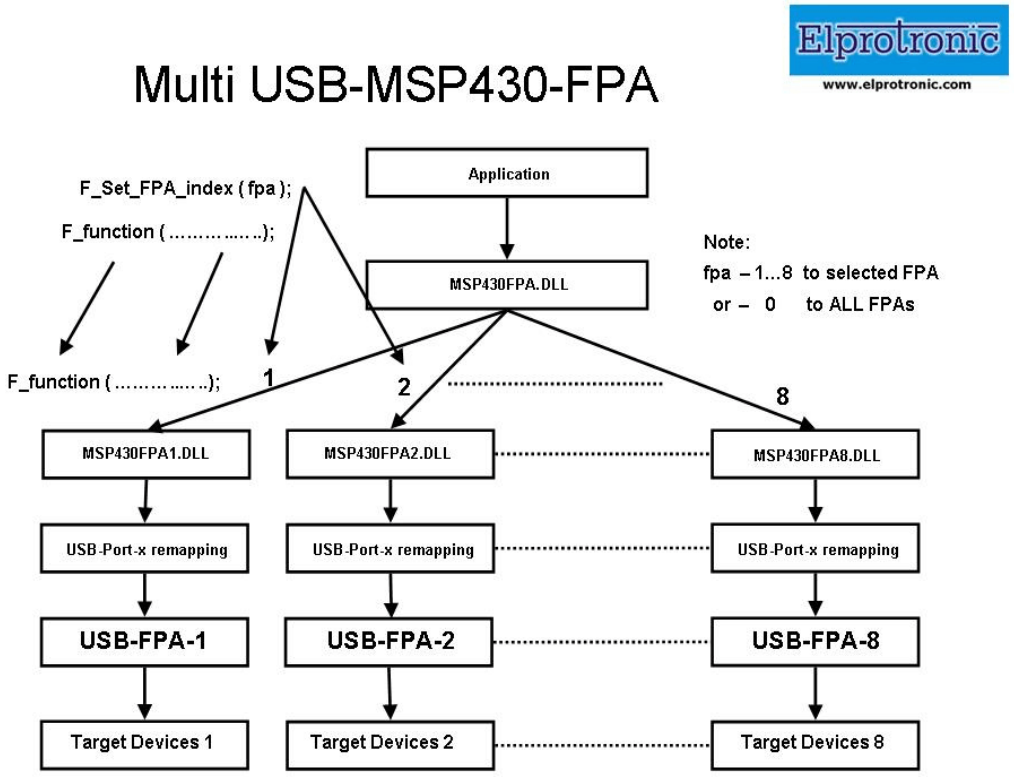


Figure 1.3

(minus 1) and all recently received results can be read individually using function

F_LastStatus(fpa)

Most of the implemented functions allows to use the determined fpa index 1 to 64 or 0 (ALL-FPAs). When functions return specific value back, like read data etc, then only determined FPA index can be used (fpa index from 1 to 64). When the fpa index is 0 (ALL-FPAs) then almost all functions are executed simultaneously. Less critical functions are executed sequentially from FPA-1 up to FPA-64 but that process can not be seen from the application software.

When the inactive fpa index is selected, then return value from selected function is -2 (minus 2). When all fpa has been selected (fpa index = 0) then only active FPAs will be serviced. For example if only one FPA is active and fpa index=0, then only one FPA will be used. It is save to prepare the universal application software that allows to remote control up to sixteen FPAs and on the startup activate only desired number of FPAs.

It should be noticed, that all single API-DLLs used with the Multi-FPA DLL are fully independent to each other. From that point of view it is not required that transferred data to one FPA should be the same as the transferred data to the others FPAs. For example code data downloaded to FPA-1 can be different that the code data downloaded to the FPA-2, FPA-3 etc. But even in this case the programming process can be done simultaneously. In this case the desired code should be read from the code file and saved in the API-DLL-1, next code file data should be saved in the API-DLL-2 etc. When it is done, then the F_AutoProgram can be executed simultaneously with selected all active FPAs. All FPAs will be serviced by his own API-DLL and data packages saved in these dlls.

The following commands are supported in the DLL library:

Initialization and termination communication with the programming adapter,
Programmer configuration setup,
Programming report message,
Code data and password data read from the file,
DC power target from the programming adapter,
Reset target device,
Auto program target device (erase, blank check, program and verify),
Password or fuse verification,
All or selected part of memory erase,
All or selected part of memory blank check,
All or selected part of memory write,
All or selected part of memory verify,
All or selected part of memory read,
Open or close communication with the target device,
Selected memory segment erase,
Selected part of memory blank check,
Selected part of memory segment write,
Selected part of memory segment read,
Security fuse blow.

The MSP430 Flash Programmer software package contains all required files to remotely control programmer from a software application. When software package is installed then by default the DLL file, library file and header file are located in:

C:\Program Files\Elprotronic\MSP430\USB FlashPro430\API-DLL

MSP430FPA.dll	- Multi-FPA selection/distribution DLL
MSP430FPA1.dll	- DLL for Elprotronic's USB-MSP430-FPA
MSPFET430UIF1.dll	- DLL fro TI's MSP-FET430UIF
MSPPrg-Dll.h	- header file for MS VC++
MSPPrg-Dos-Dll.h	- header file for Borland, DOS etc.
MSP430FPA-BC.lib	- lib file for Borland VC++
MSP430FPA.lib	- lib file for MS VC++
config.ini	- default configuration file for the FPAs
FPAs-setup.ini	- FPAs- vs USB / UIF ports configuration file

or

C:\Program Files\Elprotronic\MSP430\FET-Pro430\API-DLL

MSP430FPA.dll	- Multi-FPA selection/distribution DLL
MSPFET430UIF1.dll	- DLL fro TI's MSP-FET430UIF
MSPPrg-Dll.h	- header file for C++
MSPPrg-Dos-Dll.h	- header file for Borland, DOS etc.
MSP430FPA.lib	- lib file for MS VC++
MSP430FPA-BC.lib	- lib file for Borland VC++
config.ini	- default configuration file for the FPAs
FPAs-setup.ini	- FPAs- vs UIF ports configuration file

The API-DLL package in the USB FlashPro430 and in the FET-Pro430 subdirectories are exactly the same. However for the simplicity the dll file for the USB-MSP430-FPA adapter is not included in the FET-Pro430 package, since the only MSP-FET430UIF adapter will be used. Make sure that your application software will not call the USB-MSP430-FPA adapter if the dll for this adapter is not present. When the USB-MSP430-FPA adapter is used, then the package from the first subdirectory that contains the MSP430FPA1.dll for the USB-MSP430-FPA adapter should be used. In this package the MSPFET430UIF1.dll for the MSP-FET430UIF adapter is also included and allows to use the USB-MSP430-FPA adapter (or adapters) only, the MSP-FET430UIF adapter or both type of adapters at the same time. The entry dll (MSP430FPA.dll - dll selector) is selecting the desired dll vs used adapter.

The entry dll (MSP430FPA.dll) contains two groups of the same functions used in C++ application and Visual Basic applications All procedure names used in the Visual Basic are starting

from **VB_xxxx**, (and have the **_stdcall** calling declaration) when procedure names used in the C++ are starting from **F_xxxx (**and have the **_Cdecl** calling declaration).

Reminding files listed above are required in run time - to initialize the flash programming adapter. The config.ini is optional, if not present then default configuration is created.

When the MS VC++ application is created, then following files should be copied to the source application directory:

MSPPrg-Dll.h	- header file for C++
MSP430FPA.lib	- lib file for C++

and to the release/debug application directory

MSP430FPA.dll	- Multi-FPA selection/distribution DLL
MSP430FPA1.dll	- DLL for Elprotronic's USB-MSP430-FPA
MSPFET430UIF1.dll	- DLL fro TI's MSP-FET430UIF
config.ini	- default configuration file for the FPAs
FPAs-setup.ini	- (optiona) FPAs- vs USB ports configuration file

Executable application software package in C++ the requires following files

MSP430FPA.dll	- Multi-FPA selection/distribution DLL
MSP430FPA1.dll	- DLL for Elprotronic's USB-MSP430-FPA
MSPFET430UIF1.dll	- DLL fro TI's MSP-FET430UIF
config.ini	- default configuration file for the FPAs
FPAs-setup.ini	- (optiona) FPAs- vs USB ports configuration file

When application in Visual Basic is created, then following files should be copied to the source or executable application directory:

MSP430FPA.dll	- Multi-FPA selection/distribution DLL
MSP430FPA1.dll	- DLL for Elprotronic's USB-MSP430-FPA
MSPFET430UIF1.dll	- DLL fro TI's MSP-FET430UIF
config.ini	
FPAs-setup.ini	- FPAs- vs USB ports configuration file

When LabView application is created, then following files taken form the location

C:\Program Files\Elprotronic\MSP430\USB FlashPro430\LabView

should be copied to the source or executable application directory:

FlashPro430-Labview.dll	- LabView library
MSP430FPA.dll	- Multi-FPA selection/distribution DLL
MSP430FPA1.dll	- DLL for Elprotronic's USB-MSP430-FPA
MSPFET430UIF1.dll	- DLL fro TI's MSP-FET430UIF

config.ini
FPAs-setup.ini - FPAs- vs USB ports configuration file

All these files 'as is' should be copied to destination location, where application software using DLL library of the MSP430 Flash programmer is installed. The config.ini file has default setup information. The config.ini file can be modified and taken directly form the MSP430 Flash Programmer application software. To create required config.ini file the standard MSP430 Flash programmer software should be open and required setup (memory option, JTAG/SBW/BSL interface select etc) should be created. When this is done, programming software should be closed and the config.ini file with the latest saved configuration copied to destination location. Note, that the configuration setup can be modified using DLL library function.

Software package has a demo software written under Visual C++.net , Visual Basic.net and LabVIEW - version 7.1. All files and source code are located in:

C:\Program Files\Elprotronic\MSP430\USB FlashPro430\API-DLL-Demo\Cpp
C:\Program Files\Elprotronic\MSP430\USB FlashPro430\API-DLL-Demo\VBnet
C:\Program Files\Elprotronic\MSP430\USB FlashPro430\API-DLL-Demo\VB6
C:\Program Files\Elprotronic\MSP430\USB FlashPro430\LabView

1.1 Using TI's MSP-FET430UIF adapter

The Multi-FPA API-DLL version 4.0 and higher allows to control the TI's MSP-FET430UIF or EZ430 stick adapter with the same list of instructions as are used for the MSP-MSP430-FPA adapters. The API-DLL is prepared mostly for the flash programming only and from that reason an available list of instructions in the MSP-FET430UIF used for debugging are not used in the API-DLL. The care should be taken, that some of the features available in the USB-MSP430-FPA adapters are not supported in the MSP-FET430UIF adapters and vice-verse. The MSP-FET430UIF does not support the BSL communication interface and also does not allow to calibrate the DCO frequency. These option should be disabled in software (see software configuration) if the MSP-FET430UIF adapter is used.

The API-DLL structure and list of instructions for the MSP-FET430UIF allows to use current application software used for the USB-MSP430-FPA adapters without modification. Only the latest DLLs should replace the old dlls. Also the MSPFET430UIF1.dll file should be plased with the other dlls if the MSP-FET430UIF is used. When the USB-MSP430-FPA adapter is not used, then the MSP430FPA1.dll can be removed. Make sure that the main dll - MSP430FPA.dll is always installed. The MSPFET430UIF1.dll file is protected and can work without access key only first 30

days after first activation. After this time the access key is required. If the TI's MSP-FET430UIF adapter is not used, then the MSPFET430UIF.dll file can be removed to avoid the pop-up messages with information regarding access key installation, or in the start-up definition the option - ANY adapter should not be used. Use the FPAs serial number or FPA definition to avoid activation the API-DLL servicing the TI's MSP-FET430UIF adapter, or vice-verse - when the MSP-FET430UIF adapter is used only, then do not use ANY adapter definition. Use the UIF definition instead ANY adapter ('*').

When the access key for the MSPFET430UIF.dll file is not installed, then the following pop-up message will be displayed every time when the dll is activated.

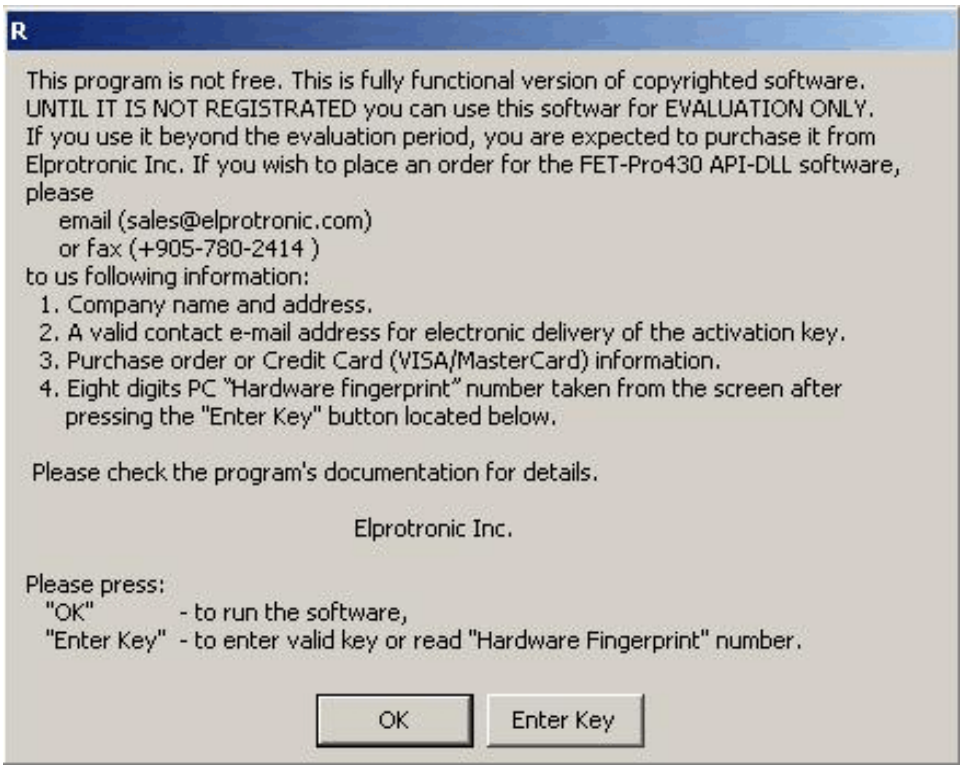


Figure 1.4

Since the application software can install and close the dll a few times on the startup then the pop-up messages can be reentered even - 2-4 times on the startup. Press OK button and go head. After expire time the dll without valid access key will reject the communication with application software. When the access key is installed, then the pop-up messages are not displayed any more.

2. Getting Started

2.1 Self Test Program

The software package contains the FlashPro430 Self Test program, that allows to test functionality of the ONE flash programming adapter, users target device and connections between these units. Software package use the Multi-FPA API-DLLs. In the test results printout are listed the DLL functions with syntax, that has been used. This printout is useful to find-out source of the problems, as well as can be used at the startup when your application software uses one programming adapter only. Software can be activated from the Start menu

Start -> Programs -> Elprotronic-Flash Programmers -> (MSP430) FlashPro430 -> FlashPro430 Self Test

or by running the program **FlashPro430SelfTest.exe** from the location

C:\Program Files\Elprotronic\MSP430\USB FlashPro430\SelfTest

The same software package can be found in the FET-Pro430 subdirectory, if the FET-Pro430 software is installed.

The Figure 2.1 presents the GUI of the FlashPro430 / FET-Pro430 Self Test.
Connect the Flash Programming Adapter (USB-MSP430-FPA or MSP-FET430UIF) to PC (USB port), connect your target device to adapter, select desired options in following selectors (see Figure 2.1) - ***"Target Device", "Target's Vcc" "Interface"*** and ***"Reset Pulse width".*** When it is done then press the button ***"TEST".*** When test is finished, then check if there is no any errors. Detailed test report is displayed. The test report can be paste to Notepad and saved if required.

> ***Note:*** *When the **MSP-FET430UIF** adapter is used then only two interface can be selected - **JTAG** or **Spy-Bi-Wire** with fixed communication speed. The **BSL** interface is not supported in this adapter.*

Following conditions are used during the test:

1. ***JTAG*** and ***Spy-Bi-Wire*** interface is used:
   * Erased and programmed MAIN memory only. The info memory (0x1000 to 0x10FF) is not erased and not modified. The DCO calibration data in the F2xx are not modified. During the test it can be displayed warning that All memory blank check failed, that of course is normal. But selected memory blank check must be OK (the full MAIN memory in this case).

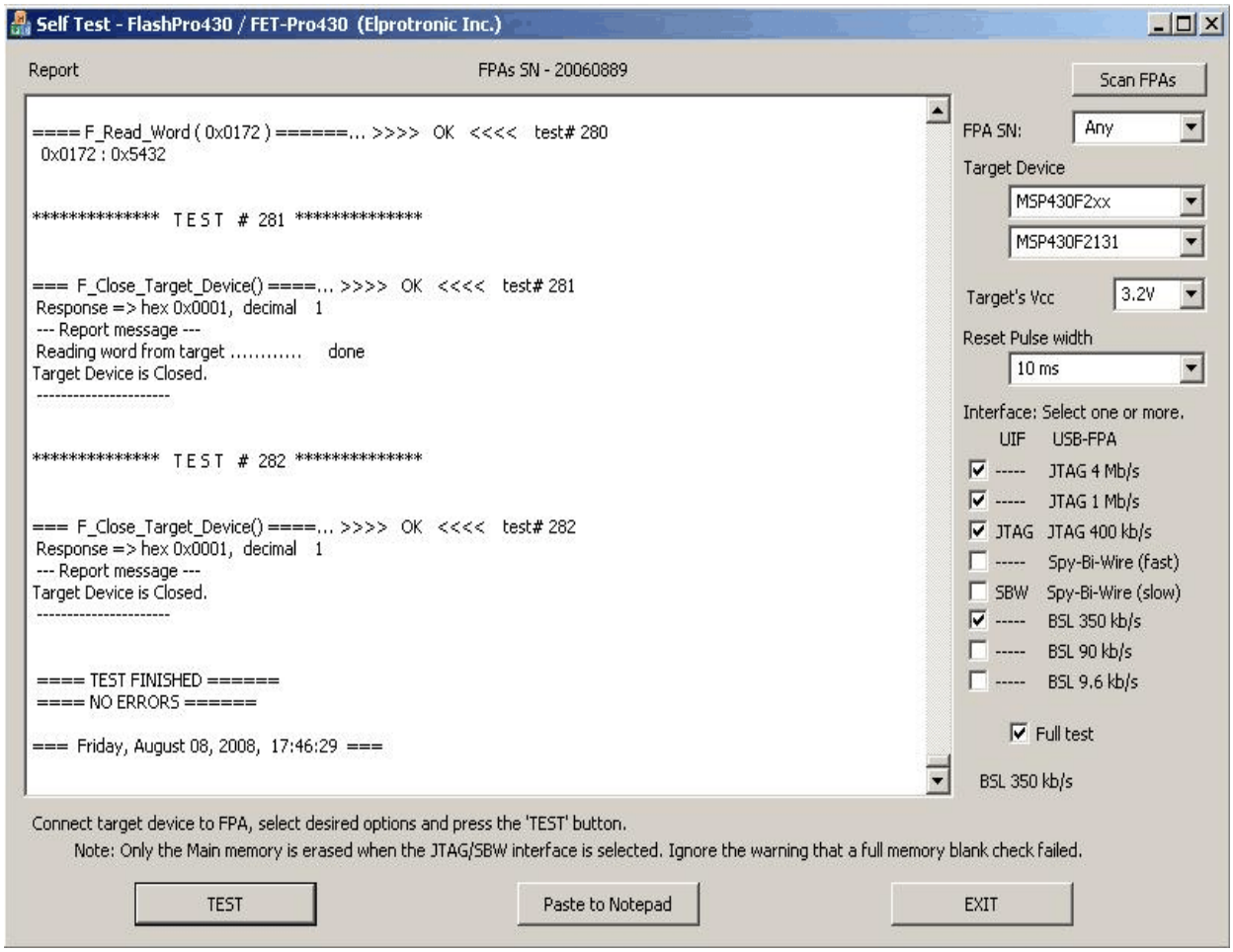


Figure 2.1

* All bytes of the main memory are erased, blank checked and programmed with the randomly generated data used as a code data. Whole MAIN memory content is verified (check sum) and also read whole data and verified byte by byte.
* One sector (location 0xFC00 to 0xFDFF) is erased and blank checked. Also contents of the two closer sectors are verified if there are not erased. Small block of data are saved and verified in the mentioned sector.

* Word write/read to TACCR0 (0x172) register.
* Byte/Word manipulation are used in the part of the RAM.

2. ***BSL*** interface is used (not supported in the MSP-FET430UIF):
   * Due to unknown access password, the whole Flash memory - MAIN and INFO are erased. In the F2xx microcontrollers the DCO calibration data will be erased. There is no way to save the DCO data if the BSL password is unknown. The DCO data can

be calibrated using the FlashPro430 GUI package software when the JTAG or Spy-Bi-Wire access is available (when the ***JTAG*** fuse is not blown). See the FlashPro430 manual for details.

* All MAIN memory is tested in the same way as it is used with the ***JTAG/Spy-Bi-Wire*** interface
* Word write/read to TACCR0 (0x172) register.
* Access to RAM if size of the RAM if higher then 256 bytes. Access to RAM space 0x200 to 0x2FF is blocked due to stack and firmware located in this RAM location.

Note: The first test (Vcc value when the power is OFF) can be failed, if the external power is connected or if the blocking capacitor on your target device connected to the Vcc line if high. The Vcc should be below 0.4V when the power is OFF, tested 2 seconds after switching-off the power from FPA, otherwise test failed.

The Self Test programming software package is located in directory

C:\Program Files\Elprotronic\MSP430\USB FlashPro430\SelfTest

or

C:\Program Files\Elprotronic\MSP430\FET-Pro430\SelfTest

and contains following files

MSP430FPA.dll	- Multi-FPA selection/distribution DLL
MSP430FPA1.dll	- USB-FPA DLL
MSPFET430UIF1.dll	- DLL fro TI's MSP-FET430UIF
config.ini	- default configuration file for the FPAs
FlashPro430SelfTest.exe	- executable file

To run the executable file ***FlashPro430SelfTest.exe*** it in the other location the files listed above should be copied "as is" to destination directory.

2.2 MyMSP430Prg Projects

The ***MyMSP430Prg*** projects are examples of using the Multi-FPA API-DLL with Microsoft Visual Studio 7.0 (2002) and for Microsoft Visual Basic 6.0. They are intended to help users create their own application that uses the API-DLL by providing a simple starting point. When using Visual Studio C++ include the following files should be included to your program:

MSP430FPA.lib
MSPPrg-Dll.h
MspFPA-Lib.h

MspFPA-Lib.cpp
MSP430SamplePrg.h
MSP430SamplePrg.cpp

The above files are located in the following directory:
...\Elprotronic\MSP430\USB FlashPro430\API-DLL-MyPrg\Cpp\scr
or
...\Elprotronic\MSP430\FET-Pro430\API-DLL-MyPrg\Cpp\scr

Files MSP430SamplePrg.cpp and MSP430SamplePrg.h can be modified in a way that suits your application. However, the remaining files should not be modified.

To run your application you will need to allow your application access to the Multi-FPA dynamically linked library. A simple way to do this is to copy the following files into your directory where executable file is located:

MSP430FPA.dll
MSP430FPA1.dll - required if the USB-MSP430-FPA adapter is used
MSPFET430UIF1.dll - required if the TI's MSP-FET430UIF is used
Config.ini (optional)

The easy demo project MyMSP430Prg uses API-DLLs and files listed above is located in directory

...\Elprotronic\MSP430\USB FlashPro430\API-DLL-MyPrg\Cpp\MyMSP430Prg
or
...\Elprotronic\MSP430\FET-Pro430\API-DLL-MyPrg\Cpp\MyMSP430Prg

and are included for demonstration purposes only. The sample project can be opened by selecting the project file **MyMSP430Prg.vcproj** located in directory

...\Elprotronic\MSP430\USB FlashPro430\API-DLL-MyPrg\Cpp\MyMSP430Prg
or
...\Elprotronic\MSP430\FET-Pro430\API-DLL-MyPrg\Cpp\MyMSP430Prg

The following dialogue box will be displayed when project executed (see figure 2.2).
Dialogue box contains few buttons, that call procedures listed in the mentioned above files. See contents in the M**yMSP430Prg.cpp** file located in the project directory, how these procedures are called from application software. There are several useful procedures located in the **MspFPA-**

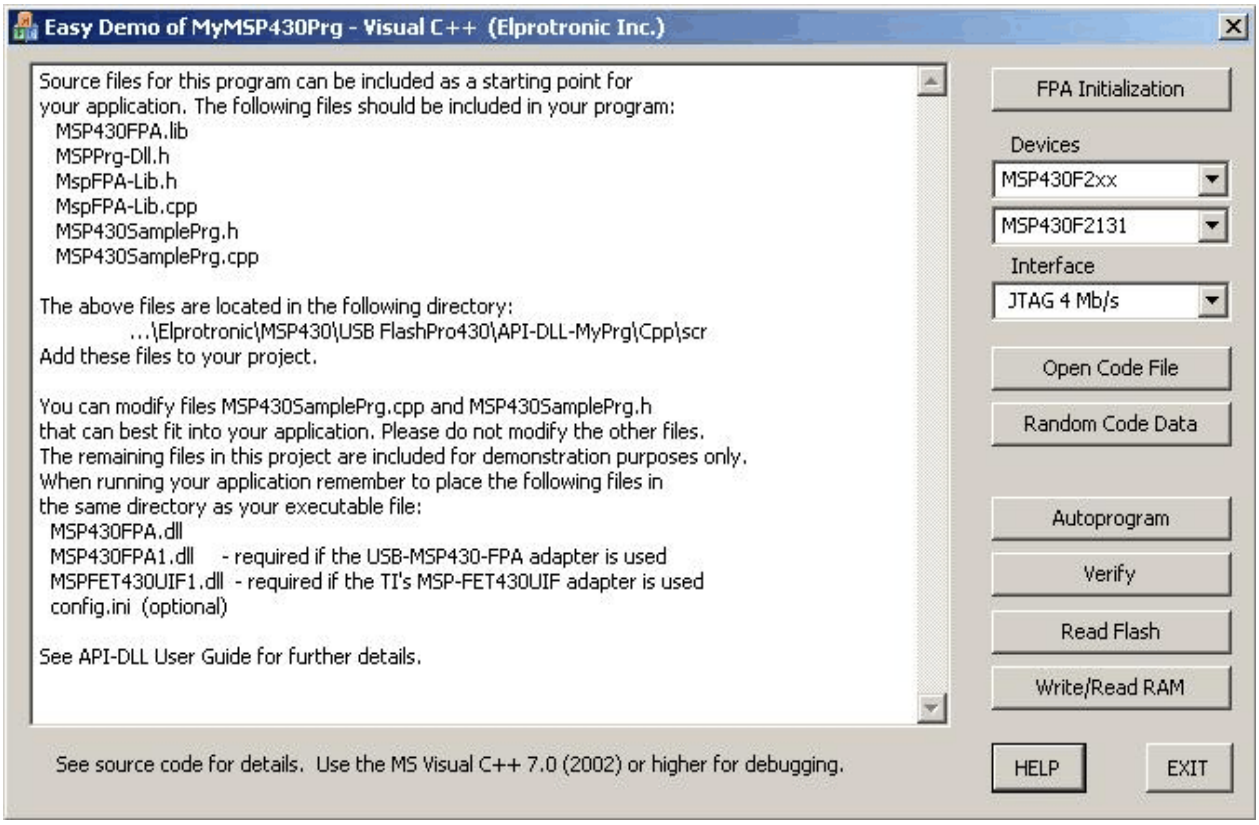


Figure 2.2

Lib.cpp file that significantly simplify the FPA initialization process. See comments for each procedures located in this file.

The first procedure named

get_FPA_and_MSP_list(.....)

searches all FPAs connected to your PC via USB ports. As the results, adapter serial numbers of the detected FPAs are located in the FPA_SN_list[k] where k = 0 up to 15. Up to sixteen FPA SN can be located in this data block. SN list are located starting from FPA_SN_list[0]. The same procedure also takes a list of supported MSP microcontrollers containing MCU name, flash start and end addresses etc. from API-DLL .The MCU list is saved in the following structure

```
typedef struct
{
      char name[DEVICE_NAME_SIZE];
      int  index;
      long flash_start_addr;
      long flash_end_addr;
      long info_flash_start_addr;
```

```
      long info_segm_size;
      long no_of_info_segm;
      long RAM_size;
      int  group;
      int  double_ID;

} DEVICELIST;
DEVICELIST DeviceList[300];
```

Up to 300 MCUs can be saved in DeviceList. When required, the size of this data block can be increased in the future. Currently, device list contains about 130 MCUs. The MCU names in the ***DeviceList*** are sorted in alphabetic order. Alphabetical order is convenient for users, however the API-DLL requires fixed MCU index when selecting the particular MCU. In the structure above the MCU index required by API-DLL is located in

DeviceList[k].index

and procedure setting the required MCU becomes as follows

```
F_SetConfig( CFG_MICROCONTROLLER, DeviceList[k].index );
```

The second procedure that can be called after the ***get_FPA_and_MSP_list(.....)*** procedure has finished successfully, is the ***AssignFPAs(.....)*** procedure that activates the DLLs and assign desired FPAs. When these two procedures are finished successfully, the programmer is ready to work. See procedure

FP430_FPA_initialization()

located in ***MyMSP430SamplePrg.cpp*** file how to call procedures above and what the next step should be.

The same procedures as described above have been implemented in the software package using Visual Basic 6.0. When the Visual Basic 6.0 is used, then the following files should be included to your program

FlashPro430Def.bas
MspFPA-Lib.bas
MSP430SamplePrg.bas

The above files are located in the following directory

...\Elprotronic\MSP430\USB FlashPro430\API-DLL-MyPrg\VB6

When running your application, remember tp place the following files in the same directory as your executable file:

MSP430FPA.dll	
MSP430FPA1.dll	- required if the USB-MSP430-FPA adapter is used
MSPFET430UIF1.dll	- required if the TI's MSP-FET430UIF is used
Config.ini (optional)	

You can modify file MSP430SamplePrg.bas to best fit into your application needs. Other files should not be modified. The remaining files in this project are located in directory

...\Elprotronic\MSP430\USB FlashPro430\API-DLL-MyPrg\VB6

and are included for demonstration purposes only. Project can be activated by selecting the project file MyMSP430Prg.vbp located in directory

...\Elprotronic\MSP430\USB FlashPro430\API-DLL-MyPrg\VB6

All procedures implemented in Visual Basic 6.0 are the same as those implemented in Visual C++. See description above. Procedures written in VB6 are located in the MspFPA-Lib.bas file. Example how to use these procedures are located in the MSP430SamplePrg.bas file. API-DLL function declaration and constant definition are located in the FlashPro430Def.bas file.

2.3 API DLL Demo Program

Application DLLs files are the same for the application software written under Visual C++, Visual Basic, LabView etc. First should be created destination directory, where the executable files and DLLs will be located. Make a copy off all required files from the Elprotronic's directory to your destination directory. The files described in the chapter 1 should be copied to the executable destination directory. It is recommended to use the demo program to verify if the setup in your PC and destination directory is done correctly.

The Demo program is small GUI program with a lot of buttons allowing to separately call functions using DLL library package software. Source code and all related project files are located in the following directory:

C:\Program Files\Elprotronic\MSP430\USB FlashPro430\API-DLL-Demo\Cpp\Exe

VBnet version

C:\Program Files\Elprotronic\MSP430\USB FlashPro430\API-DLL-Demo\VBnet
VB6 version
C:\Program Files\Elprotronic\MSP430\USB FlashPro430\API-DLL-Demo\VB6
Labview (ver 7.1)
C:\Program Files\Elprotronic\MSP430\USB FlashPro430\LabView

when the FlashPro430 package is used, or in directory

C:\Program Files\Elprotronic\MSP430\FET-Pro430\API-DLL-Demo\Cpp\Exe
VBnet version
C:\Program Files\Elprotronic\MSP430\FET-FlashPro430\API-DLL-Demo\VBnet
VB6 version
C:\Program Files\Elprotronic\MSP430\FET-FlashPro430\API-DLL-Demo\VB6
Labview (ver 7.1)
C:\Program Files\Elprotronic\MSP430\FET-FlashPro430\LabView
when the FET-Pro430 package is used.

It is recommended to also copy the demo software
FlashPro-Multi-FPA-Demo.exe
taken from the Elprotronic's directory (default location)
C:\Program Files\Elprotronic*MSP430*\USB FlashPro430\API-DLL-Demo\Cpp\Exe

To make a run the demo program, then the following files should be located in the same directory where the executable program in located. Assume that the demo program

FlashPro-Multi-FPA-Demo.exe

is used, then also the following files should be located in the same directory

MSP430FPA.dll	- Multi-FPA selection/distribution DLL
MSP430FPA1.dll	- required if the USB-MSP430-FPA adapter is used
MSPFET430UIF1.dll	- required if the TI's MSP-FET430UIF is used
config.ini	- (optional) default configuration file for the FPAs

The **FlashPro-Multi-FPA-Demo.exe** program contains GUI (Figure 2.3) that allows to activate one or more Flash Programming Adapters (FPA), TI's MSP-FET430UIF adapter or mixed like in an example below - USB-MSP430-FPA and MSP-FET430UIF adapters . When one adapter is used then the button ***Open Instances And FPA ("*# *")*** should be pressed. The first detected FPA

adapter connected to USB port(s) will be activated. If the USB-MSP430-FPA adapter is not present, then software is searching for the MSP-FET430UIF adapter. If more then one adapter are connected, then only fisrt will be used, all others adapters will be ignored. When the adapter is accepted by software, then the ***1. Initialization*** button must be pressed. When the ***1. Initialization*** button is pressed then communication with the programming adapter is initialized. Now the desired configuration setup should be downloaded to DLLs and programming adapters (using button ***'2. Setup File'***), code file with data to be downloaded to target devices (using button ***'3. Open Code'***)

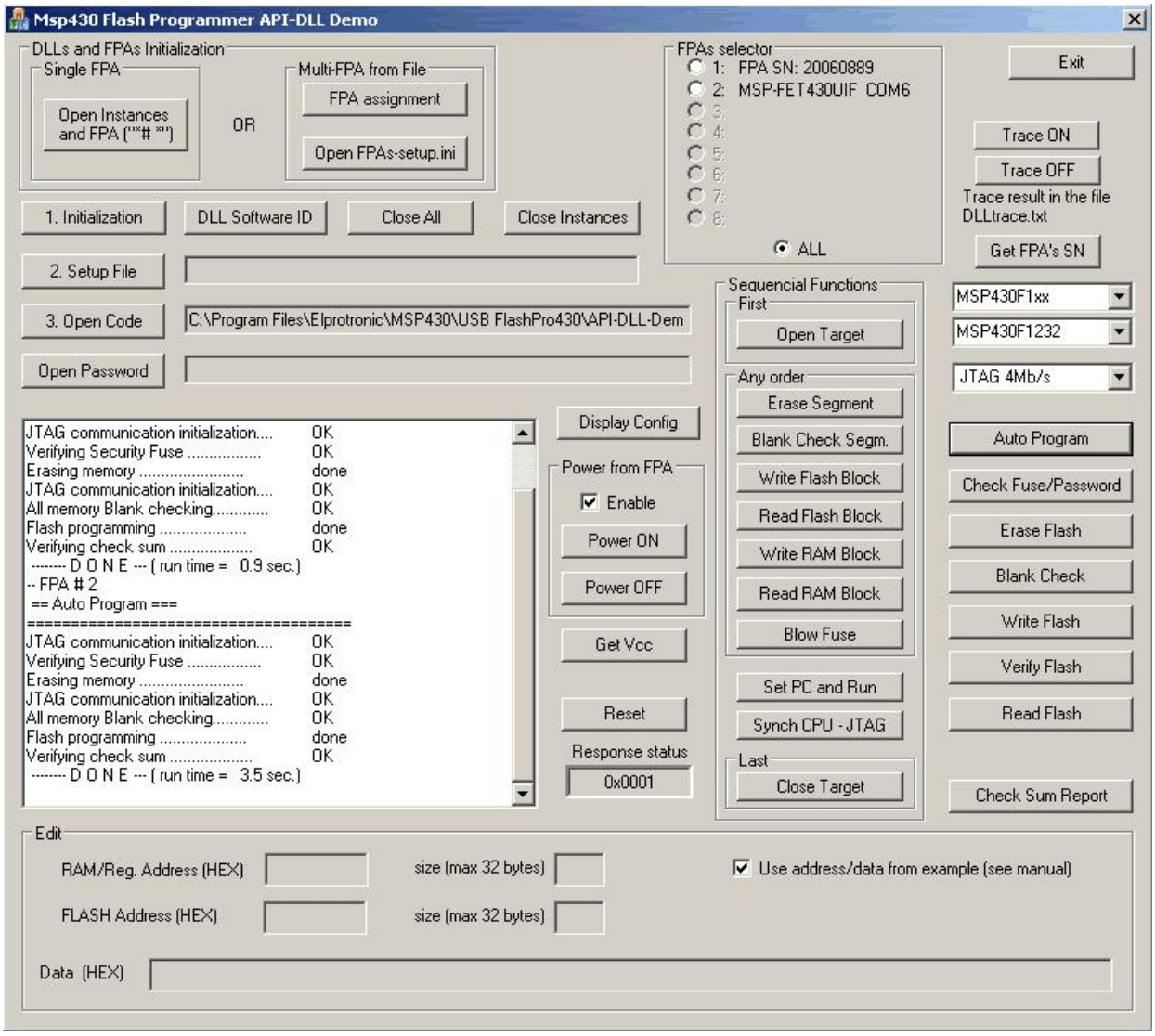


Figure 2.4 Demo program dialogue screen using DLLs.

and password file, if required (using button ***'Open Password'***). Setup file can be created using standard FlashPro430 programming software. Setup file used in the FlashPro430 has the same format as the configuration file used in the application DLL.

All other buttons used in the demo program are calling one API-DLL function per one button. For example button ***'Autoprogram'*** is calling

```
F_Autoprogram(1);
```

function, button ***'Open Target'*** is calling

```
F_OpenTarget();
```

function etc. Using any button pressing sequence it is possible to test how the application dll is responding for these combinations. Some of the buttons assigning extra data to be able to simulate some write/erase procedures as follows.

* button ***'Erase segment'*** allows to erase segment located on address 0x1000 to 0x107F.
* button ***'Blank Check Segm.'*** allows to check the segment defined in the ***'Erase segment'*** button.
* button ***'Write Flash Block'*** allows to write block data
  0x01, 0x02, 0x03, 0x04, 0x05, 0x06, 0x07, 0x08
  to flash location starting from 0x1020.
* button ***'Read Flash Block'*** allows to read data from flash addresses 0x1000 to 0x103F.

When the check mark named ***'Use address/data from example (see manual) '*** in the ***'Edit'*** frame is unmarked, then edit fields becomes active and addresses to the function described above can customized and defined in the ***'RAM Address (HEX)'*** or ***'Flash Address (HEX)'***. Content of data can be specified in the ***'Data (HEX)'*** field. All data should be separated by white character (space). Maximum size data should be specified in the ***'size (max 32 bytes)'*** fields (RAM or Flash).

When any button related to encapsulated functions is used (***'Autoprogram'***, ***'Erase Flash'***, ***'Blank Check'***, ***'Write Flash'***, ***'Verify Flash'***) then data taken from the code file is used (press button ***'3. Open Code'*** to take desired code data).

Described demo program allows to understand how to use the dll functions in the application software.

When more then one adapter is connected to PC, then the Multi-FPA API-DLL feature should be activated. Currently up to 64 adapters can be controlled from one application software. For simplicity the presented demo program can control up to eight adapters only. The Multi-FPA API-DLL can assign specified FPA serial number to desired FPA index or specified COM port or eq. serial number for the MSP-FET430UIF, where index can be from 1 up to 64 (1 to 8 in presented demo software). At the startup software is scanning all available FPAs and MSP-FET430UIFs and assigning adapters according to defined FPA's serial number list. See the F_OpenInstancesAndFPAs(..) Instruction for details. Configuration will be always the same regardless used the FPA vs USB port location. All

adapters not specified in the desired FPA list will be ignored. Make sure that the desired list uses correct FPAs serial numbers. The FPA serial number is printed in the FPA's label. When the MSP-FET430UIF is used then check the assigned port for particular adapter (use FET-Pro430 software for it) or use the **UIF** definition to accept any UIF-MSP430UIF adapter. Note, that only one MSP-FET430UIF can be used, so definition **UIF** can be used for simplicity.

Assume, that we are using one USB-MSP430-FPA programming adapter and one MSP-FET430UIF adapter. In the next step, the configuration file should be created, that contains list off all FPA's used in the application. Using the ***Notepad*** editor open the default FPA's configuration file ***'FPAs-setup.ini'*** taken from your destination location (copied before from Elprotronic's directory) and write the serial numbers or IDs of used adapters. Take a serial numbers from the FPAs labels and write it on the desired FPAs locations FPA-1 up to FPA-8. For two adapters as above the configuration file can use an IDs - FPA and UIF only as follows:

```
;====================================================================
; USB-MSP430-FPA configuration setup                                *
; Elprotronic Inc.                                                  *
;--------------------------------------------------------------------
; up to eight FPA can be specified and connected via USB to PC      *
; syntax:                                                           *
;   FPA-x   Serial Number                                           *
;   where  FPA-x can be  FPA-1, FPA-2, FPA-3 .... up to FPA-8       *
;   Serial number - get serial number ir ID from the desires        *
;   adapter's label                                                 *
;  Minimum one FPA's must be specified                              *
;  FPA-x order - any                                                *
;                                                                   *
;  e.g  (without semicolon  - comment)                              *
;  Available options for Elprotronic's FPA's:                       *
;    ANY adapter FPA or UIF          - *                            *
; or ANY FPA adapter                 - FPA                          *
; or FPA with serial number only eg. - 20080123                     *
;                                                                   *
;  Available options for TI's MSP-FET430UIF                         *
;    ANY adapter FPA or UIF          - *                            *
; or ANY UIF adapter                 - UIF                          *
; or UIF used COM x port             - COM4                         *
; or UIF used HID x port             - HID3                         *
;                                                                   *
;FPA-1   20050116                                                   *
;FPA-3   20050199                                                   *
;FPA-5   20050198                                                   *
;====================================================================

FPA-1   FPA
FPA-2   UIF
```

Note, that only lines without comments (without semicolon on the front) are used by software. All lines with comment are ignored. The FPA's serial numbers and FPA's indexes can be listed in any order and with gap like FPA-1, FPA-5 etc. without FPA-2, 3 etc. Minimum one valid FPA with correct ID or SN must be specified. Up to sixteen adapters can be declared. When the FPA's configuration file is created then file should be saved using name starting from ***FPA*** and with extention ***ini*** e.g ***FPAs-setup.ini***.

Connect all required adapters to USB connectors and run the **FlashPro-Multi-FPA-Demo.exe** demo software. First the DLL instances should be opened and all connected FPA's should be assigned to desired FPA's indexes. When the button ***'FPA assigment'*** is pressed, then the DLL function named

```
F_OpenInstancesAndFPAs( FileName );
```

is called. This function is taking list of defined FPA's numbers or IDs from the FPAs configuration file and assigning all adapters to desired FPA indexes (1 to64). Number of instances to be opened is calculated automatically, one per available and valid adapter. On described example with two asdapters in the ***'FPAs selector'*** will display two valid adapters with list of used FPAs' serial numbers or COM port for the MSP-FET430UIF. All, others FPA-x fields will be disabled. In this example only two DLL instances becomes opened. Valid FPA indexes becomes 1,2 and ALL.

When the dll instances becomes opened and FPA adapter assigned to desired FPA's indexes, then the initialization procedure `F_Initialization()` must be called. It is recommended to initialize all opened instances by calling function

```
F_Set_FPA_index(ALL_ACTIVE_FPA);
```

when more then one FPA adapter is used, or

```
F_Set_FPA_index(1);
```

when one FPA (assigned to index 1 by default) is used

prior to initialization function

```
F_Initialization();
```

On the demo program initialization procedure all these procedures are called when the button ***'1. Initialization'*** is pressed. Now adapters are ready to take other commands. In the demo above the ***'Autoprogram'*** button has been used to download code simultaneously to two target devices MSP430F1232 via two types of programming adapters - USB-MSP430-FPA and TI's MSP-FET430UIF. See programming report in the ***Report*** window - under FPA-#1 report taken from first adapter, and under FPA #2 - report taken from the second adapter. In reality always the same type adapters will be used, but this example showing flexibility of the API-DLL, that allows to swap adapters and use application software with different adapters without modifying an application software.

3. Example with API DLL

3.1 Example with single FPA

The code example described below uses one programming adapter. The Multi-FPA API-DLL selector should be select for FPA-1 only. The ***fpa_index*** should be set to 1 or should be unmodified. The default value of the fpa_index when one adapter is detected only is 1.

Initialization opening procedure for the USB-FPA can be as follows:

```
response = F_OpenInstancesAndFPAs( "*# *" );
           // DLL and FPA (one only) initialization
if( response == 0 )
    {
      //The FPA has not been found. Exit from the program.
    }
F_Set_FPA_index( 1 );             // select FPA 1 for
F_Initialization( );              // init FPA
```

Below is an example of the simplified (without error handling procedures) application program written in C++ that allows to initialize one FPA, and run an autoprogram with the same features like an autoprogram in the standard FlashPro430 (GUI) software.

1. Download data to target device

```
F_OpenInstancesAndFPAs( "*# *" ); // DLL and FPA (one only) initialization
if( response == 0 )
    {
      //The FPA has not been found. Exit from the program.
    }
F_Set_FPA_index( 1 );             // select FPA 1 only
F_Initialization( );              // init FPA
  //- functions above initialized at the startup only ----
F_ReadConfigFile(  filename );            // read configuration data and save
                                          // to API-DLLs
F_ReadCodeFile(  format, filename );      // read code data and save to DLL

  do
   {
    status = F_AutoProgram( 1 );        //start autoprogram
    if ( status != TRUE )
    {
     ..............................
    }
    else
```

```
    {
        ..........................................
    }
   } while(1); //make an infinite loop until last target device programmed
.............................................................
  //- functions below called at the end of session
F_CloseInstances();
```

Note: The ***F_OpenInstancesAndFPAs(..)*** and ***F_Initialization()*** functions should be called once and the startup and the ***F_CloseInstances()*** function should be called as the last one after all functions are finished in similar way like the ***FlashPro430*** GUI software is opening once and closed at the end when job is finished. The startup initialization take few seconds (when the ***F_OpenInstancesAndFPAs(..)*** and ***F_Initialization()*** are executed) until dll installation is established and desired firmware downloaded to FPA adapter(s). Application software should call the initialization procedures at the startup only, and close access to API-DLL at the end, when all tests of a lot of units are finished. Closing instances and opening it again is a waist a time.

3.2 Example with Multi-FPA API DLL

The code example described below uses Multi-FPA API-DLL. The multi-FPA API-DLL is a shell that allows to transfer incoming instructions from application software to desired FPA's. All instructions related to single FPA are detailed described in the chapters 4.2, 4.3, 4.4 and 4.4. Instructions specific to Multi-FPA features described in the chapter 4.1.

Application DLL should be initialized first, before other DLLs instruction can be used.

```
response = F_OpenInstancesAndFPAs( FPAs-setup.ini );
    // DLL and FPA initialization
if( response == 0 )
    {
      //The FPA has not been found. Exit from the program.
    }
F_Set_FPA_index( ALL_ACTIVE_FPA );       // select all FPA's
F_Initialization( );                     // init all FPA's
```

In example above number of the opened USB-FPAs are specified in the ***'FPAs-setup.ini'***

Below is an example of the simplified (without error handling procedures) application program written in C++ that allows to initialize all dlls and FPA, and run an autoprogram with the same features like autoprogram in the standard FlashPro430 application software.

1. Download data to all target devices (uses USB-FPAs)

```
response = F_OpenInstancesAndFPAs( FPAs-setup.ini);
           // DLL and FPA initialization
if( response == 0 )
    {
      //The FPA has not been found. Exit from the program.
    }
F_Set_FPA_index( ALL_ACTIVE_FPA );       // select all FPA's
F_Initialization( );                     // init all FPA's
F_ReadConfigFile(  filename );           // read configuration data and save
                                         // to all API-DLLs
F_ReadCodeFile(  format, filename );     // read code data and save to all
                                        // API-DLLs
  do
   {
    status = F_AutoProgram( 1 );
          //start autoprogram-to program all targets simultaneously with
          //the same downloaded data to all target devices.
    if ( status != TRUE )
    {
     if ( status == FPA_UNMACHED_RESULTS )
      {
       for (n=1; n<=MAX_FPA_INDEX; n++ ) status[n] =  = F_LastStatus( n);
        ..............................................
      }
     else
      {
        ..............................................
      }
    }
   } while(1); //make an infinite loop until last target device programmed
.............................................................
F_CloseInstances();
```

Note, that all single API-DLL are independent from each others and it is not required that all data and configuration should be the same for each API-DLLs (each FPAs, or target devices) . For example - code data downloaded to the first target device can be the same (but it is not required) as code data downloaded to second target device etc. In the example below the downloaded code to target devices are not the same .

2. Download independent data to target devices (uses USB-FPAs)

```
F_OpenInstancesAndFPAs( FPAs-setup.ini); // DLL and FPA initialization
F_Set_FPA_index( ALL_ACTIVE_FPA );       // select all FPA's
```

```
  F_Initialization( );                      // init all FPA's
.....................................................................
  F_Set_FPA_index( ALL_ACTIVE_FPA );        // select all FPA's
  F_ReadConfigFile(  filename );            // read configuration data and save
                                            // to all API-DLLs
  F_Set_FPA_index( 1 );                     // select  FPA 1
  F_ReadCodeFile(  format, filename1 );     // read code data and save to
                                            // API-DLL-1
  F_Set_FPA_index( 2 );                     // select  FPA 2
  F_ReadCodeFile(  format, filename2 );     // read code data and save to
                                            // API-DLL-2
.....................................................................
  F_Set_FPA_index(7 );                      // select  FPA 7
  F_ReadCodeFile(  format, filename7 );     // read code data and save to
                                            // API-DLL-7
  F_Set_FPA_index( 8 );                     // select  FPA 8
  F_ReadCodeFile( 8, format, filename8 );   // read code data and save to
                                            // API-DLL-8
  F_Set_FPA_index( ALL_ACTIVE_FPA );        // select all FPA's
    do
     {
      status = F_AutoProgram( 1 );
       //start autoprogram  - to program all targets simultaneously
       //with the independent downloaded data to all target devices.

      if ( status != TRUE )
      {
       if ( status == FPA_UNMACHED_RESULTS )
        {
          for (n=1; n<=MAX_FPA_INDEX; n++ ) status[n] =  = F_LastStatus( n);
           ..............................................
        }
       else
        {
          ..............................................
        }
      }
    } while(1); //make an infinite loop until last target device programmed
  ...............................................................
  F_CloseInstances();
```

See source code in the DEMO program written in Visual C++, Visual Basic or LabView for more detail.

4. List of the DLL instructions

Application DLLs files are the same for the application software written under Visual C++, Visual Basic, LabView etc. From that reason the API-DLL not transfers the pointers from the API-DLL to application, because Visual Basic (or other software) will not be able to use these functions. When a lot of data are transferred from API-DLL to application, then these data should be read item by item.

All DLL instructions are divided to four groups - related to Multi-FPA selector, single FPA generic, single FPA encapsulated and single FPA sequential instructions. Multi-FPA specific instructions are related to the Multi-FPA DLL only. Generic instructions are related to initialization programmer process, while encapsulated and sequential instructions are related to target device's function. Encapsulated and sequential instructions can write, read, and erase contents of the target device's flash memory.

Multi-FPA specific instructions are related to load and release the single-FPA dlls, selection of the transparent path and sequential/simultaneous instructions transfer management. All other instructions are related to single FPAs.

Generic instructions are related to initialization programmer process, configuration setup and data preparation, Vcc and Reset to the target device. Generic instructions should be called first, before encapsulated and sequential instruction.

Encapsulated instructions are fully independent executable instructions providing access to the target device. Encapsulated instructions can be called at any time and in any order. When called then all initialization communication with the target device is starting first, after that requested function is executed and at the end communication with the target device is terminated and target device is released from the programming adapter.

The encapsulated functions should be mainly used for programming target devices. These functions perform most tasks required during programming in an easy to use format. These functions use data provided in Code Files, which should be loaded before the encapsulated functions are used. To augment the functionality of the encapsulated functions, sequential functions can be executed immediately after to complete the programming process.

Sequential instructions allow access to the target device in a step-by-step fashion. For example, a typical sequence of instructions used to read data from the target device would be to open the target device, then read data and then close the target device. Sequential instruction have access to the target device only when communication between target device and programming adapter is initialized. This can be done when ***Open Target Device*** instruction is called. When communication is established, then any number of sequential instruction can be called. When the process is finished, then at the end ***Close Target Device*** instruction should be called. When communication is terminated, then sequential instructions can not be executed.

Note: Inputs / outputs has been defined as INP_X, and LONG_X. Both of them are defined as 4 bytes long (see MSPPrg-Dll.h header file)
#define INP_X _int32
#define LONG_X _int32
Make sure that an application using the DLL file has the same length of desired data.

Figure 4.1 shows the structure of the Multi-FPA API-DLL. It shows that the Multi-FPA DLL is used to communicate with the user application as well as the target devices. Each of the target devices is accessed by a single DLL associated with it. When more then one FPA is needed, up to 64 DLLs can be created to communicate with up to 64 devices at a time. Each instance of an FPA-DLL contains its own copy of buffers, as shown in Figure 4.2

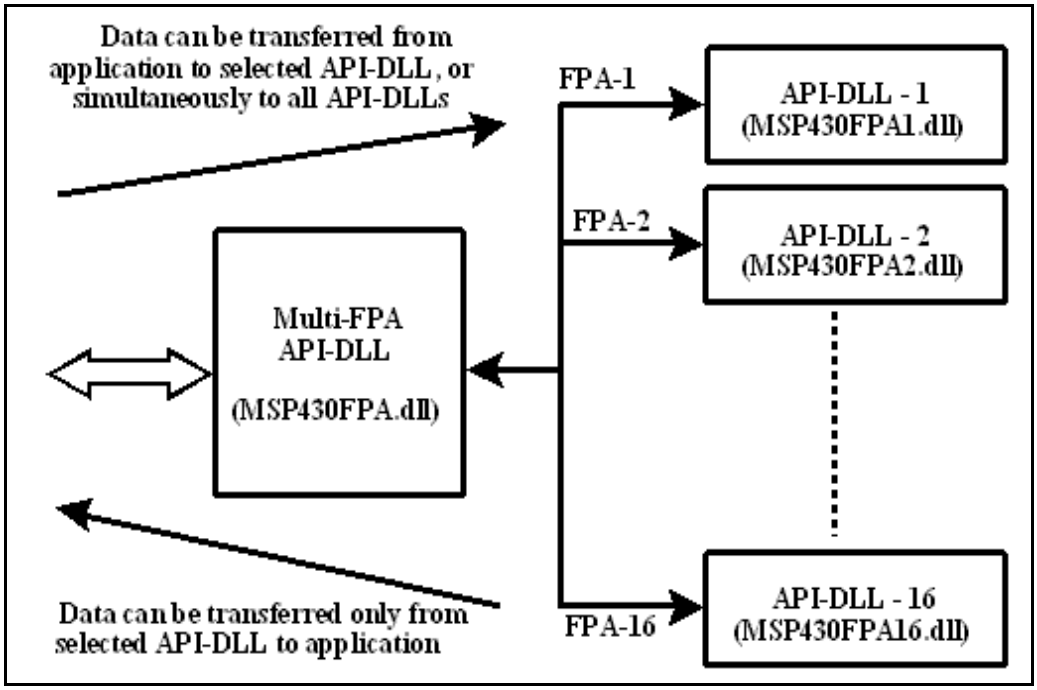


Figure 4.1 Multi-FPA API-DLL diagram.

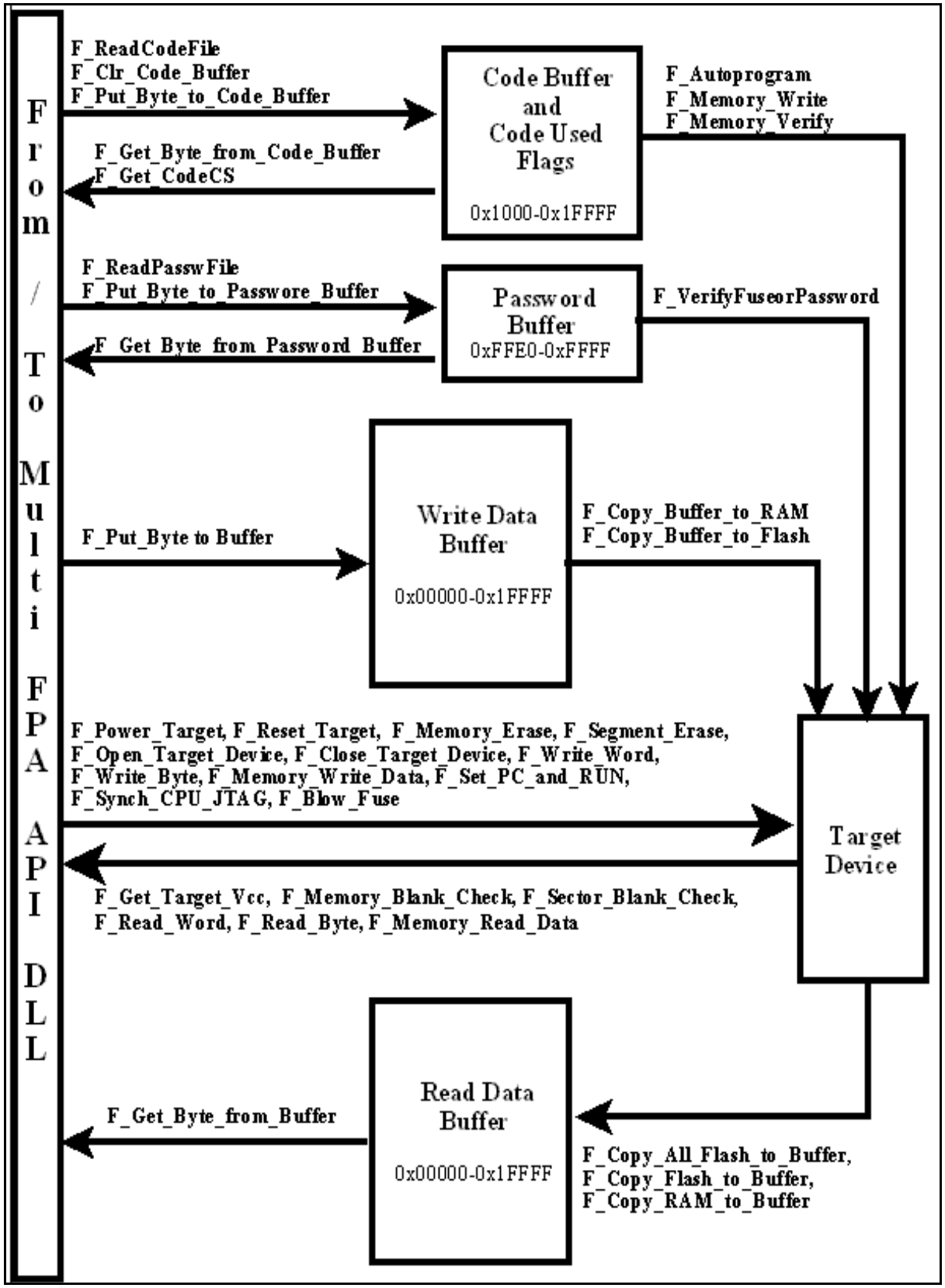


Figure 4.2 - API-DLL block diagram.

4.1 Multi-FPA instructions

The Multi-FPA API-DLL instructions are related to Multi-FPA selector only. These instructions allows to initialize all single applications dlls and select the instruction patch between application software and desired FPA and sequential/simultaneous instructions transfer management Up to sixteen independent FPAs can be remotely controlled from the application software. All instructions from application software can be transferred to one selected FPA or to all FPAs at once. That feature allows to increase programming speed and also allows to have individual access to any FPA is required.

F_Trace_ON

F_Trace_ON - This function activate the tracing.

The F_Trace_ON() opens the DLLtrace.txt file located in the current directory and records all API-DLL instructions called from the application software. This feature is useful for debugging. When debugging is not required then tracing should be disabled. Communication history recorded in the in the last session can be viewed in the DLLtrace.txt located in the directory where the API-DLL file is located. When the new session is established then the file DLLtrace.txt is erased and new trace history is recorded.

Note: *Tracing is slowing the time execution, because all information passed from application software to API-DLL are recorded in the dlltrace.txt file.*

Syntax:

```
void MSPPRG_API  F_Trace_ON( void );
```

F_Trace_OFF

F_Trace_OFF - Disable tracing, See **F_Trace_ON** for details.

Syntax:

```
void MSPPRG_API  F_Trace_OFF( void );
```

F_OpenInstances

F_OpenInstances - API-DLL initialization in the PC.

Instruction must be called first - before all other instruction. Instead this function the F_OpenInstancesAndFPAs is recommended.

Important: It is **not recommended** to use this function. Function used only for compatible with the old software. Use the **F_OpenInstancesAndFPAs** instead.
Do not use the **F_OpenInstances** or **F_Check_FPA_access** after using the **F_OpenInstancesAndFPAs**. The **F_OpenInstancesAndFPAs** is assigning the FPAs to USB ports and it is not recommended to reassign once again the USB port using the **F_Check_FPA_access** function. To check the communication activity with FPA use the **F_Get_FPA_SN** function that allows to check te communication with the FPA adapter without modifying the USB ports assignment.

DO NOT use this instruction for activating connection with the MSP-FET430UIF adapter. Use the **F_OpenInstancesAndFPAs** for it.

Syntax:

```
INT_X      MSPPRG_API  F_OpenInstances ( BYTE no );
```

Parameters:

```
no -> number of the single API-DLL to be open
no -> 1 to MAX_USB_DEV_NUMBER
          where MAX_USB_DEV_NUMBER = 64
```

Return value:

```
number of opened instances
```

F_CloseInstances

F_CloseInstances - Close all active API-DLLs and free system memory.

Syntax:

```
INT_X      MSPPRG_API  F_CloseInstances ( void );
```

Parameters:

```
void
```

Return value:

```
TRUE
```

F_OpenInstancesAndFPAs, F_OpenInstances_AndFPAs

F_OpenInstancesAndFPAs or **F_OpenInstances_AndFPAs** - API-DLL initialization in the PC and programming adapters scan and assignment to desired USB port according to contents of the FPA's list specified in the string or FPA's configuration file.

Instruction must be called first - before all other instruction. Function is opening the number of the desired API-DLL and assigning the desired adapters to available USB ports. Regardless of the USB port open sequence and connection of the USB-FPA or MSP-FET430UIF to USB ports, the F_OpenInstancesAndFPAs instruction is reading the FPA's list, scanning all available adapters connected to any USB ports and assigning the indexes to all adapters according to contents of the FPA list (from string or configuartion file). All adapters not listed in the FPA configuration file and connected to USB ports are ignored.

Important: Do not use the **F_Check_FPA_access** after using the **F_OpenInstancesAndFPAs**. The **F_OpenInstancesAndFPAs** is assigning the FPAs to USB ports and it is not recommended to reassign once again the USB port using the **F_Check_FPA_access** function. To check the communication activity with FPA use the **F_Get_FPA_SN** function that allows to check te communication with the FPA adapter without modifying the USB ports assignment.

Syntax:

```
INT_X      MSPPRG_API  F_OpenInstancesAndFPAs( char * List );
INT_X      MSPPRG_API  F_OpenInstances_AndFPAs( CString List );
```

Parameters:

1. When the first two characters in the List string are *#, then reminding characters of the string contain a list of desired FPAs serial numbers or IDs assigned to FPA-1, -2, ...-n indexes, eg.

```
"*# 20060123, 20060234, 20060287"
```

2. When the first two characters in the List string are not *#, then the string contain file name or full path of the file with a list of the FPA's serial numbers, eg.

```
"C:\Program Files\Elprotronic\FPAs-setup.ini"
```

Return value:

```
number of opened instances
```

1. The FPA list in the string:

String -> `"*# SN1, SN2, SN3, SN4, SN5..."`

Where the

SN1- FPA's serial number that should be assigned to FPA-1 index

SN2- FPA's serial number that should be assigned to FPA-2 index

etc.

As a delimiter the comma ',' or white space ' ' can be used.

Example:

"*# 20060123, 20060346, 20060222, 20060245"

or

"*# 20060123 20060346 20060222 20060245"

List of the acceptable numbers or IDs for USB-MSP430_FPA adapters:

1. FPAs **serial number** - 8 digits eg. 20060222

   eg, "*# 20060123 20060346 20060222 20060245"

   Four USB-MSP430-FPA will be used with SN as listed above

   FPA-1 20060123
   FPA-2 20060346
   FPA-3 20060222
   FPA-4 20060245

   If from any reason the listed adapter is not found, then the FPA-x becomes empty. All other adapters will have the same FPA-x indexes as specified in the list eg if the FPA SN is missing, then only the FPA-3 will be empty. The FPA-4 will have the same position as before.

   FPA-1 20060123
   FPA-2 20060346
   FPA-3 Empty
   FPA-4 20060245

2. ID **FPA** - to select any USB-MSP430-FPA only. No FPA's serial number can be specified after this definition.

   eg, "*# 20060123 20060346 20060222 FPA"

   Last one will be an any adapter USB-MSP430-FPA not listed before.

3. ID **'*'** - to select any adapter - USB-MSP430-FPA or MSP-FET430UIF. No other adapters can be specified after this definition.

eg, "*# 20060123 20060346 20060222 *"

Last one will be any adapter USB-MSP430-FPA or MSP-FET430UIF not listed before.

List of the acceptable numbers or IDs for the MSP-FET430UIF adapter:

When the MSP-FET430UIF adapter is used, then fro compatibility with the USB-MSP430-FPA adapters software is assigning the serial number for these adapters. Serial number for these adapters is created with following formula

SN = 20010000 + 200 * HID + 100 * COM + port_number

For example if adapter is using COM port # 6 then the eq. serial number is calculated as

SN = 20010000 + 200 * 0 + 100 * 1 + 6 = 20010106

Assigned serial number allows to use application software without modification for the USB-MSP430-FPA and MSP-FET430UIF adapters. No modification of the application software is required. However, for simplicity the current API-DLL software can accept also other, more convenient definition for the MSP-FET430UIF adapters .

1. FPAs **serial number** - 8 digits eg. 20010106

   eg, "*# 20060123 20060346 20060222 20010106"

   Four USB-MSP430-FPA will be used with SN as listed above

FPA-1	20060123	- USB-MSP430-FPA
FPA-2	20060346	- USB-MSP430-FPA
FPA-3	20060222	- USB-MSP430-FPA
FPA-4	20010106	- MSP-FET430UIF

2. ID **UIF** - to select any MSP-FET430UIF only. No UIF's serial number can be specified after this definition.

   eg, "*# 20060123 20060346 20060222 UIF"

   Last one will be an any adapter MSP-FET430UIF.

   eg, "*# UIF"

   The MSP-FET430UIF adapter only.

3. ID **'*'** - to select any adapter - USB-MSP430-FPA or MSP-FET430UIF. No other adapters can be specified after this definition.

   eg, "*# 20060123 20060346 20060222 *"

   Last one will be any adapter USB-MSP430-FPA or MSP-FET430UIF not listed before.

Note: If it is used one any **MSP-FET430UIF** adapter, then it is recommended to use definition "***# UIF**" instead "***# ***". With the first definition software will search only the **MSP-FET430UIF** adapter. With the second definition software will search the **USB-MSP430-FPA** adapter first, and if this adapter is

not found, then the **MSP-FET430UIF** will be searched. So - the first declaration is faster, the second is slower, but more universal - any adapter can be used without definition modification

Initialization examples:

```
1.    F_OpenInstances_AndFPAs( "*# *" ); // only one any adapter
```

or

```
2.    F_OpenInstances_AndFPAs( snlist ); // hardcoded SN list
```

2.The FPA list in the configuration file:

String -> `"C:\Program Files\Elprotronic\FPAs-setup.ini"`

The FPA list can be specified in the file using the same rules as the definitions described above. Each defined adapter is listed after FPA-index s below eg:

```
;====================================================================
; USB-MSP430-FPA configuration setup                                *
; Elprotronic Inc.                                                  *
;--------------------------------------------------------------------
; up to eight FPA can be specified and connected via USB to PC      *
; syntax:                                                           *
;   FPA-x   Serial Number                                           *
;   where  FPA-x can be  FPA-1, FPA-2, FPA-3 .... up to FPA-8       *
;   Serial number - get serial number ir ID from the desires        *
;   adapter's label                                                 *
;  Minimum one FPA's must be specified                              *
;  FPA-x order - any                                                *
;                                                                   *
;  e.g  (without semicolon  - comment)                              *
;  Available options for Elprotronic's FPA's:                       *
;    ANY adapter FPA or UIF          - *                            *
; or ANY FPA adapter                 - FPA                          *
; or FPA with serial number only eg. - 20080123                     *
;                                                                   *
;  Available options for TI's MSP-FET430UIF                         *
;    ANY adapter FPA or UIF          - *                            *
; or ANY UIF adapter                 - UIF                          *
; or UIF used COM x port             - COM4                         *
; or UIF used HID x port             - HID3                         *
;                                                                   *
;FPA-1   20050116                                                   *
;FPA-3   20050199                                                   *
;FPA-5   20050198                                                   *
;====================================================================

FPA-1   20060123
FPA-2   20070234
```

```
; NotePad editor can be used to create the FPA configuration file.
```

When the '*' is used instead FPA's SN, then any FPA will be accepted. The '*' can be used only once and on the end of the FPA's list eg.

```
FPA-1   20050116
FPA-2   20050199
FPA-3   *

or

FPA-1   *
```

when only one adapter (any adapter) is used.

Example:

1. Only one FPA is used:

```
F_OpenInstancesAndFPAs( "*# *" ); //DLL startup and FPA assignment
            //by default - FPA-1 is selected.
            //The F_Set_FPA_index(1) is not required.
F_Initialization();               //FPA 1 initialization
F_ReadConfigFile( filename );     //download configuration to DLLs.
F_ReadCodeFile( format, filename );  //download code file to DLLs.
do
{
  status = AutoProgram(1);    //start autoprogram
  if( status != TRUE )
      {
          // service software when results from FPAs are not the same
      }
        else
         {
         }
        ......................
      {
  ......................
} while(1);
F_CloseInstances();
      // release DLLs from memory
```

2. More then one FPA is used.

```
F_OpenInstancesAndFPAs( FPAs-setup.ini );
            //DLL startup and FPA assignment
F_Set_FPA_index (ALL_ACTIVE_FPA);
            //select all available FPAs
F_Initialization();
            //init all FPAs
```

```
F_ReadConfigFile( filename );
            //download the same configuration to all DLLs.
F_ReadCodeFile( format, filename );
            //download the same code file to all DLLs.
do
{
  status = AutoProgram(1);
            //start autoprogram to all FPAs simultaneously.
  if( status != TRUE )
      {
        if( status == FPA_UNMATCHED_RESULTS )
         {
           // service software when results from FPAs are not the same
         }
        else
         {

         }
        ......................
      {
  ......................
} while(1);
F_CloseInstances();
      // release DLLs from memory
```

F_Set_FPA_index

F_Set_FPA_index - Select desired FPA index (desired DLL instance)

VALID FPA index - (1 to 64) or 0 (ALL FPAs).

Syntax:

```
INT_X      MSPPRG_API  F_Set_FPA_index ( BYTE fpa );
```

Parameters:

```
fpa -> 1 to MAX_FPA_INDEX  where MAX_FPA_INDEX  = 64
       or 0 -> ALL_ACTIVE_FPA
```

note: instead of '0' value it can be used global defined
ALL_ACTIVE_FPA that is defined as

```
#define    ALL_ACTIVE_FPA    0
```

in the header file

Return value:

```
TRUE - if used fpa index is valid
FPA_INVALID_NO - if used fpa index is not activated or out of range
```

note: FPA_INVALID_NO -> -2 (minus 2)

IMPORTANT: **When any function is trying to access the invalid FPA, then return value from this function is -2 (FPA_INVALID_NO)**

Note: When index ***ALL_ACTIVE_FPA (0)*** is used, then all data can be transferred from application to all active FPA's (API-DLLs). However, when the data is transferred from FPA (or API-DLLs) to the application, then the FPA index CANNOT be ***ALL_ACTIVE_FPA (0).*** Index must select desired FPA**.** When the simultaneous process is required eg. reading flash contents from all target devices, then the ***F_Copy_All_Flash_to_Buffer()*** should be called after the **F_Set_FPA_index(** ***ALL_ACTIVE_FPA*** **).** When finished, the contents of each buffer (inside each API-DLLx) can be read using the **F_Set_FPA_index(1)**, **F_Set_FPA_index(2) .....**, and **F_Get_Byte_from_Buffer(..)**. See below .

```
F_Set_FPA_index (ALL_ACTIVE_FPA); //select all available FPAs
F_Copy_All_Flash_to_Buffer();     //simultaneous process
for( fpa=1; fpa=fpa_max; fpa++ )
{
  if( F_Set_FPA_index(fpa) == FPA_INVALID_NO ) continue;
  for(addr = addr_min; addr <= addr_max; addr++)
  {
          data[addr][fpa-1]   =   F_Get_Byte_from_Buffer(addr);
  }
}
```

F_Get_FPA_index

F_Get_FPA_index - Get current FPA index

Syntax:

```
BYTE MSPPRG_API  F_Get_FPA_index ( void );
```

Return value:

```
current FPA index
```

F_Check_FPA_index

F_Check_FPA_index - Get current FPA index and check if index is valid.

Similar function to the F_Get_FPA_index, however, while the F_Get_FPA_index is returning current FPA index ragardless if the index is valid or not, simply returning the value set by the function F_Set_FPA_index(..). The Check_FPA_index will return -2 (minus two) `FPA_INVALID_NO` if FPA is pointing not initialized FPA (dll instance).

Syntax:

```
INT_X MSPPRG_API F_Check_FPA_index ( void );
```

Return value:

```
current FPA index ( 0, 1 to 64)
or -2 (minus two) FPA_INVALID_NO
```

F_Disable_FPA_index

F_Disable_FPA_index - Disable desired FPA index (desired DLL instance)
VALID FPA index - (1 to 64)

Function allows to disable communication with selected FPA adapter. From application point of view, all responses will be the same as from the not active FPA. Communication with target devices connected to selected FPA will be stopped. When the F_Set_FPA_index(0) will be used, then selected FPA will be ignored. Result will not be presented in the Status results (Status and F_LastStatus(..)).

Syntax:

```
void MSPPRG_API  F_Disable_FPA_index ( BYTE fpa );
```

Parameters:

```
fpa -> 1 to MAX_FPA_INDEX  where MAX_FPA_INDEX  = 64
```

F_Enable_FPA_index

F_Enable_FPA_index - Enable desired FPA index (desired DLL instance)
VALID FPA index - (1 to 64)

Function allows to enable communication with selected FPA adapter if the mentioned FPA has been disabled using the function F_Disable_FPA_index(...). By default, all FPAs are enabled.

Syntax:

```
void  MSPPRG_API  F_Enable_FPA_index ( BYTE fpa );
```

Parameters:

```
fpa -> 1 to MAX_FPA_INDEX  where MAX_FPA_INDEX  = 64
```

F_LastStatus

F_LastStatus - Get current FPA index
VALID FPA index - (1 to 64)

Syntax:

```
INT_X      MSPPRG_API  F_LastStatus ( BYTE fpa );
```

Parameters:

```
fpa - FPA index of the desired status
      fpa index -> 1..64
```

Return value:

```
Last status from the desired FPAs
```

All F_xxx functions returns the same parameters (status) as the original API_DLL is returning. When function is transferred to all API-DLLs (when the fpa=0) then returned parameter (status) is the same as the returned value from the API-DLLs when the ALL returned values ARE THE SAME. If not, then returned value is

```
FPA_UNMATCHED_RESULTS
```

(value of the `FPA_UNMATCHED_RESULTS` is minus 1).

To get the returned values from each FPAs, use the

For(n=1; n<=64; n++) status[n] = F_LastStatus(n);

where n -> desired FPA index
and get the last status data from FPA-1, 2, .. up to .64

F_Multi_DLLTypeVer

F_Multi_DLLTypeVer function returns integer number with DLL ID and software revision version.

Syntax:

```
MSPPRG_API      INT_X F_Multi_DLLTypeVer( void );
```

Return value:

```
VALUE = (DLL ID) | ( 0x0FFF & Version)
DLL ID = 0x1000   - Single-DLL for the FlashPro430 - Parallel Port
DLL ID = 0x2000   - Single-DLL for the FlashPro430 - USB
DLL ID = 0x3000   - Single-DLL for the GangPro430 - USB
DLL ID = 0x6000   - Multi-DLL for the FlashPro430
DLL ID = 0x7000   - Multi-DLL for the GangPro 430
```

```
Version = (0x0FFF & VALUE)
```

F_Get_FPA_SN

F_Get_FPA_SN - Get FPAs Serial number assigned to selected FPA-index (selected DLL instance number).

Syntax:

```
LONG_X     MSPPRG_API  F_Get_FPA_SN ( BYTE fpa );
```

Parameters:

```
fpa – FPA index of the desired status
      fpa index -> 1..64
```

Return value:

```
Serial number of the selected FPA
or FPA_INVALID_NO – if used fpa index is not activated or out of range.
note:  FPA_INVALID_NO  ->  -2 (minus 2)(0xFFFFFFFE)
```

4.2 Generic instructions

Generic instructions are related to initialization programmer process, configuration setup and preparation data, turning ON and OFF target's DC and RESET target device. Any communication with the target device is provided when any of the generic instruction is executed. Generic instructions should be called before encapsulated and sequential instruction.

F_Check_FPA_access

F_Check_FPA_access - Check available Flash Programming Adapter (USB-MSP430-FPA or MSP-FET430UIF) connected to specified USB drivers (USB driver index from 1 to 64)

VALID FPA index (DLL instance number) - (1 to 64)

Important: It is **not recommended** to use this function. Function used only for compatible with the old software. Use the **F_OpenInstancesAndFPAs** instead.
Do not use the **F_OpenInstances** or **F_Check_FPA_access** after using the **F_OpenInstancesAndFPAs**. The **F_OpenInstancesAndFPAs** is assigning the FPAs to USB ports and it is not recommended to reassign once again the USB port using the **F_Check_FPA_access** function. To check the communication activity with FPA use the **F_Get_FPA_SN** function that allows to check te communication with the FPA adapter without modifying the USB ports assignment.

F_Check_FPA_access should be called as a first function when the *.dll is activated. Function returns serial number of the detected flash programming adapter, or zero, if programming adapter has not been detected with selected USB driver. Up to 64 USB drivers can be scanned.
To make a Multi-FPA software back compatible, the F_Check_FPA_access procedure is calling the function **F_OpenInstances** if none of the instances has not been activated before. That allows to use old application software without calling the new type of Multi-FPA functions.

Syntax:

```
MSPPRG_API      LONG_X      F_Check_FPA_access ( INT_X USB_index );
```

Parameters:

```
Index: USB driver index from 1 to MAX_USB_DEV_NUMBER
         where MAX_USB_DEV_NUMBER = 64
       To search ONLY the USB-MSP430-FPA adapters.
Index = Index | 0x100
       To search the USB-MSP430-FPA and MSP-FET430UIF adapters.
```

Return value:

```
0 – FALSE
>0 – Detected USB-MSP430-FPA or MSP-FET430UIF Serial Number
```

Example:

```
long SN[MAX_USB_DEV_NUMBER+1];
      F_OpenInstances( 1 );   // DLL initialization – one instance
      F_Set_FPA_index( 1 );   // select access to the first instance
      n = 0;      //no of detected FPAs
      for( k=1; k<=MAX_USB_DEV_NUMBER ; k++ )
       {
        SN[k] = F_Check_FPA_access(k);
        if ( SN[k] > 20000000 ) n++;
       }
      F_CloseInstances();     // DLL initialization – one instance
      F_OpenInstances( n );   // Open 'n' instances – one per FPA

// Find desired FPAs SN and assign the FPAs serial number every time to the same
// FPA-index.
//  For example if the
//    SN[1]= 20060123
//    SN[2]= 20060147
//    SN[3]= 0                – adapter not present
//    SN[4]= 20060135
// and desired assignment
//    FPA-1   20060123
//    FPA-2   20060135
//    FPA-3   20060147
// then following sequence instructions can be used

      F_Set_FPA_index( 1 );   // select access to the first instance
      F_Check_FPA_access( 1 ); //assign FPA SN[1] = 20060123 to FPA-1
      F_Set_FPA_index( 2 );   // select access to the second instance
      F_Check_FPA_access( 4 ); //assign FPA SN[4] = 20060135 to FPA-2
      F_Set_FPA_index( 3 );   // select access to the third instance
      F_Check_FPA_access( 2 ); //assign FPA SN[2] = 20060147 to FPA-3

      F_Set_FPA_index( ALL_ACTIVE_FPA );  // select all active instances
      F_Initialization()      // All FPAs initialization

     ..........................
```

F_Initialization

F_Initialization - Programmer initialization.

VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

F_Initialization function should be called after the communication with the FPA adapter is established. To make a Multi-FPA software back compatible, the F_Initialization procedure is calling the function **F_OpenInstancesAndFPAs("*# *")** if none of the instances has not been activated before. Also the FPA index is selected to 1 by default. That allows to use old application software without calling the new type of Multi-FPA functions.
When the **F_Initialization** is called then:

- all internal data is cleared or set to the default value,
- initial configuration is downloaded from the config.ini file,
- USB driver is initialized if has not been initialized before.

Programming adapter must be connected to the USB to establish communication between PC and programming adapter. Otherwise the F_Initialization will return FALSE result.

Syntax:

```
MSPPRG_API      INT_X  F_Initialization( void );
```

Return value:

```
0 – FALSE
1 – TRUE
4 – Programming adapter not detected.
-2 (0xFFFFFFFE)   – FPA_INVALID_NO
```

Example:

```
.........................
F_API_DLL_Directory( ".....” ) // optional – see F_API_DLL_Directory()
If( F_Initialization() != TRUE ) //required API-Dll  – initialization
{
   // Initialization error
}
.........................
```

F_API_DLL_Directory

F_API_DLL_Directory - The DLL directory location.
VALID FPA index - irrelevant - the same directory location for all DLLs.

The ***F_API_DLL_Directory*** command can specify the directory path where the DLLs are located. This command is not mandatory and usually is not required. But in some application software the default location of the DLLs is not transferred to the DLL. In this case the related files with DLLs located in the same directory where the DLLs are located can not be find. To avoid this problem the full path of the directory where the DLLs are located can be specified. The ***F_API_DLL_Directory*** must be used before ***F_Initialization()*** function.

Syntax:

```
      MSPPRG_API  void   F_API_DLL_Directory( Cstring APIDLLpath );
or    MSPPRG_API  void   F_APIDLL_Directory( char*  APIDLLpath );
```

Example:

```
.............................
 F_API_DLL_Directory( "C:\\Program Files\\Test\\" );
    // directory where the API-DLLs are located
 If( F_Initialization() != TRUE )    //required API-Dll  - initialization
 {
    // Initialization error
 }
.............................
```

F_Close_All

F_Close_All - Close communication with the programming adapter and release PC memory.

VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

F_Close_All function should be called as the last one before *.dll is closed. When the F_Close_All is called then communication port becomes closed and all internal dynamic data will be released from the memory. To activate communication with the programmer when the function F_Close_All has been used the F_Initialization function must be called first.

Syntax:

```
  MSPPRG_API      INT_X  F_Close_All( void );
```

Return value:

```
0 - FALSE
1 - TRUE
-2 (0xFFFFFFFE)   - FPA_INVALID_NO
```

Example:

```
 F_Initialization();          //required API-Dll  - initialization
.............................
.............................
 F_Close_All;
.............................
```

F_GetSetup

F_GetSetup - Get configuration setup from the programmer.
VALID FPA index - (1 to 64)

See F_ConfigSetup description for more details.

Syntax:

```
MSPPRG_API      INT_X  F_GetSetup( CONFIG_BLOCK *config );
```

Return value:

```
0 – FALSE
1 – TRUE
–2 (0xFFFFFFFE)   – FPA_INVALID_NO
```

F_ConfigSetup

F_ConfigSetup - Setup programmer's configuration.
VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

The F_ConfigSetup can modify configuration of the programmer. When the F_ConfigSetup is called, then the structure data block is transferred from the software application to the programmer software. Current programmer setup can be read using function setup F_GetSetup. When data block is taken from the programmer, then part or all of the configuration data can be modified and returned back to programmer using F_ConfigSetup function. Configuration data structure and available data for all listed items in this structure are defined below. Listed name and indexes in the [] brackets are related to the **F_SetConfig** and **F_GetConfig** instructions.

Note: See the MSPPRG-Dll.h header file for the list of the latest indexes, definitions etc.

Note Currently number of parameters used in configuration exceed the structure created for this goal. The configuration structure is not modified that allows to use the new API-DLL with customer's old application software without modifying it. The new API-DLL is back-compatible with the old ones. The new configuration data are accessible via F_SetConfig and F_GetConfig instructions.

Syntax:

```
MSPPRG_API      INT_X  F_ConfigSetup( CONFIG_BLOCK config );
```

Return value:

```
0 – FALSE
1 – TRUE
-2 (0xFFFFFFFE)   – FPA_INVALID_NO
```

```
typedef struct
{
      INT_X  Interface;
      INT_X  uProcIndex;
      INT_X  PowerTargetEn;
      INT_X  CommSpeedIndex;
      INT_X  ResetTimeIndex;
      INT_X  FlashEraseModeIndex;
      INT_X  EraseSegmA;
      INT_X  EraseSegmB;
      LONG_X EraseFlashStartAddr;
      LONG_X EraseFlashStopAddr;
      INT_X  FlashReadModeIndex;
      INT_X  ReadSegmA;
      INT_X  ReadSegmB;
      LONG_X ReadStartAddr;
      LONG_X ReadStopAddr;
      INT_X  VerifyModeIndex;
      INT_X  BlowFuseEn;
      INT_X  ApplicationStartEn;
      INT_X  BeepEnable;
      INT_X  EraseInfoSegmC;
      INT_X  EraseInfoSegmD;
      INT_X  DefEraseMainMemEn;
      INT_X  ReadInfoSegmC;
      INT_X  ReadInfoSegmD;
      INT_X  JtagSpeedIndex;
      INT_X  VccIndex;
      LONG_X CustomResetPulseTime;
      LONG_X CustomResetIdleTime;
      INT_X  RstVccToggleTime;
      INT_X  ApplResetVccTime;
} CONFIG_BLOCK;
```

Indexes used by the **F_SetConfig** and **F_GetConfig** functions

CFG_INTERFACE	0	
CFG_MICROCONTROLLER	1	(See new function **F_Set_MCU_Name(..)**)
CFG_POWERTARGETEN	2	
CFG_COMMSPEED	3	

CFG_RESETTIME	4
CFG_FLASHERASEMODE	5
CFG_ERASEINFOA	6
CFG_ERASEINFOB	7
CFG_ERASESTARTADDR	8
CFG_ERASESTOPADDR	9
CFG_FLASHREADMODE	10
CFG_READINFOA	11
CFG_READINFOB	12
CFG_READSTARTADDR	13
CFG_READSTOPADDR	14
CFG_VERIFYMODE	15
CFG_BLOWFUSE	16
CFG_APPLSTARTEN	17
CFG_BEEPEN	18
CFG_ERASEINFOC	19
CFG_ERASEINFOD	20
CFG_DEFERASEMAINEN	21
CFG_READINFOC	22
CFG_READINFOD	23
CFG_JTAGSPEEDINDEX	24
CFG_VCCINDEX	25
CFG_CUSTOMRESETPULSETIME	26
CFG_CUSTOMRESETIDLETIME	27
CFG_RSTVCCTOGGLETIME	28
CFG_APPLRESETVCCTIME	29
CFG_POP_UP_EN	30
CFG_JTAG_SPEED	31
CFG_BSL_ENH_ENABLE	32
CFG_BSL_ENH_INDEX	33
CFG_RETAIN_CAL_DATA_INDEX	34
CFG_RETAIN_DEF_DATA_INDEX	35
CFG_RETAIN_START_ADDR_INDEX	36
CFG_RETAIN_STOP_ADDR_INDEX	37
CFG_APPLPRGRUNTIME	38
CFG_RELEASEJTAGSTATE	39
CFG_RUNTIMETDIGENEN	40
CFG_RUNTIMETDIGENDIV	41
CFG_RUNTIMETDIGENPRESCALER	42
CFG_DCO1_CAL_ENABLE	43
CFG_DCO2_CAL_ENABLE	44
CFG_DCO3_CAL_ENABLE	45
CFG_DCO4_CAL_ENABLE	46
CFG_DCO5_CAL_ENABLE	47
CFG_DCO6_CAL_ENABLE	48

CFG_DCO7_CAL_ENABLE 49
CFG_DCO8_CAL_ENABLE 50
CFG_DCO1_CAL_FREQ_INDEX 51
CFG_DCO2_CAL_FREQ_INDEX 52
CFG_DCO3_CAL_FREQ_INDEX 53
CFG_DCO4_CAL_FREQ_INDEX 54
CFG_DCO5_CAL_FREQ_INDEX 55
CFG_DCO6_CAL_FREQ_INDEX 56
CFG_DCO7_CAL_FREQ_INDEX 57
CFG_DCO8_CAL_FREQ_INDEX 58
CFG_DCO_DEFINED_ADDR_EN 59
CFG_DCO_DEFINED_ADDRESS 60
CFG_RUNTIMEBSLTXGENEN 61
CFG_RESERVED_1 62 //empty - for compatibility with GangPro430
CFG_MASSERASE_AND_INFOA_EN 63
CFG_DCO_CONST_2XX_VERIFY_EN 64
CFG_DCOCAL_2XX_EN 65
CFG_FIRST_BSL_PASSW_INDEX 66
CFG_CS_TYPE_INDEX 69
CFG_CS_INIT_INDEX 70
CFG_CS_RESULT_INDEX 71
CFG_CS_CODE_OVERWIRIE_EN 72
CFG_CS_POLYNOMINAL 73
CFG_CS1_CALC_EN 74
CFG_CS1_START_ADDR 75
CFG_CS1_END_ADDR 76
CFG_CS1_RESULT_ADDR 77
CFG_CS2_CALC_EN 78
CFG_CS2_START_ADDR 79
CFG_CS2_END_ADDR 80
CFG_CS2_RESULT_ADDR 81
CFG_CS3_CALC_EN 82
CFG_CS3_START_ADDR 83
CFG_CS3_END_ADDR 84
CFG_CS3_RESULT_ADDR 85
CFG_CS4_CALC_EN 86
CFG_CS4_START_ADDR 87
CFG_CS4_END_ADDR 88
CFG_CS4_RESULT_ADDR 89
CFG_BSL_FLASH_WR_EN 90
CFG_BSL_FLASH_RD_EN 91
CFG_DCO_EXT_RESISTOR_EN 92

```
[ CFG_INTERFACE  0 ]
Interface                    - JTAG/SBW/BSL interface selection
```

```
      INTERFACE_JTAG          0     - JTAG Interface - 4 wires
      INTERFACE_BSL           1     - BSL Interface
      INTERFACE_SBW           3     - Spy-Bi-Wire  - 2 wires

[ CFG_MICROCONTROLLER  1 ]    - supported, but not recommended -
```

(See new function **F_Set_MCU_Name(..)**)

```
      - Microcontroller type selection
      MSP430_ANY        0     - Any microcontroller - from F1xx or F4xxst
                        1 - MSP430F110
                        2 - MSP430F1101
                        3 - MSP430F1101A
                        4 - MSP430F1111A
            etc.
      See the latest MSP430 list and indexes in the FlashPro430 (GUI) software.
      Run software -> list available under pull down menu
```

Setup-> MSP list

```
      Also the MCU index and MCU names can be taken from the instruction
      F_Get_Device_Info(). See description of this instruction in this manual
      for details.

[ CFG_POWERTARGETEN  2 ]
PowerTargetEn                       - Power Target from the Programming Adapter
                  0 - disable
                  1 - enable

[ CFG_COMMSPEED  3 ]
CommSpeedIndex                      - BSL communication speed
      COMM_SPEED_9k6_INDEX    0
      COMM_SPEED_75k_INDEX    1     - 90 kB/s -> USB
      COMM_SPEED_300k_INDEX   2     - 350kb/s -> USB

[ CFG_RESETTIME  4 ]
ResetTimeIndex                      - Reset Pulse time setup
      RESET_50MS_INDEX        0     - USB->10ms, PP->50ms Reset Pulse time
      RESET_100MS_INDEX       1     - 100 ms Reset Pulse time
      RESET_200MS_INDEX       2     - 200 ms Reset Pulse time
      RESET_500MS_INDEX       3     - 500 ms Reset Pulse time
      RESET_CUSTOM_INDEX      4
      RESET_TOGGLE_VCC_INDEX  5
      RESET_SOFT_JTAG_INDEX   6


[ CFG_FLASHERASEMODE  5 ]
FlashEraseModeIndex           - Flash Write/Erase/Verify mode index
      ERASE_NONE_MEM_INDEX      0 - Write and verify only. No erase flash
      ERASE_ALL_MEM_INDEX       1 - Erase/Write/Verify all memory
      ERASE_PRG_ONLY_MEM_INDEX  2 - Erase/Write/Verify program memory only
                                    (without  info  segments  A  abd  B)
```

```
      ERASE_INFILE_MEM_INDEX    3 - Erase only segments used by the code taken
                                    from the file.
                                    Leave other segment unmodified.
      ERASE_DEF_CM_INDEX        4 - Erase/Write/Verify only specified by data
                                 EraseSegmA, EraseSegmB,
                                 EraseFlashStartAddr, EraseFlashStopAddr
```

[CFG_ERASEINFOA 6]

```
EraseSegmA              - Info Segment A (0x1080-0x10fF) Erase/Write/Verify,
                        - in the MSP430F2xx - (0x10C0-0x10fF)
                              if  FlashEraseModeIndex = ERASE_DEF_CM_INDEX

[ CFG_ERASEINFOB 7 ]
EraseSegmB              - Info Segment B (0x1000-0x107F) Erase/Write/Verify,
                        - in the MSP430F2xx - (0x1080-0x10BF)
                              if  FlashEraseModeIndex = ERASE_DEF_CM_INDEX
[ CFG_ERASEINFOC  19 ]
EraseSegmC              - MSP430F2xx only - Info Segment C  (0x1040-0x107F)
                        Erase/Write/Verify,
                              if  FlashEraseModeIndex = ERASE_DEF_CM_INDEX
[ CFG_ERASEINFOD  20 ]
EraseSegmD              - MSP430F2xx only - Info Segment B (0x1000-0x107F)
                        Erase/Write/Verify,
                              if  FlashEraseModeIndex = ERASE_DEF_CM_INDEX
      0     - Do not Write/Erase/Verify in segment A,B,C or D
      1     - Write/Erase/Verify in segment A,B,C or D


[ CFG_ERASESTARTADDR  8 ]
EraseFlashStartAddr           - Program Memory Start Address (0x1100-0x1FFFE)
                              Erase/Write/Verify,
                              if  FlashEraseModeIndex = ERASE_DEF_CM_INDEX
                              0x1100 to 0x1FFFE

[  CFG_ERASESTOPADDR  9 ]
EraseFlashStopAddr            - Program Memory Stop Address (0x1101-0x1FFFF)
                              Erase/Write/Verify,
                              if  FlashEraseModeIndex = ERASE_DEF_CM_INDEX
                              0x1101 to 0x1FFFF

[ CFG_FLASHREADMODE  10 ]
FlashReadModeIndex            - Read Flash memory mode
      READ_ALL_MEM_INDEX      0     - Read all Flash memory
      READ_PRGMEM_ONLY_INDEX  1     - Read only program memory (0x1100-0x1FFFF)
      READ_INFOMEM_ONLY_INDEX 2     -  Read  only  Info  Flash  memory  (0x1000-
                                    0x10FF)
      READ_DEF_MEM_INDEX      3     - Read Flash memory defined by
                                      ReadSegmA, B, C, D
                                      ReadStartAddr and ReadStopAddr
```

[CFG_READINFOA 11]

```
ReadSegmA               - Read from the Info Segment A

[ CFG_READINFOB  12 ]
ReadSegmB               - Read from the Info Segment B

[ CFG_READINFOC  22 ]
ReadSegmC               - Read from the Info Segment B

[ CFG_READINFOC  23 ]
ReadSegmD               - Read from the Info Segment B
                        if  FlashReadModeIndex = READ_DEF_MEM_INDEX

[ CFG_READSTARTADDR  13 ]
ReadStartAddr           0x1100 to 0x1FFFE ;see above

[ CFG_READSTOPADDR  14 ]
ReadStopAddr            0x1101 to 0x1FFFF ;see above

[ CFG_VERIFYMODE  15 ]
VerifyModeIndex         - Program Verification method
      VERIFY_NONE_INDEX 0     - no verification
      VERIFY_STD_INDEX  1     - standard verification (read and verify)
      VERIFY_FAST_INDEX 2     - fast verification (calculate CS and verify)

[ CFG_BLOWFUSE  16 ]
BlowFuseEn              - Blow the security fuse - only using JTAG/SBW interface
      0     - disable
      1     - enable when called from F_Blow_Fuse()
      3     - enable when called from F_Blow_Fuse() or F_Autoprogram(..)


[ CFG_APPLSTARTEN  17 ]
ApplicationStartEn            -  reset  and  start  the  microcontroller's
                              application software when flash is successfully
                              programmed
   APPLICATION_KEEP_RESET     0     - Hardware Reset Line permanent LOW
   APPLICATION_TOGGLE_RESET   1     - Hardware Reset (Pulse Low)
   APPLICATION_TOGGLE_VCC     2     - Toggle VCC Reset
   APPLICATION_JTAG_RESET     3     - JTAG software reset


[ CFG_BEEPEN  18 ]
BeepEnable              - beep on the end of flash programming
                  0     - disable
                  1     - enable

[ CFG_JTAGSPEEDINDEX  24 ]
JtagSpeedIndex          - valid for the USB model only
            JTAG_SPEED_1MB_INDEX    0     //JTAG 4Mb/s, Spy-Bi-Wire->FAST
            JTAG_SPEED_4MB_INDEX    1     //JTAG 1Mb/s, Spy-Bi-Wire->FAST
```

```
            JTAG_SPEED_400K_INDEX   2     //JTAG 400kb/s, Spy-Bi-Wire->SLOW

[ CFG_VCCINDEX  25 ]
VccIndex                - valid for the USB-MSP430-FPA version 2.x and higher
            VCC_2V2_INDEX           0
            VCC_2V4_INDEX           1
            VCC_2V6_INDEX           2
            VCC_2V8_INDEX           3
            VCC_3V0_INDEX           4
            VCC_3V2_INDEX           5
            VCC_3V4_INDEX           6
            VCC_3V6_INDEX           7

[ CFG_CUSTOMRESETPULSETIME  26 ]
CustomResetPulseTime          value 1 to 1000 step 1 in miliseconds
        valid only when the ResetTimeIndex = RESET_CUSTOM_INDEX

[ CFG_CUSTOMRESETIDLETIME  27 ]
CustomResetIdleTime           value 1 to 2000 step 1 in miliseconds
        valid only when the ResetTimeIndex = RESET_CUSTOM_INDEX

[ CFG_RSTVCCTOGGLETIME  28 ]
RstVccToggleTime              value 50 to 5000 step 1 in miliseconds
        valid only when the ResetTimeIndex = RESET_TOGGLE_VCC_INDEX


[ CFG_APPLRESETVCCTIME  29 ]
ApplResetVccTime              value 50 to 5000 step 1 in miliseconds
        valid only when the ApplicationStartEn = APPLICATION_TOGGLE_VCC


[ CFG_POP_UP_EN  30 ]
PopUpEnable       - enable or disable to display pop-up message in run time
                  0     - warning message popup disable
                  1     - enable all
                  2     - disable all

[ CFG_BSL_ENH_ENABLE  32 ]     - BSL mode (valid for BSL version 2.0 and higher)
                  (See FlashPro430 Manual - chapter 9)
                  0 - disable
                  1 - enable
[ CFG_BSL_ENH_INDEX  33 ]
                  (See FlashPro430 Manual - chapter 9)
      BSL_ENH_DISABLE   0     Disable access via BSL
      BSL_ENH_NONE      1     Do not erase flash if the BSL password is invalid
                               (allows to make a next try)
      BSL_ENH_ERASE     2     Erase whole flash if the BSL password is invalid
                               (one try only)

[ CFG_RETAIN_CAL_DATA_INDEX   34 ]
```

```
                (See FlashPro430 Manual - chapter 6)
      0 -   Disable retain the DCO Calibration Data for the F2xx family.
      1 -   Enable retain the DCO Calibration Data for the F2xx family. Data are
            saved in the INFO flash memory at location 0x10F8 to 0x10FF

[ CFG_RETAIN_DEF_DATA_INDEX   35 ]
                (See FlashPro430 Manual - chapter 6)
      0 -   Disable retain the user defined data in flash.
      1 -   Enable retain the user defined data in flash. Data specified in the
            user defined location (see indexes below) will be restored after
            erase and program.

[ CFG_RETAIN_START_ADDR_INDEX 36 ]
      start address - start address for the user defined retain data
                  (protected data) in flash.
            Size of protected data can not exceed 256 bytes.

[ CFG_RETAIN_STOP_ADDR_INDEX  37 ]
      stop address - stop address for the user defined retain data
                  (protected data) in flash.
            Size of protected data can not exceed 256 bytes.


[ CFG_APPLPRGRUNTIME    38]
    data 0  - unlimited time
    1 to 120 seconds - (limited time)

[ CFG_RELEASEJTAGSTATE  39]
      DEFAULT_JTAG_3ST  0
      DEFAULT_JTAG_HI   1
      DEFAULT_JTAG_LO   2

[ CFG_RUNTIMETDIGENEN   40]
      0-disable,  1-enable

[ CFG_RUNTIMETDIGENDIV  41]
      data 1 to 255

[ CFG_RUNTIMETDIGENPRESCALER  42 ]
      RUNTIMETDIPRESCALER_6MHZ      0
      RUNTIMETDIPRESCALER_2MHZ      1

[ CFG_DCO1_CAL_ENABLE   43 ]
[ CFG_DCO2_CAL_ENABLE   44 ]
[ CFG_DCO3_CAL_ENABLE   45 ]
[ CFG_DCO4_CAL_ENABLE   46 ]
[ CFG_DCO5_CAL_ENABLE   47 ]
[ CFG_DCO6_CAL_ENABLE   48 ]
[ CFG_DCO7_CAL_ENABLE   49 ]
[ CFG_DCO8_CAL_ENABLE   50 ]
```

```
    0-disable,  1-enable

[ CFG_DCO1_CAL_FREQ_INDEX     51 ]
[ CFG_DCO2_CAL_FREQ_INDEX     52 ]
[ CFG_DCO3_CAL_FREQ_INDEX     53 ]
[ CFG_DCO4_CAL_FREQ_INDEX     54 ]
[ CFG_DCO5_CAL_FREQ_INDEX     55 ]
[ CFG_DCO6_CAL_FREQ_INDEX     56 ]
[ CFG_DCO7_CAL_FREQ_INDEX     57 ]
[ CFG_DCO8_CAL_FREQ_INDEX     58 ]
    range from 100 to 16000 (100kHz to 16 MHz)
    see the MSP430 data sheet for acceptable freq range.

[ CFG_DCO_DEFINED_ADDR_EN     59 ]
    0-disable,  1-enable

[ CFG_DCO_DEFINED_ADDRESS     60 ]
    DCO block base address

[ CFG_RUNTIMEBSLTXGENEN       61 ]
    0-disable,  1-enable

[ CFG_MASSERASE_AND_INFOA_EN  63  ]
      Valid only for MSP430F2xx
    0-disable  - INFO-A erase disabled when the mass memory erase is enabled.
    1-enable   - INFO-A erase enabled when the mass memory erase is enabled.

[ CFG_DCO_CONST_2XX_VERIFY_EN 64  ]
      Valid only for MSP430F2xx

    0-disable,  1-enable

[ CFG_DCOCAL_2XX_EN           65  ]
      Valid only for MSP430F2xx
       0-disable,  1-enable   -> make a DCO calibration if DCO constants are
                              invalid.

[ CFG_FIRST_BSL_PASSW_INDEX   66  ]
      0  -  FIRST_BSL_PASSW_DEFAULT
      1  -  FIRST_BSL_PASSW_FROM_PASSW_FILE
      2  -  FIRST_BSL_PASSW_FROM_CODE_FILE
      3  -  FIRST_BSL_PASSW_EMPTY

[ CFG_CS_TYPE_INDEX           69  ]
      0 - " n o n e "
      1 - "Arithmetic sum           ( 8b / 16b )"
      2 - "Arithmetic sum           ( 8b / 32b )"
      3 - "Arithmetic sum           (16b / 16b )"
      4 - "Arithmetic sum           (16b / 32b )"
      5 - "CRC16 (Poly = 0x11021)   ( 8b / 16b )"
```

```
      6 - "CRC16 defined polynomial  ( 8b / 16b )"
      7 - "CRC32 (Poly = 0x04C11DB7) ( 8b / 32b )"
      8 - "CRC32 defined polynomial  ( 8b / 32b )"

[ CFG_CS_INIT_INDEX           70  ]
      0 - CS_INIT_VALUE_0_INDEX
      1 - CS_INIT_VALUE_1_INDEX
      2 - CS_INIT_VALUE_ADDR_INDEX

[ CFG_CS_RESULT_INDEX         71  ]
      0 - “As Is”
      1 - Inverted

[ CFG_CS_CODE_OVERWIRIE_EN    72  ]
      0 - disable
      1 - enable

[ CFG_CS_POLYNOMINAL          73  ]
      - polynominal value

[ CFG_CS1_CALC_EN             74  ]
[ CFG_CS2_CALC_EN             78  ]
[ CFG_CS3_CALC_EN             82  ]
[ CFG_CS4_CALC_EN             86  ]
      0 - disable
      1 - enable

[ CFG_CS1_START_ADDR          73  ]
[ CFG_CS2_START_ADDR          79  ]
[ CFG_CS3_START_ADDR          83  ]
[ CFG_CS4_START_ADDR          87  ]
      - Start address value

[ CFG_CS1_END_ADDR            76  ]
[ CFG_CS2_END_ADDR            80  ]
[ CFG_CS3_END_ADDR            84  ]
[ CFG_CS4_END_ADDR            88  ]
      - End address value

[ CFG_CS1_RESULT_ADDR         77  ]
[ CFG_CS2_RESULT_ADDR         81  ]
[ CFG_CS3_RESULT_ADDR         85  ]
[ CFG_CS4_RESULT_ADDR         89  ]
      - Result address value

[ CFG_BSL_FLASH_WR_EN         90  ]
      Sum of enabled BSL sectors
      - 0x01 - BSL Segment 0 (0x1000-0x11FF)
      - 0x02 - BSL Segment 1 (0x1200-0x13FF)
      - 0x04 - BSL Segment 2 (0x1400-0x15FF)
```

```
      - 0x08 - BSL Segment 3 (0x1600-0x17FF)

[ CFG_BSL_FLASH_RD_EN         91  ]
      Sum of enabled BSL sectors
      - 0x01 - BSL Segment 0 (0x1000-0x11FF)
      - 0x02 - BSL Segment 1 (0x1200-0x13FF)
      - 0x04 - BSL Segment 2 (0x1400-0x15FF)
      - 0x08 - BSL Segment 3 (0x1600-0x17FF)

[ CFG_DCO_EXT_RESISTOR_EN     92  ]
      0 - disable
      1 - enable
```

Note: See the MSPPRG-Dll.h header file for the list of the latest indexes, definitions etc.

Example:

Example below shows the method of modification of the programmers configuration setup. First the current setup from the programmer is uploaded to the application, after that some of the parameters have been modified and at the end the modified setup is returned back to the programmer.

```
CONFIG_BLOCK      config;           //programmer's configuration data
.....................

      F_GetSetup( &config );
                        //API-DLL  - get configuration from the programmer
      config.Interface = INTERFACE_JTAG;
                        //select JTAG interface
      config.BlowFuseEn = 0;
                        //disable fuse blow option
      config.FlashEraseModeIndex = ERASE_ALL_MEM_INDEX;
                        //select all memory erase option
      F_ConfigSetup( config );
                        //API-DLL  - setup configuration in the programmer
```

The same configuration can be read/set using the by the **F_SetConfig** function as follows

```
      F_SetConfig( CFG_INTERFACE, INTERFACE_JTAG );
      F_SetConfig( CFG_BLOWFUSE, 0 );
      F_SetConfig( CFG_FLASHERASEMODE, ERASE_ALL_MEM_INDEX );
```

F_SetConfig

F_SetConfig - Setup one item of the programmer's configuration.

VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

Similar to the **F_ConfigSetup**, but only one item from the **CONFIG_BLOCK** structure is modified.

Syntax:

```
MSPPRG_API      INT_X  F_SetConfig( INT_X index, LONG_X data );
```

See index list in the F_ConfigSetup for details.

Return value:

```
0 – FALSE
1 – TRUE
–2 – FPA_INVALID_NO
```

Example:

```
.....................
.....................
   F_SetConfig( CFG_INTERFACE, config.Interface );
.....................
```

F_GetConfig

F_GetConfig - Get one item of the programmer's configuration.
VALID FPA index ***- (1 to 64)***

Similar to the **F_GetSetup**, but only one item from the **CONFIG_BLOCK** structure is read.

Syntax:

```
MSPPRG_API      LONG_X      F_GetConfig( INT_X index );
```

Index's list – see F_SetConfig

Return value:

```
Requested setup parameter;
1 – TRUE
–2 (0xFFFFFFFE)   – FPA_INVALID_NO
```

Example:

```
.....................
   config.Interface = F_GetConfig( CFG_INTERFACE );
.....................
```

F_Set_MCU_Name

F_Set_MCU_Name - Set microcontroller type.
VALID FPA index - (1 to 64)

The F_Set_MCU_Name(..) replaced the old function

```
F_SetConfig( CFG_MICROCONTROLLER, MCU_index );
```

The MCU name must be entered exactly with the same name as it is in the GUI software - MCU type pull down menu.

Syntax:

```
MSPPRG_API      INT_X  F_Set_MCU_Name( char * MCU_name );
```

Return value:

```
>= 0 - Index of the selected MCU
-1 - error - invalid MCU name.
```

Example:

```
.....................
   F_Set_MCU_Name( "MSP430F5438" );
.....................
```

F_Get_Device_Info

F_Get_Device_Info - Get information related to selected microcontroller.
VALID FPA index - (1 to 64)

Syntax:

```
MSPPRG_API      INT_X  F_Get_Device_Info( INT_X index );
```

where index:

DEVICE_NAME	0
DEVICE_NAME_SIZE	20
DEVICE_MAIN_FLASH_START_ADDR	20
DEVICE_MAIN_FLASH_END_ADDR	21
DEVICE_INFO_START_ADDR	22
DEVICE_INFO_SEGM_SIZE	23
DEVICE_NO_INFO_SEGMENTS	24
DEVICE_RAM_SIZE	25

Return value:

```
-1 (0xFFFFFFF)    -  invalid data
-2 (0xFFFFFFFE)   - FPA_INVALID_NO
or
```

```
index - 0 to 19  ->      device name - char by char starting from index->0
                         => M eg.  MSP430F149
index 0 -> 'M'
index 1 -> 'S'
index 2 -> 'P'
index 3 -> '4'
index 4 -> '3'
index 5 -> '0'
index 6 -> 'F'
index 7 -> '1'
index 8 -> '4'
index 9 -> '9'
index 10 -> 0x0000  -> end of string
index 11 to 19 -> after end of string - irrelevant data.
index 20 -> MAIN Flash Start Address  eg 0x1100  (for F149)
index 21 -> MAIN Flash End  Address   eg 0xFFFF  (for F149)
index 22 -> INFO start address        eg 0x1000
index 23 -> INFO segment size         eg 0x0080  (for F149)
index 24 -> No of INFO segments       eg 0x0002  (for F149)
index 25 -> RAM size                  eg 0x0800  (for F149)
```

Note: The device info is related to selected microprocessor. Desired index processor should be first set in the configuration using ***F_SetConfig(CFG_MICROCONTROLLER, uP_index)***;

Below is an example of the procedure that can take names of all supported devices by the API-DLL. The max size can be tested from the API-DLL, until device name is empty when the microprocessor index is incremented from the zero up to max value. In the example below is assumed that te max number of supported devices is 300, however this value can be dynamically modified if required. In the procedure below the names and uP index are saved in the `DEVICELIST` structure, where the name and index pair are kept in the same `DEVICELIST DeviceList[]` element. When the `DeviceList[]` is created, then all names are kept in the alphabetic order. Microprocessor name and corresponded microprocessor index used by the API-DLL can be taken from following elements:

```
Microprocessor name (string)        <- DeviceList[k].name;
Microprocessor index (int)          <- DeviceList[k].index;
```

```
#include "MSPPrg-Dll.h"
#define   MAX_NO_OF_DEVICES   300

typedef struct
{
      char name[DEVICE_NAME_SIZE];
      int  index;
}DEVICELIST;

DEVICELIST DeviceList[MAX_NO_OF_DEVICES];
```

```
    ....................................................
      response = F_OpenInstancesAndFPAs( "*# *" );  //get first FPA
      if( response > 0 )
      {
        response = F_Set_FPA_index( 1 );
        response = F_Initialization();
        get_device_names();         //now you can read data from API-DLL
      }
    ....................................................

int   get_device_names( void )
{
      int n,k, st, index_bak, max_up_index;
      DEVICELIST  tmp;

      tmp.index = 0;  *tmp.name = '\0';

      index_bak = F_GetConfig( CFG_MICROCONTROLLER ); //get current uP index
      for(k=0; k<MAX_NO_OF_DEVICES; k++)
                  DeviceList[k] = tmp;               //clr device list

      max_up_index = 0;
      for(k=0; k<MAX_NO_OF_DEVICES; k++)
      {
       F_SetConfig( CFG_MICROCONTROLLER, k );        //set new uP index
       for( n = 0; n<DEVICE_NAME_SIZE; n++ )
       {
        DeviceList[k].name[n] = char(0xFF & F_Get_Device_Info( DEVICE_NAME+n ));
       }
       if( DeviceList[k].name[0] == 0 ) break;       //break if name is empty
       DeviceList[k].index = k;
       max_up_index = k;
      }
      F_SetConfig( CFG_MICROCONTROLLER, index_bak );  //restore uP index

            //sort names in the table from min to max.
      if( max_up_index > 0 )
       for( k=0; k<max_up_index; k++ )
       {
        st = FALSE;
        for( n=1; n <= max_up_index; n++ )
        {
         if( strcmp( DeviceList[n-1].name, DeviceList[n].name ) >=0 )
         {
           st = TRUE;
           tmp = DeviceList[n-1];
           DeviceList[n-1] = DeviceList[n];
           DeviceList[n] = tmp;
         }
        }
```

```
        if( st == FALSE) break;
       }
 return( max_up_index );
}
```

F_DispSetup

F_DispSetup - Copy programmer's configuration to report message buffer in text form.
VALID FPA index ***- (1 to 64)***

Syntax:

```
MSPPRG_API      INT_X  F_DispSetup( void );
```

Return value:

```
1 – TRUE;
–2 (0xFFFFFFFE)   – FPA_INVALID_NO
```

Example:

```
   ....................
   ....................
      F_DispSetup();
      Disp_report_message();
              //see F_ReportMessage or F_GetReportMessage for details
  ....................
```

F_ReportMessage, F_ReportMessage

F_ReportMessage - Get the last report message from the programmer.
or **F_Report_Message**
VALID FPA index ***- (1 to 64)***

When any of the DLL functions is activated, a message is created and displayed on the dynamically created programmer's dialogue box. At the end of execution the dialogue box is closed and function returns back to the application program. Reported message is closed as well. The last report message can be read by application program using F_ReportMessage function. When F_ReportMessage is called, then report message up to 1000 characters is imported from the programmer software to the application software. Make sure to declare characters string length no less then 1000 characters. When F_ReportMessage is called then at the end the internal report message buffer in the programmer software is cleared. When F_ReportMessage is not called after every communication

with the target device, then the report message will collect all reported information up to 1000 last characters.

Syntax:

```
MSPPRG_API      void F_ReportMessage( char * text );
MSPPRG_API      char* F_Report_Message( void );
```

Return value:

none

note: **F_Report_Message** is available only with the Multi-FPA API-DLL.

Example:

```
char text[1002];
   ......................
   ......................
       F_ReportMessage( text );
   ......................
```

Example below shows how to take a message and display it in the scrolling box. The Edit box with the ID e.g. IDC_REPORT must be created first.

```
.........................................
Cstring Message = "";
.........................................

void CMspPrgDemoDlg::Disp_report_message()
{
  char text[1002];                  //must be min. size - 1000
    F_ReportMessage( text );        //API-Dll  - get last report message
    Message = text;
    SetDlgItemText(IDC_REPORT, Message.GetBuffer(Message.GetLength()));
    CEdit* pEdit = (CEdit*) GetDlgItem(IDC_REPORT);
    pEdit->LineScroll(pEdit->GetLineCount(), 0);
    UpdateWindow();
}
```

F_GetReportMessageChar

F_GetReportMessageChar - Get one character of the the last report message from the programmer.

VALID FPA index - (1 to 64)

See comment for the **F_ReportMessage** function.

F_GetReportMessageChar allows to get character by character from the report message buffer. This function is useful in the Visual Basic application, where all message can not be transfered via pointer like it is possible in the C++ application.

Syntax:

```
MSPPRG_API      char F_GetReportMessageChar( INT_X index );
```

Return value:

Requested character from the Report Message buffer. 1 – TRUE

Example:

```
char text[1002];
INT_X k;
   ......................
      for( k = 0; k< 1000; k++ )
         text[k] = F_GetReportMessageChar( k );
   ......................
```

Example below shows how to take a message and display it in the scrolling box. The Edit box with the ID e.g. IDC_REPORT must be created first.

```
.......................................
Cstring Message = "";
.......................................
void CMspPrgDemoDlg::Disp_report_message()
{
  char text[1002];                  //must be min. size – 1000
  INT_X k;
    for( k = 0; k< 1000; k++ )
         text[k] = F_GetReportMessageChar( k );
    Message = text;
    SetDlgItemText(IDC_REPORT, Message.GetBuffer(Message.GetLength()));
    CEdit* pEdit = (CEdit*) GetDlgItem(IDC_REPORT);
    pEdit->LineScroll(pEdit->GetLineCount(), 0);
    UpdateWindow();
}
```

F_DLLTypeVer

F_DLLTypeVer - Get information about DLL software type and software revision.
VALID FPA index - (1 to 64)

F_DLLTypeVer function returns integer number with DLL ID and software revision version and copying text message to report message buffer about DLL ID and software revision. Text content can downloaded using one of the following functions

F_GetReportMessageChar(index)

or F_ReportMessage(text)

Syntax:

```
MSPPRG_API      INT_X F_DLLTypeVer( void );
```

Return value:

```
VALUE = (DLL ID) | ( 0x0FFF & Version)
DLL ID = 0x1000   - Single-DLL for the FlashPro430 - Parallel Port
DLL ID = 0x2000   - Single-DLL for the FlashPro430 - USB
DLL ID = 0x3000   - Single-DLL for the GangPro430 - USB
DLL ID = 0x6000   - Multi-DLL for the FlashPro430
DLL ID = 0x7000   - Multi-DLL for the GangPro 430
Version = (0x0FFF & VALUE)
-2 (0xFFFFFFFE)   - FPA_INVALID_NO
```

Example:

```
INT_X id;
   ......................
   ......................
      id = F_DLLTypeVer();
      Disp_report_message();
              //see F_ReportMessage or F_GetReportMessage for details
   ......................
```

F_ConfigFileLoad, F_Config_FileLoad

F_ConfigFileLoad - Modify programmer's configuration setup according to data taken
or **F_Config_FileLoad** from the specified configuration file.
VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

The **F_ConfigFileLoad** function can download the programmer setup from the external setup file. Setup file can be created using standard MSP430 Flash Programmer software. When setup from the file is downloaded, then old configuration setup is overwritten. New setup can be modified using **F_GetSetup** and **F_ConfigSetup** functions.
Location path and file name of the config file must be specified.

Syntax:

```
MSPPRG_API      INT_X  F_ConfigFileLoad( char * filename );
MSPPRG_API      INT_X  F_Config_FileLoad( CString filename );
```

filename – configuration file name including path, file name and extention

Return value:

0 – FALSE
1 – TRUE
(0xFFFe & info) | state
where state is defined as follows:
0 – FALSE
1 – TRUE
-2 (0xFFFFFFFE) – FPA_INVALID_NO
info is defined as follows:
error -> OPEN_FILE_OR_READ_ERR

note: **F_Config_FileLoad** is available only when the Multi-FPA dll is used.

Configuration file can be created using the FlasgPro430 GUI software. Run FlashPro430 software, select desired configuration and save the file using option ***Save Setup as..***and_file_name

Specified parameters in the configuration file can be listed in any order. Configuration file can specified few or all parameters. Parameter name and value must be separated by minimum one white character like space or tabulation. See the configuration file created by the FlashPro430 software for details. Use the ***Notepad*** to open the configuration file..

Example:

```
st = F_ConfigFileLoad( "c:\test\configfile.cfg" );
if(( st & 1 ) == TRUE )
{
    .....................
}
else
{
    Info = st & 0xFFFE;
   .....................
   .....................
}
```

F_Power_Target

F_Power_Target - Turn ON or OFF power from programming adapter to target device.
VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

Function F_Power_Target switches ON or OFF power from the programming adapter to the target device.

Note: **`PowerTargetEn`** *flag must be set to TRUE (1) in the configuration setup to switch the power from the programming adapter ON.*

Syntax:

```
MSPPRG_API      INT_X  F_Power_Target( INT_X OnOff );
```

Return value:

```
0 – FALSE
1 – TRUE
–2 (0xFFFFFFFE)   – FPA_INVALID_NO
```

Example:

```
.....................
F_Power_Target( 1 );          // Turn Power ON
.....................
F_Power_Target( 0 );          // Turn Power OFF
.....................
```

F_Reset_Target

F_Reset_Target - Generate short RESET pulse on the target's device RESET line.

VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

Function F_Reset_Target resets target device and target device's application program can start. Length of the RESET pulse time is specified by `ResetTimeIndex` in configuration setup. See **F_ConfigSetup** description for details.

Syntax:

```
MSPPRG_API      INT_X  F_Reset_Target( void );
```

Return value:

```
0 – FALSE
1 – TRUE
–2 (0xFFFFFFFE)   – FPA_INVALID_NO
```

Example:

```
.....................
F_Reset_Target( void );
.....................
```

F_Get_Targets_Vcc

F_Get_Targets_Vcc - Get Vcc in [mV] supplied target device.
VALID FPA index - (1 to 64)

Syntax:

```
MSPPRG_API      INT_X F_Get_Targets_Vcc( void );
```

Return value:

```
INT_X – Vcc in milivolts e.g 3000 -> 3.0 V
or (-1) if USB-FPA is not active.
-2 (0xFFFFFFFE)   – FPA_INVALID_NO
```

F_Set_fpa_io_state

F_Set_fpa_io_state - Set state of the Reset, Vcc and Jtagl lines
VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

Syntax:

```
MSPPRG_API INT_X F_Set_fpa_io_state( BYTE jtag, BYTE reset, BYTE Vccon void );
```

```
jtag ->  TMS, TCK, TDI (output from FPA)
            0  -> DEFAULT_JTAG_3ST
            1  -> DEFAULT_JTAG_HI
            2  -> DEFAULT_JTAG_LO
reset ->    0  -> output from FPA RESET – LO
            1  -> output from FPA RESET – HI
VccOn ->    0  -> output Vcc from FPA – OFF
            1  -> output Vcc from FPA – ON
                  (level 2.2V to 3.6V set in CFG_VCCINDEX )
```

4.3 Data Buffers access instructions

All data coming to of from target device can be saved in the temporary buffers (see Figure 4.2) located inside the API-DLL. The data saved in these buffers can be copied to target devices using an encapsulated or sequential functions. When the full block of data is ready to be saved (eg. code data), then the part of the data buffers can be modified by adding some unique data like serial numbers, calibration data etc. to each target before executing the flash programming process. Data buffers can be modified at any time, as long as the ***F_OpenInstancesAndFPAs(..)*** and ***F_Initialization()*** have been executed successfully. When more then one FPA are used then it is recommended to use only an executable instructions uses the data buffers for read and write. For example when the read process is used with external data buffer like it is in instruction ***F_Memory_Read(BYTE * data)***, then the simultaneous process can not be used and data from each targets must be read sequentially. Using for this purpose instruction ***F_Copy_All_Flash_to_Buffer()*** allows to make this process simultaneously. Results from each targets are saved in a Read Data buffers - one Read Buffer per one API-DLL. When the simultaneous process is done, then the content from each buffers can be individually read. The API-DLL contains four buffers (see Figure 4.2) - **Code**, **Password**, **Write Data** and **Read Data** buffers. Contents for the **Code** and **Password** buffers can be taken from the files, or data can be written directly to the specified buffer location. Data to the **Write Data** buffer can be written directly only, while data from the **Read Data** buffer can be read directly only. The FLASH memory can be programmed using contents taken from the **Code** buffer or from the **Write Data** buffer. Data to RAM, registers, I/O (seen as RAM) can be taken from **Write Data** buffer only. Contents from RAM, registers, I/O and flash are saved in **Read Data** buffer.

Note: The **Code** buffer contains two items inside - data and flag in each address location. Data is related to the written value 0 to 0xFF, while flag - ***used*** or ***empty*** informs is the particular byte is used and should be programmed, verified etc, or if it is empty and should be ignored even if data is 0xFF. All flags are cleared when the new code from the file is downloaded, or if the **F_Clr_Code_Buffer()** instruction is used.

Below are listed the data buffers access between an application and API-DLL buffers instruction.

F_ReadCodeFile, F_Read_CodeFile

F_ReadCodeFile - Read code data from the file and download it to internal buffer.
or F_Read_CodeFile
VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

Function ***F_ReadCodeFile*** downloads code from the file to internal memory buffer. Code file format and file name and location path of the desired file must be specified. Three file formats are supported

- Texas Instruments text format, Motorola *.s19 format and Intel *.hex format. When file is downloaded then contents of this file is analysed. Only code memory location valid for the MSP430 microcontroller family will be downloaded to the internal Code buffer. Any code data located outside memory space of the MSP430 microcontroller will be ignored and warning message will be created. When the ***F_ReadCodeFile*** function is used then the full **Code** buffer is filled with data 0xFF and all flags are cleared (***empty*** flag) first. When the valid data are taken from the code buffer, the data is saved in buffer and flag modified from ***empty*** to ***used***.

Syntax:

```
MSPPRG_API      INT_X  F_ReadCodeFile( int file_format, char * FileName );
MSPPRG_API      INT_X  F_Read_CodeFile( int file_format, CString FileName );
```

```
file_format:
           FILE_TI_FORMAT          (1) for TI (*.txt) format
           FILE_MOTOROLA_FORMAT    (2) for Motorola (*.s19, *.s28 or *.s37)
           FILE_INTEL_FORMAT       (3) for Intel (*.hex)
           FILE_IAR_D43_FORMAT     (4) for IAR (UBROF9) *.d43 format
     or    FILE_DEBUG_A43_FORMAT   (5) for IAR HEX or Motorola debug format

   FileName:  file name including path, file name and extention
```

note: F_Read_CodeFile is available only when the Multi-FPA dll is used.

Return value:

```
      (0xFFFe & info) | state
        where state is defined as follows:
           0 - FALSE
           1 - TRUE
           -2 (0xFFFFFFFE)   - FPA_INVALID_NO
         info is defined as follows:
           warning ->  CODE_IN_ROM
                       CODE_IN_RAM
                       CODE_OUT_OF_FLASH
                       CODE_OVERWRITTEN
           error ->    INVALID_CODE_FILE
                       OPEN_FILE_OR_READ_ERR
```

Example:

```
int st;
     ..................
      st = F_ReadCodeFile( FILE_TI_FORMAT, "c:\test\demofile.txt" );
      if(( st & 1 ) == TRUE )
      {
          ..................
      }
```

```
else
{
    if ( st & CODE_IN_ROM ) {......}
    if ( st & CODE_OUT_OF_FLASH ) {......}
    if ( st & INVALID_CODE_FILE ) {......}
    if ( st & OPEN_FILE_OR_READ_ERR ) {......}
   ..................
   ..................
}
```

F_Get_CodeCS

F_Get_CodeCS - Read code from internal code buffer and calculate the check sum.
VALID FPA index - (1 to 64).

Syntax:

```
MSPPRG_API LONG_X  F_Get_CodeCS( int index );
```

```
index – index of the desired code
Index = 1  – Calculate check sum of the code from internal code buffer.
       2  –  Return Code Cs used in the last Autprogram session.
       3  –  Return Memory Cs used in the last Autprogram session.
            Other Index values – reserved for the future option.
```

Return value:

```
Calculated check sum  or
-2 (0xFFFFFFFE)   – FPA_INVALID_NO
```

F_ReadPasswFile, F_Read_PasswFile

F_ReadPasswFile - Read code password data from the file and download it to internal buffer.
or F_Read_PasswFile
VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

Function F_ReadPasswFile downloads part of the code from the file to internal memory buffer. From the code file only data related to the password data (location 0xFFE0 to 0xFFFF) are stored in the password memory buffer. All other data is ignored. Code file format and file name and location path of the desired file must be specified. Three file formats are supported - Texas Instruments text format, Motorola *.s19 format and Intel *.hex format.

Syntax:

```
MSPPRG_API    INT_X  F_ReadPasswFile( INT_X file_format, char * FileName );
```

```
MSPPRG_API    INT_X  F_Read_PasswFile( INT_X file_format, CString FileName );

   file_format -> specify code file format - TI (*.txt), Motorola (*.s19, *.s28,
*.s37),  Intel (*.hex), IAR UBROF9 (*.d43) or IAR debug (*.a43) format
            FILE_TI_FORMAT          (1) for TI (*.txt) format
            FILE_MOTOROLA_FORMAT    (2) for Motorola (*.s19, *.s28 or *.s37)
            FILE_INTEL_FORMAT       (3) for Intel (*.hex)
            FILE_IAR_D43_FORMAT     (4) for IAR (UBROF9) *.d43 format
       or   FILE_DEBUG_A43_FORMAT   (5) for IAR HEX or Motorola debug format

   FileName -> full file name including path, file name and extention
```

note: F_Read_PasswFile is available only when the Multi-FPA dll is used.

Return value:

```
(0xFFFe & info) | state
where state is defined as follows:
      0 - FALSE
      1 - TRUE
      -2 (0xFFFFFFFE)   - FPA_INVALID_NO
info is defined as follows:
  error ->  INVALID_CODE_FILE
            OPEN_FILE_OR_READ_ERR
            PASSWORD_NOT_FOUND
```

Example:

```
st = F_ReadPasswFile( FILE_TI_FORMAT, "c:\test\demofile.txt" );
if(( st & 1 ) == TRUE )
{
    .....................
}
else
{
    Info = st & 0xFFFE;
   .....................
   .....................
}
```

F_Clr_Code_Buffer

F_Clr_Code_Buffer - Clear content of the ***Code*** buffer.

VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

Function fill the full Code buffer with data ***0xFF*** and clear all flags to ***empty*** value.

Syntax:

```
MSPPRG_API INT_X  F_Clr_Code_Buffer( void );
```

Return value:

```
0 – FALSE
1 – TRUE
–2 – FPA_INVALID_NO
```

Example:

```
.....................
F_Clr_Code_Buffer();
.....................
```

F_Put_Byte_to_Code_Buffer

F_Put_Byte_to_Code_Buffer - Write code data to Code buffer.
VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

Instruction allows to write contents of the code to code buffer instead using the ***F_ReadCodeFile*** instruction. Contents of the downloaded code data can be modified or filled with the new data, if code buffer has been cleared first (using ***F_Clr_Code_Buffer*** function).
Instruction write the data to ***Code*** buffer in specified address location and set the ***used*** flag in that location.

Note: Writing the 0xFF to the specified location where the other then the 0xFF data was located do not remove the contents from the buffer in fully. The new data (0xFF) will be written to **Code** buffer location, but flag still will be set to ***used***. Use the ***F_Clr_Code_Buffer()*** instruction to fully clear the **Code** buffer before writing the new data block.

Syntax:

```
MSPPRG_API INT_X  F_Put_Byte_to_Code_Buffer( LONG_X address,
                                BYTE data );
```

```
Parameters  value:
      code address – 0x1000 to 0x1FFFF
      data         – 0x00 to 0xFF
```

Return value:

```
0 – FALSE
1 – TRUE
```

```
      -2 - FPA_INVALID_NO
```

Example:

```
BYTE  code[0x20000];
      ..................
      F_Clr_Code_Buffer();
      for( address = 0x1000;  address < 0x20000; address ++ )
      {
        F_Put_Byte_to_Code_Buffer( address, code[address]);
      }
      ..................
```

F_Get_Byte_from_Code_Buffer

F_Get_Byte_from_Code_Buffer - Read code data from code buffer.
VALID FPA index - (1 to 64)

Instruction allows to read or verify contents of the code from code buffer. Data returns value 0x00 to 0xFF if in the particular **Code** buffer location the flag is set to ***used***, otherwise return value **-1** (minus one) if data is empty.

Syntax:

```
MSPPRG_API INT_X  F_Get_Byte_from_Code_Buffer( LONG_X address );

Parameters  value:
      code address - 0x1000 to 0x1FFFF
```

Return value:

```
      0x00 to 0xFF  - valid code data
      -1 (0xFFFFFFFF)   - code data not initialized on particular address
      -2 (0xFFFFFFFE)   - FPA_INVALID_NO
```

F_Put_Byte_to_Password_Buffer

F_Put_Byte_to_Password_Buffer - Write code data to password buffer.
VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

Instruction allows to write contents of the code to code buffer instead using the F_ReadPasswordFile instruction.

Note: All 32 bytes of the password data must be written to the **Password** buffer to make a valid password for the BSL access.

Syntax:

```
  MSPPRG_API      INT_X  F_Put_Byte_to_Password_Buffer( LONG_X address,
                                BYTE data );

Parameters  value:
      code address - 0xFFE0 to 0xFFFF
      data         - 0x00 to 0xFF
```

Return value:

```
      0 - FALSE
      1 - TRUE
      -2 (0xFFFFFFFE)    - FPA_INVALID_NO
```

Example:

```
BYTE  code[0x20000];
      ......................
      for( address = 0xFFE0;  address <= 0xFFFF; address ++ )
      {
        F_Put_Byte_to_Password_Buffer( address, code[address]);
      }
      ......................
```

F_Get_Byte_from_Password_Buffer

F_Get_Byte_from_Password_Buffer - Read code data from password buffer.
VALID FPA index - (1 to 64)

Instruction allows to read or verify contents of the code from **Password** buffer. Data returns value 0x00 to 0xFF if in the particular **Password** buffer location the flag is set to ***used***, otherwise return value **-1** (minus one) if data is empty.

Syntax:

```
  MSPPRG_API      INT_X  F_Get_Byte_from_Password_Buffer( LONG_X address );

Parameters  value:
      code address - 0xFFE0 to 0xFFFF
```

Return value:

```
0x00 to 0xFF  - valid code data
-1 (0xFFFFFFFF)   - code data not initialized on particular address
-2 (0xFFFFFFFE)   - FPA_INVALID_NO
```

F_Put_Byte_to_Buffer

F_Put_Byte_to_Buffer - Write byte to temporary Write Data Buffer (See Figure 4.2)
VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

Syntax:

```
MSPPRG_API INT_X  F_Put_Byte_to_Buffer( LONG_X address, BYTE data );

address:    temporary buffer address equal the RAM, register, I/O or Flash
            destination address ( 0x0000 to 0x1FFFF )
data:       Byte to be written.
```

Return value:

```
1 - TRUE if specified address is legal (0x0000 to 0x1FFFF)
0-  FALSE - if address is not valid
-2 - FPA_INVALID_NO.
```

NOTE: *Specified address in the temporary RAM or Flash buffer is the same as a physical RAM/FLASH address.*

Example:

```
  ..................
   ..................
      for( addr = 0x1000; addr<0x1100; addr++ )
         st = F_Put_Byte_to_Buffer( addr, data[addr] );
      st = F_Copy_Buffer_to_Flash( 0x1000, 0x100 );
   ..................
```

see also **F_Copy_Buffer_to_Flash,**
F_Copy_Buffer_to_RAM,

F_Get_Byte_from_Buffer

F_Get_Byte_from_Buffer - Read one byte from the temporary Read Data Buffer (see Figure 4.2)
VALID FPA index - (1 to 64)

Syntax:

```
MSPPRG_API      BYTE  F_Get_Byte_from_Buffer( LONG_X address );
```

Return value:

Requested byte from the specified address of the Read Data Buffer.

Example:

see F_Copy_All_Flash_To_Buffer,
F_Copy_Flash_to_Buffer,
F_Copy_RAM_to_Buffer.

4.4 Encapsulated instructions

Encapsulated functions are powerful and easy to use. When called then all device actions from the beginning to the end are done automatically and final result is reported as TRUE or FALSE. Required configuration should be set first using **F_GetSetup** and **F_ConfigSetup** functions. Also Code file and Password File (if required) should be opened first. Encapsulated function has following sequence:

- Power from the programming adapter becomes ON if `PowerTargetEn` in configuration setup is enabled.
- Vcc is verified to be higher then 2.7V.
- JTAG/SBW or BSL communication between programming adapter and target device is initialized. JTAG/SBW or BSL interface is selected in configuration setup in `Interface`.
- Selected encapsulated instruction is executed (Autoprogram, Verify Fuse or Password, Memory Erase etc.).
- Communication between target device and programming adapter is terminated.
- Power from the programming adapter becomes OFF (if selected).
- Target device is released from the programming adapter.

F_AutoProgram

F_AutoProgram - Target device program with full sequence - erase, blank check, program, verify and blow security fuse (if enabled).

VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed simultaneously.

Auto Program button is the most frequently function when programming microcontrollers in the production process. Auto Program function activates all required procedures to fully program and verify the flash memory contents. Typically, when flash memory needs to be erased, *Auto Program* executes the following procedures:

- initialization
- erase flash memory - restore retain data (including DCO constants) if enabled,
- confirm if memory has been erase,
- flash programming and verification,
- flash memory check sum verification,
- blowing the security fuse (if flag BlowFuseEn = 3).

Syntax:

```
MSPPRG_API      INT_X  F_AutoProgram( INT_X mode );
    mode = 0;
    mode = 1 and up - reserved
```

Return value:

```
    0 - FALSE
    1 - TRUE
    -2 (0xFFFFFFFE)   - FPA_INVALID_NO
```

Example:

```
.........................
if( F_Initialization() != TRUE )    //required API-Dll  - initialization
{
   // Initialization error
}
int st = F_ConfigFileLoad( "c:\test\configfile.cfg" );
if(( st & 1 ) != TRUE )
{
    Info = st & 0xFFFE;
   .................
}

F_GetSetup( &config ); //API-DLL  - get configuration from the programmer
......................... // modify configuration if required
F_ConfigSetup( config );    // download setup to programmer
F_SetConfig( ....., ..... ) // modify configuration if required

do{

   .................   // prepare next microcontroller

      F_AutoProgram(0);
   .................    //exit if the last microcontroller
                        // has been programmed

  } while(1);
 .................
```

F_VerifyFuseOrPassword

F_VerifyFuseOrPassword -Verify the Security fuse if JTAG/SBW interface is active, or verify the password access if BSL interface is active.

VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed simultaneously.

Syntax:

```
MSPPRG_API      INT_X  F_VerifyFuseOrPassword( void );
```

Return value:

```
0 – FALSE   (JTAG fuse blown or BSL password wrong)
1 – TRUE    (valid access to MSP430)
–2 (0xFFFFFFFE)   – FPA_INVALID_NO
```

F_Memory_Erase

F_Memory_Erase **-** Erase Target's Flash Memory
VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed simultaneously.

Erase flash size, or sector to be erased, should be specified in the configuration setup. When mode erase flag is set to one, then all memory will be erased, regardless erase memory configuration setup value. When the ***Retain Data*** are specified (including DCO constants in the F2xx), then retain data are read before erase process, and restored after the erase process.

Syntax:

```
MSPPRG_API      INT_X  F_Memory_Erase( INT_X mode );
    mode = 0 -> erase space specify by the FlashEraseModeIndex and
                restore retain data if enabled;
    mode = 1 -> erase all Flash memory, regardless FlashEraseModeIndex and
                restore retain data if enabled;
```

Return value:

```
0 – FALSE
1 – TRUE
–2 (0xFFFFFFFE)   – FPA_INVALID_NO
```

F_Memory_Blank_Check

F_Memory_Blank_Check **-** Check if the Target's Flash Memory is blank.
VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed simultaneously.

Syntax:

```
MSPPRG_API      INT_X  F_Memory_Blank_Check( void );
```

Return value:

```
0 – FALSE
1 – TRUE
–2 (0xFFFFFFFE)   – FPA_INVALID_NO
```

F_Memory_Write

F_Memory_Write **-** Write content taken from the Code file to the Target's Flash Memory.
VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed simultaneously.

Syntax:

```
MSPPRG_API      INT_X  F_Memory_Write( INT_X mode );
    mode = 0;
    mode = 1 and up - reserved
```

Return value:

```
    0 - FALSE
    1 - TRUE
    -2 (0xFFFFFFFE)   - FPA_INVALID_NO
```

F_Memory_Verify

F_Memory_Verify **-** Verify contents of the Target's Flash Memory and Code Buffer**.**
VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed simultaneously.

Note: *During the verification process either all memory or just the selected part of the memory is verified, depending on settings specified in the configuration setup* `FlashEraseModeIndex`**.** *Only valid data taken from the Code Buffer are compared with the target's flash memory. If size of the flash memory is bigger then code size then all reminding data in flash memory is ignored.*

Syntax:

```
MSPPRG_API      INT_X   F_Memory_Verify( INT_X mode );
    mode = 0;
    mode = 1 and up - reserved
```

Return value:

```
    0 - FALSE
    1 - TRUE
    -2 (0xFFFFFFFE)   - FPA_INVALID_NO
```

F_Memory_Read

F_Memory_Read - Read contents of the Target's Flash Memory**.**
VALID FPA index - (1 to 64)

Size of the read memory size is defined in the configuration setup
FlashReadModeIndex, ReadSegmA, ReadSegmB, ReadStartAddr, ReadStopAddr.
All data will be saved in destination byte buffer.

IMPORTANT: **Declared size of this buffer must be at least 0x1F000.** The biggest Flash memory size (currently 120kB in the MSP430X) can be transferred from target to mentioned buffer. If buffer is smaller, then application will crash during execution.

This function reads the data from the flash memory starting at address 0x1000.
At the [0x0000] location - byte taken from the Flash memory at location 0x1000;
.....
At the [0xEFFF] location - byte taken from the Flash memory at location 0xFFFF;

It is recommended to use the **F_Copy_All_Flash_to_Buffer()** instruction combined with the **F_Get_Byte_from_Buffer(..)** instead **F_Memory_Read()**. The **F_Copy_All_Flash_to_Buffer()** instruction uses all internal buffers and size of the external buffer is irrelevant . Read contents from the flash saved in the Read Data Buffer (see Figure 4.2) can be read from them byte by byte using the ***F_Get_Byte_From_Buffer(...)***. The size of the Read Data Buffer is adjusted to the latest size of the MSP430 flash memory and user can read only desired data size from this buffer, avoiding crashing problem if from any reason the data buffer size in user's application software is too small. Also the ***F_Copy_All_Flash_to_Buffer()*** can run simultaneously if more then one FPA are used, saving significantly execution time. The function ***F_Memory_Read(..)*** cannot be executed simultaneously. So, when more then one FPA is used then the reading time is much faster if the ***F_Copy_All_Flash_to_Buffer()*** instead ***F_Memory_Read(..)*** is used.

Syntax:

```
MSPPRG_API      INT_X  F_Memory_Read( unsigned char * data );
```

Return value:

```
0 – FALSE
1 – TRUE
–2 (0xFFFFFFFE)    – FPA_INVALID_NO
```

Example:

```
unsigned int data[0x1F000];
```

```
.....................
   st = F_Memory_Read( data );
   if ( st != TRUE )
    { ............... }
.....................
```

F_Copy_All_Flash_to_Buffer

F_Copy_All_Flash_to_Buffer - Read contents of the Target's Flash Memory and save it in the temporary Read Data buffer (see Figure 4.2)**.**

VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed simultaneously.

See **F_Memory_Read** for comments. Function useful in Visual Basic application, where all memory block can not be transferred to the Visual Basic application via pointer. Contents of the temporary flash buffer can be read using **F_Get_Byte_from_Buffer(address)** instruction.

Syntax:

```
MSPPRG_API      INT_X  F_Copy_All_Flash_to_Buffer( void );
```

Return value:

```
0 – FALSE
1 – TRUE
```

Example:

```
unsigned int data[0x20000];
LONG_X addr;
  .....................
     st = F_Copy_All_Flash_to_Buffer();
     if ( st == TRUE )
      {
        for( addr = 0x1000; addr<=0x1FFFF; addr++)
          data[ addr ] = F_Get_Byte_from_Buffer( addr );
      }
  .....................
```

F_Restore_JTAG_Security_Fuse

F_Restore_JTAG_Security_Fuse - Restore JTAG security fuse in F5xx, F6xx MCUvia BSL interface

VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed simultaneously.

Syntax:

```
MSPPRG_API      INT_X  F_Restore_JTAG_Security_Fuse( void );
```

Return value:

0 – FALSE
1 – TRUE

4.5 Sequential instructions

Sequential instructions allow access to the target device in any combination of the small instructions like erase, read, write sector, modify part of memory etc. Sequential instruction have an access only when communication between target device and programming adapter is initialized. This can be done when ***F_Open_Target_Device*** instruction is called. When communication is established, then any of the sequential instruction can be called. When the process is finished, then at the end ***F_Close_Target_Device*** instruction should be called. When communication is terminated, then sequential instructions can not be executed.

Note: *Erase/Write/Verify/Read configuration setup is not required when sequential instructions are called. Also code file is not required to be downloaded. All data to be written, erased, and read is specified as a parameter to the sequential functions. Data downloaded from the code file is ignored in this case.*

Very important:

The sequential functions allows to program words in the FLASH memory on any flash space location. Also the same bytes / words can be programmed few times. Software is not be able to control how many times the same location of the flash has been programmed between erasures. User should take a full responsibility to program the flash memory according to the MSP430 specifications. See TI's data sheets and manuals for details.

The following flash programming limitation should be taken to consideration:

1. The same word or byte can not be programmed more then twice between erasures. Otherwise, damage can occur.
2. In byte/word mode, the internally-generated programming voltage is applied to the complete 64-byte block, each time a byte or word is written, for 32 of the 35 f_{FTG} cycles. With each byte or word write, the amount of time the block is subjected to the programming voltage accumulates. The cumulative programming time, t_{CPT} , must not exceeded for any block. If the cumulative programming time is met, the block must be erased before performing any further writes to any address within the block. The cumulative time for the older MSP430 microcontrollers (F1xx, F4xx) is typically 4 ms. For the newer ones - 10 ms. See the device-specific datasheet for specifications. .

   The FTG frequency used in the USB-MSP430-FPA with the single word (two bytes) programming mode is 428 kHz. This means that programming time of the single word is appr 75 us. Programming time of the one byte would be the same.

   Cumulative time for the 64 bytes uses byte write mode would be appr.

$$t_{CPT} = 64(\text{bytes}) * 75\ \text{us} = 4.8\ \text{ms}.$$

This time can exceed the cumulative time for the older MSP430 microcontrollers. From that reason the USB-MSP430-FPA uses the word write mode that allows to decrease 2 times the cumulative time.

$$t_{CPT} = 32(words) * 75\ us = 2.4\ ms.$$

F_Open_Target_Device

F_Open_Target_Device - Initialization communication with the target device.
VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed simultaneously.

When **F_Open_Target_Device** is executed, then

- Power from the programming adapter becomes ON if `PowerTargetEn` in configuration setup is enabled.
- Vcc is verified to be higher then 2.7V.
- JTAG/SBW or BSL communication between programming adapter and target device is initialized.

Note: The correct BSL password should be downloaded to password or data buffer to be able to activate target devices if BSL or Fast BSL intefrace is used. If password is unknown the use encapsulated **F_Memory_Erase()** function first.

Target device is ready to get other sequential instructions.

Syntax:

```
MSPPRG_API      INT_X  F_Open_Target_Device( void );
```

Return value:

```
0 - FALSE   (communication failed)
1 - TRUE    (communication is OK)
2 - JTAG security blown - communication failed
-2 (0xFFFFFFFE)   - FPA_INVALID_NO
```

Example:

```
int st;
.....................
   F_Open_Target_Device();
.....................
   F_Segment_Erase(0x1000);
   st = F_Sectors_Blank_Check( 0x1000, 0x107f );
   if ( st != TRUE )
    { ............... }
   F_Memory_Write_Data( 0x1000, 0x20, data );
   F_Memory_Write_Data( 0x1050, 0x20, data );
```

```
    F_Segment_Erase(0x4000);
    F_Segment_Erase(0x4200);
    F_Segment_Erase(0x4400);
    F_Segment_Erase(0x4600);
    st = F_Sectors_Blank_Check( 0x4000, 0x47ff );
    if ( st != TRUE )
     { ............... }
    F_Memory_Write_Data( 0x4000, 0x100, data1 );
    F_Memory_Write_Data( 0x4100, 0x100, data2 );
 ..................
    F_Close_Target_Device();
 ..................
```

F_Close_Target_Device

F_Close_Target_Device - Termination communication between target device and programming adapter.

VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

Instruction should be called on the end of the sequential instructions. When **F_Close_Target_Device** instruction is executed then:

- Communication between target device and programming adapter is terminated.
- Power from the programming adapter becomes OFF (if selected).
- Target device is released from the programming adapter.

Syntax:

```
MSPPRG_API      INT_X  F_Close_Target_Device( void );
```

Return value:

```
0 – FALSE
1 – TRUE
-2 (0xFFFFFFFE)   – FPA_INVALID_NO
```

Example:

See example above (**F_Open_Target_Device**).

F_Segment_Erase

F_Segment_Erase - Erase any segment of the MSP430 Flash memory.

VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

Parameters:

segment address - Even number from 0x1000 to 0x1FFFE,

To erase a memory segment specify an address within that memory segment. For example to erase segment 0x2000-0x21FF any address from the range 0x2000 to 0x21FF can be specified. To erase all memory segments, erase the memory segment by segment, or used the encapsulated instruction

```
F_Memory_Erase(1);
```

***Note**: When encapsulated instruction is executed, then next access to the sequential instruction can be accessed only when **F_Open_Target_Device** instruction is called again.*

Syntax:

```
MSPPRG_API      INT_X  F_Segment_Erase( LONG_X address );
```

Return value:

```
0 – FALSE
1 – TRUE
–2 (0xFFFFFFFE)   – FPA_INVALID_NO
```

Example:

```
.....................
   F_Segment_Erase(0x4000);      // erase segment 0x4000 to 0x41FF
   F_Segment_Erase(0x4100);      // erase the same segment
   F_Segment_Erase(0x1010); // erase INFO segment 0x1000 to 0x107F
.....................
```

F_Sectors_Blank_Check

F_Sectors_Blank_Check - Blank check part or all Flash Memory. Start and stop address of the tested memory should be specified.

VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

Parameters:

start address - Even number from 0x1000 to 0x1FFFE,

stop address - Odd number from 0x1001 to 0x1FFFF,,

Syntax:

```
MSPPRG_API  INT_X  F_Sectors_Blank_Check( LONG_X start_addr,
                                           LONG_X stop_addr );
```

Return value:

```
0 – FALSE
1 – TRUE
–2 (0xFFFFFFFE)    – FPA_INVALID_NO
```

Example:

```
.....................
   F_Sectors_Blank_Check (0x1000, 0x107F) ;   //INFO secto blank check
   F_Sectors_Blank_Check (0x8000, 0xFFFF) ;   //32 kB memory size blank check
   F_Sectors_Blank_Check (0x1220, 0x123f) ;   //part of sector blank check
.....................
```

F_Write_Word

F_Write_Word - Write one word (two bytes) to RAM, registers, IO etc. without FLASH.
VALID FPA index ***- (1 to 64) or 0 (ALL FPAs) executed sequentially.***

Note: When the **BSL** or **Fast BSL** is used then an access to RAM location 0x200 to 0x2FF is blocked. This RAM area is used by stack and firmware for the BSL or Fast BSL.

Write one word to any location of the target device. Write to Flash has no effect.
Parameters:

address	- **Even** address from 0x0000 to 0x1FFFE,
data	- one word to be written to target device

Syntax:

```
MSPPRG_API  INT_X  F_Write_Word( LONG_X addr, INT_X data );
```

Return value:

```
0 – FALSE
1 – TRUE
–2 (0xFFFFFFFE)    – FPA_INVALID_NO
```

Example:

```
F_Write_Word( 0x0124, 0x2143 );
```

F_Read_Word

F_Write_Word - Read one word (two bytes) from RAM, registers, IO, Flash etc.
VALID FPA index ***- (1 to 64) or 0 (ALL FPAs) executed sequentially.***

Read one word to any location of the target device.
Parameters:

address - **Even** address from 0x0000 to 0x1FFFE,

Syntax:

```
MSPPRG_API  INT_X  F_Read_Word( LONG_X addr );
```

Return value:

```
data – one word
–2 (0xFFFFFFFE)   – FPA_INVALID_NO
```

Example:

data = `F_Read_Word( 0x0124 );`

F_Write_Byte

F_Write_Word - Write one byte to RAM, registers, IO etc. without FLASH.
VALID FPA index ***- (1 to 64) or 0 (ALL FPAs) executed sequentially.***

NOTE: Instruction not supported in **BSL** and **Fast BSL**.

Write one byte to any location of the target device. Write to Flash has no effect.
Parameters:

address - **Any** address from 0x0000 to 0x1FFFF,
data - one byte to be written to target device

Syntax:

```
MSPPRG_API  INT_X  F_Write_Byte( LONG_X addr, BYTE data );
```

Return value:

```
0 – FALSE
1 – TRUE
–2 (0xFFFFFFFE)   – FPA_INVALID_NO
```

Example:

```
F_Write_Byte( 0x33, 0x20 );
```

F_Read_Byte

F_Read_Byte - Read one byte from RAM, registers, IO, Flash etc.
VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

NOTE: Instruction not supported in **BSL** and **Fast BSL**.

Read one byte from any location of the target device.
Parameters:

address - **Any** address from 0x0000 to 0x1FFFF,

Syntax:

```
MSPPRG_API BYTE  F_Read_Byte( LONG_X addr );
```

Return value:

```
data – one byte
```

Example:

```
data = F_Read_Byte( 0x33 );
```

F_Memory_Write_Data

F_Memory_Write_Data - Write data block to Flash Memory.
VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

Blank check before writing and verification after writing in not provided.
Parameters:

start address - Even number from 0x1000 to 0x1FFFE,
size - Even number - 2 or higher
block of data in bytes to be written.

Note: Function is useful for writing small data block, usually shorter then 200 bytes, like calibration data, serial numbers etc. Function can also be used to writing longer data block, however for this purpose it is recommended to use an encapsulated function ***F_Memory_Write()*** described in this manual. The ***F_Memory_Write_Data()*** uses byte by byte flash write procedure. When the ***JTAG*** or ***Spy-Bi-Wire*** interface is used, then the ***F_Memory_Write_Data()*** use the ***JTAG/SBW*** protocol to directly program the Flash memory. The ***F_Memory_Write()*** function

first download the Flash Loader to RAM memory, and use the block write flash procedures, speeding up programming process.

Syntax:

```
MSPPRG_API  INT_X  F_Memory_Write_Data( LONG_X start_addr,
                                        INT_X size, unsigned char *data );
```

Return value:

```
0 – FALSE
1 – TRUE
–2 (0xFFFFFFFE)   – FPA_INVALID_NO
```

Example:

```
unsigned char data[0x100];
  ..................
    for( int k=0; k<256; k++ )  data[k] = k;
  ..................
  ..................
     F_Memory_Write_Data( 0x1000, 0x20, data );
     F_Memory_Write_Data( 0x1050, 0x20, data+0x80 );
     F_Memory_Write_Data( 0x2000, 0x100, data );
  ..................
```

F_Memory_Read_Data

F_Memory_Read_Data - Read data block from Flash Memory only.
VALID FPA index - (1 to 64)

Parameters:

start address - Even number from 0x1000 to 0x1FFFE,
size - Even number - 2 or higher
block of bytes where data should be saved.

Syntax:

```
MSPPRG_API   INT_X  F_Memory_Read_Data( LONG_X start_addr,
                                        INT_X size, unsigned char *data );
```

Return value:

```
0 – FALSE
1 – TRUE
–2 (0xFFFFFFFE)   – FPA_INVALID_NO
```

Example:

```
unsigned char rd_data[0x800];
int st;
   ..................
      st = F_Memory_Read_Data( 0x1000, 0x800, rd_data );
      if ( st != TRUE )
       { .................. }
   ..................
```

F_Copy_Buffer_to_Flash

F_Copy_Buffer_to_Flash - Write "size" number of bytes from the Write Data Buffer (see Figure 4.2) to flash. Starting address is specified in the "start address"**.**

VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

Syntax:

```
MSPPRG_API      INT_X  F_Copy_Buffer_to_Flash( LONG_X start_address,
                                               LONG_X  size );
```

Parameters:

```
start address     - Even number from 0x1000 to 0x1FFFE,
size              - Even number
```

Return value:

```
1 - TRUE if data has been saved successfully
0 - FALSE.
-2 - FPA_INVALID_NO.
```

NOTE: ***Specified address in the Write Data Buffer is the same as a physical FLASH address.***

Note: Function is useful for writing small data block, usually shorter then 200 bytes, like calibration data, serial numbers etc. Function can also be used to writing longer data block, however for this purpose it is recommended to use an encapsulated function ***F_Memory_Write()*** described in this manual. The ***F_Copy_Buffer_to_Flash()*** (the same as the ***F_Memory_Write_Data()*** function) uses byte by byte flash write procedure. When the ***JTAG*** or ***Spy-Bi-Wire*** interface is used, then the ***F_Copy_Buffer_to_Flash()*** use the ***JTAG/SBW*** protocol to directly program the Flash memory. The ***F_Memory_Write()*** function first download the Flash Loader to RAM memory, and use the block write flash procedures, speeding up programming process.

Example:

```
  ..................
   ..................
      for( addr = 0x1000; addr<0x1100; addr++ )
         st = F_Put_Byte_To_Buffer( addr, data[addr] );
      st = F_Copy_Buffer_to_Flash( 0x1000, 0x100 );
   ..................
```

F_Copy_Flash_to_Buffer

F_Copy_Flash_to_Buffer - Read specified in "size" number of bytes from the Flash and save it in the Read Data Buffer (see Figure 4.2). Starting address is specified in the "start address"**.**

VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

Syntax:

```
MSPPRG_API      INT_X  F_Copy_Flash_to_Buffer( LONG_X start_address,
                                               LONG_X  size );
```

Parameters:

```
start address     - Even number from 0x1000 to 0x1FFFE,
size              - Even number
```

Return value:

```
1 - TRUE if data has been read successfully
0 - FALSE.
-2 - FPA_INVALID_NO.
```

NOTE:
Specified address in the temporary flash buffer is the same as a physical FLASH address.

Example:

```
  ..................
   ..................
      st = F_Copy_Flash_to_Buffer( 0x1000, 0x100 );
      if( st == TRUE )
       {
         for( addr = 0x1000; addr<0x1100; addr++ )
           data[addr] = F_Get_Byte_from_Buffer( addr );
       }
      else
       {
          ..................
       }
   ..................
```

F_Copy_Buffer_to_RAM

F_Copy_Buffer_to_RAM - Write "size" number of bytes from Write Data Buffer (see figure 4.2) to RAM. Starting address is specified in the "start address"**.**

VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

Note: When the **BSL** or **Fast BSL** is used then an access to RAM location 0x200 to 0x2FF is blocked. This RAM area is used by stack and firmware for the BSL or Fast BSL.

Syntax:

```
MSPPRG_API      INT_X  F_Copy_Buffer_to_RAM( LONG_X start_address,
                                             LONG_X  size );
```

Parameters:

```
start address     - Even address
size              - Even number
```

Return value:

```
1 - TRUE if data has been saved successfully
0 - FALSE.
-2 - FPA_INVALID_NO.
```

NOTE: Specified address in the Write Data Buffer is the same as a physical RAM address.

Example:

```
.....................
 .....................
    for( addr = 0x220; addr<0x300; addr++ )
       st = F_Put_Byte_To_Buffer( addr, data[addr] );
    st = F_Copy_Buffer_to_RAM( 0x220, 0xE0 );
 .....................
```

F_Copy_RAM_to_Buffer

F_Copy_RAM_to_Buffer - Read specified in "size" number of bytes from the RAM and save it in the Read Data Buffer (see Figure 4.2). Starting address is specified in the "start address"**.**

VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

Syntax:

```
MSPPRG_API      INT_X  F_Copy_RAM_to_Buffer( LONG_X start_address,
                                             LONG_X  size );
```

Parameters:

```
start address     - Even address
size              - Even number
```

Return value:

```
1 - TRUE if data has been read successfully
0 - otherwise FALSE.
-2 - FPA_INVALID_NO.
```

NOTE: *Specified address in the Read Data Buffer is the same as a physical RAM address.*

Example:

```
  .....................
   .....................
      st = F_Copy_RAM_to_Buffer( 0x220, 0xE0 );
      if( st == TRUE )
       {
         for( addr = 0x0220; addr<0x0300; addr++ )
           data[addr] = F_Get_Byte_from_Buffer( addr );
       }
      else
       {
          ...................
       }
   .....................
```

F_Set_PC_and_RUN

F_Set_PC_and_RUN - Instructions allows to run program in microcontroller from specified PC in the RAM or Flash location. Program should be downloaded first using the Write to Flash or Ram procedures. When the processor is running then the JTAG is disconnected from the CPU. The CPU can be controlled from JTAG again when the instruction **F_Open_Target_Device** or **F_Synch_CPU_JTAG** is used.

Note: *The **F_Open_Target_Device** instruction is resetting the CPU. All internal registers states are set to default value. The **F_Synch_CPU_JTAG** is synchronizing the CPU and JTAG on fly. The CPU is stopped, but all registers have not been modified.*

VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

NOTE: Instruction not supported in **BSL** and **Fast BSL**.

Syntax:

```
MSPPRG_API      INT_X  F_Set_PC_and_RUN( LONG_X PC_address );
```

Return value:

```
1 - TRUE
0 - FALSE;
-2 - FPA_INVALID_NO.
```

Example:

```
unsigned char rd_data[0x100];

   ..................
      F_Autoprogram(0); // download the test code
      F_Open_Target_Device();
   ..................
      F_Set_PC_and_RUN( PC1 ) // run the test program from location PC1
       // monitor PC address until PC address reach the desired value with
       // timeout set by k and delay
      for(k=0; k<1000; k++)
       {
          PC_addr = F_Capture_PC_Addr();
          if(( PC_addr >= addr_min1 ) && ( PC_addr <= addr_max1 )) break;
          delay( ... );
       }
      F_Synch_CPU_JTAG();
      F_Copy_RAM_to_Buffer( address, size );
                        // read the test-1 result from the RAM
                        //using F_Get_Byte_from_Buffer(..)
   ..................
      F_Set_PC_and_RUN( PC2 ) // run the test program from location PC2
      for(k=0; k<1000; k++)
       {
          PC_addr = F_Capture_PC_Addr();
          if(( PC_addr >= addr_min2 ) && ( PC_addr <= addr_max2 )) break;
          delay( ... );
       }
      F_Synch_CPU_JTAG();
      F_Copy_RAM_to_Buffer( address, size );
                        // read the test-1 result from the RAM
                        // using F_Get_Byte_from_Buffer(..)
   ..................
   ..................
   ..................
      F_Set_PC_and_RUN( PCn ) // run the test program from location PCn
      for(k=0; k<1000; k++)
       {
          PC_addr = F_Capture_PC_Addr();
          if(( PC_addr >= addr_min3 ) && ( PC_addr <= addr_max3 )) break;
          delay( ... );
       }
      F_Synch_CPU_JTAG();
```

```
      F_Copy_RAM_to_Buffer( address, size );
                        // read the test-1 result from the RAM
                        //using F_Get_Byte_from_Buffer(..)

      F_Close_Target_Device();
   ..................
      F_Autoprogram(0); // download the final code
```

F_Capture_PC_Addr

F_Capture_PC_Addr – Instructions monitoring the PC address on fly without stopping the MCU

VALID FPA index – (1 to 64)

NOTE: Instruction not supported in **BSL** and **Fast BSL**.

Syntax:

```
  MSPPRG_API      INT_X  F_Capture_PC_Addr( void );
```

Return value:

0 – FALSE;
>0 – Capture PC address

Example:

See example in the **F_Set_PC_and_RUN** instruction.

F_Synch_CPU_JTAG

F_Synch_CPU_JTAG – Instructions allows to synchronize CPU with JTAG and stop the CPU when the **F_Set_PC_and_RUN** has been executed.

Note: *When the CPU is executing wrong code with critical error, or hardware **RESET** has been used, then only the **F_Open_Target_Device** can recover the JTAG communication with CPU.*

VALID FPA index – (1 to 64) or 0 (ALL FPAs) executed sequentially.

NOTE: Instruction not supported in **BSL** and **Fast BSL**.

Syntax:

```
  MSPPRG_API      INT_X  F_Synch_CPU_JTAG( void );
```

Return value:

```
1 – TRUE
0 – FALSE;
–2 – FPA_INVALID_NO.
```

Example:

See example in the **F_Set_PC_and_RUN** instruction.

F_Blow_Fuse

F_Blow_Fuse - Blow the security fuse instruction.

VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

NOTE: Instruction not supported in **BSL** and **Fast BSL**.

To access the security fuse and blow it, the flag **BlowFuseEn** in the configuration setup must be enable (BlowFuseEn = 1 or 3) and JTAG/SBW communication with the target device must be selected. Otherwise function returns - FALSE.

The fuse can also be blown when the **F_AutoProgram** instruction is executed with enabled blow security fuse option.

When the BSL communication is active then instruction **F_Blow_Fuse** cannot be successfully executed and returns - FALSE.

Note: *When* ***BlowFuseEn*** *in configuration setup is enabled and* ***F_AutoProgram*** *function is executed, then at the end of autoprogram process security fuse will be blown. No other access to the target device via JTAG/SBW interface will be possible. If some communication with the target device is required after autoprogram, like to modify some calibration data etc., then* ***BlowFuseEn*** *flag should be disabled before* ***F_AutoProgram*** *is called. Flag* ***BlowFuseEn*** *should be enabled at the end of communication with the target device just before execution of the* ***F_Blow_Fuse*** *instruction and disabled after.*

Syntax:

```
MSPPRG_API      INT_X  F_Blow_Fuse( void );
```

Return value:

```
0 – FALSE
1 – TRUE
–2 – FPA_INVALID_NO.
```

Example:

```
int   st;
```

```
      ..................
      do{
         ..................   // prepare next microcontroller
            F_SetConfig( CFG_INTERFACE, INTERFACE_JTAG);//select JTAG interface
            F_SetConfig( CFG_BLOWFUSE, 0 )//disable fuse blow option
           ............................ // modify configuration if required
            st = F_AutoProgram(0);
            ..................          // do extra communication with
                                        // the target device

            F_SetConfig( CFG_BLOWFUSE, 1 )//enable fuse blow option
            st = F_Blow_Fuse( void );   // Blow the security Fuse
            F_SetConfig( CFG_BLOWFUSE, 0 )//disable fuse blow option
            ..................
            ..................          // break; if the last microcontroller
                                        // has been programmed
          } while(1);
       ..................

or
      do{
         ..................   // prepare next microcontroller
            F_SetConfig( CFG_INTERFACE, INTERFACE_JTAG);//select JTAG interface
            F_SetConfig( CFG_BLOWFUSE, 1 )
                  //enable blow security fuse using F_Blow_Fuse() funtion only.
                  //The F_AutoProfgram will not blow the fuse.
                ............................ // modify configuration if required
            st = F_AutoProgram(0);      // Fuse blow is disabled
            ..................          // do extra communication with
                                        // the target device
            st = F_Blow_Fuse( void );   // Blow the security Fuse
            ..................          // break; if the last microcontroller
                                        // has been programmed
          } while(1);

or
      do{
         ..................   // prepare next microcontroller
            F_SetConfig( CFG_INTERFACE, INTERFACE_JTAG);//select JTAG interface
            F_SetConfig( CFG_BLOWFUSE, 3 )
                  //enable blow security fuse when the F_Autoprogram is executed
                  //(if all passed)
                                        // modify configuration if required
            st = F_AutoProgram(0);      // Fuse blow is disabled
            ..................          // break; if the last microcontroller
                                        // has been programmed
          } while(1);
```

F_Adj_DCO_Frequency

F_Adj_DCO_Frequency - Adjust DCO to desired frequency and return register value for that frequency.

VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

Syntax:

```
MSPPRG_API      INT_X  F_Adj_DCO_Frequency( INT_X freq_Hz );
```

freq_Hz – 100000 to 16000000 (100kHz to 16 MHz)

Return value:

-1 – FALSE;
>=0 – DCO Register value

The DCO register value has the same format as the DCO constants saved in the Info-A segments. See TI's documentation for detail.

Example:

```
data = F_Adj_DCO_Frequency( 2000000 );
```

When more then one FPA is used then instruction can be executed simultaneously and register value read after the function if finished in all targets.

```
F_Set_FPA_index( ALL_ACTIVE_FPA );   // select all FPA's
F_Adj_DCO_Frequency( 2000000 );
for (n=1; n<=MAX_FPA_INDEX; n++ )
   data[n] = F_LastStatus( n);
```

F_Test_DCO_Frequency

F_Test_DCO_Frequency - Measure DCO frequency for desired DCO register value

VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

Syntax:

```
MSPPRG_API      INT_X  F_Test_DCO_Frequency( INT_X DCO_Const );
```

DCO_const – 0x0000 to 0xFFFF

Return value:

-1 – FALSE;
>=0 – DCO Frequency in Hz

Example:

```
freq = F_Test_DCO_Frequency( 0x1234 );
```

When more then one FPA is used then instruction can be executed simultaneously and register value read after the function if finished in all targets.

```
F_Set_FPA_index( ALL_ACTIVE_FPA );   // select all FPA's
F_Test_DCO_Frequency( 0x1234 );
for (n=1; n<=MAX_FPA_INDEX; n++ )
   Freq[n] = F_LastStatus( n);
```

4.6 Customized JTAG instruction

Customized JTAG instruction allows to create any sequence on the JTAG output lines - TMS, TDO, TCK and read sequence on the input TDI line. These instructions are useful in development - not exactly related to MSP430 microcontrollers. Instructions allows to transfer sequences from PC via USB to target device. JTAG protocol and list of high level instructions should be created by user.

F_init_custom_jtag

F_init_custom_jtag – Switch FPA from MSP430 protocol to custom ized JTAG stream..

VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

NOTE: Instruction not supported in **BSL** and **Fast BSL**.

Syntax:

```
MSPPRG_API      void  F_init_custom_jtag( INT_X state, INT_X Vcc_index );
```

state - 0 - turn-OFF FPA
state - 1 - turn-ON FPA and create default (all zeros) states of I/O lines.
Vcc_index - Vcc from FPA
0 - 2.2 V
1 - 2.4 V
2 - 2.6 V
3 - 2.8 V
4 - 3.0 V
5 - 3.2 V
6 - 3.4 V
7 - 3.6 V

F_custom_jtag_stream

F_custom_jtag_stream – Transfer JTAG stream taken from the data buffer.

VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed sequentially.

NOTE: Instruction not supported in **BSL** and **Fast BSL**.

Syntax:

```
MSPPRG_API      INT_X  F_custom_jtag_stream( INT_X mode, INT_X size,
                    BYTE * data_out, BYTE * data_in );
```

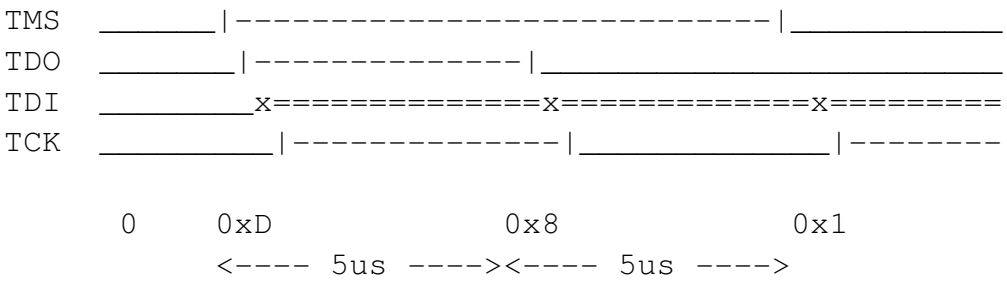
```
mode  - 0   -     send data_out buffer only to TMS, TDO, TCK.
        1   -     send data_out buffer to TMS, TDO, TCK and transfer TMS,
                  TDO, TDI, TCK JTAG states to data_in buffer.
size        -     stream size - 1 to 120 bytes
data_out    -     buffer with data to be transmitted - up to 120 bytes
                  Bit   7   6   5   4     3   2   1   0
                        -   -   -   -    TMS TDO  -  TCK

data_in     -     buffer with data received from JTAG - up to 120 bytes
                  Bit   7   6   5   4     3   2   1   0
                        -   -   -   -    TMS TDO TDI TCK
```

Return value:

```
0 - FALSE
1 - TRUE
-2 (0xFFFFFFFE)   - FPA_INVALID_NO
```

When instruction F_custom_jtag_stream is executed then TMS, TDO and TDI states are transferred to JTAG I/O in order - first TMS state, then TDO, then TDI is read (if required) and on the end state of TCK is modified. Time between all these states are 250 ns. Time between the next JTAG state - 5 us. Below is an timing example for a following data_out block - 0x0, 0xD, 0x8, 0x1

```
0x0    - all LOW
0xD    - TMS-HI,  TDO-HI, TCK-HI
0x8    - TMS-HI, TDO-LO, TCK-LO
0x1    - TMS-LO, TDO-LO, TCK-HI
```



Time between TMS/TDO, TDO/TDI, TDI/TCK changes - appr 250 ns.
Max stream size - up to 120 data block will be transmitted in 600 us. One 120 block size slot allows to transmit 2 to 3 full JTAG sequences.
See attached in the software package example
C:\Program Files\Elprotronic\USB FlashPro430\API-DLL-Demo\JTAG-Stream
how the customized JTAG instruction can be used. Package contains one source file
FPA-JTAG-Demp.cpp
and header file MSPPrg-Dll.h that is taken from DLL package. In the subdirectory ***Release***

C:\Program Files\Elprotronic\USB FlashPro430\API-DLL-Demo\JTAG-Stream\Release

executable file uses standard DLLs (attached in this subdirectory). To create JTAG sequences run the executable file with argument contains JTAG sequences in hex string. For the example described above 0x0, 0xD, 0x8, 0x1 following program with argument 0D81 should be executed from the **DOS Command Prompt** box.

FPA_JTAGStream-Demo.exe 0D81

from subdirectory

C:\Program Files\Elprotronic\USB FlashPro430\API-DLL-Demo\JTAG-Stream\Release

JTAG sequence as described above will be generated and states of all JTAG I/O lines will displayed on the screen.

4.7 UART

The FPA adapter (FlafhPro430 - USB-MSP430-FPA only) can provide UART communication via BSL-Tx and BSL-Rx pins (#12 and #14). The UART is simplified and has following limitations:

- can be used only when the BSL communication is not used,
- message via UART can be send and received when the JTAG communication is finished eg. after ro before programming the target device,
- Baud rate 9.6 kb/s or 57.6 kb/s - start bit, 8 message bits, parity bit and stop bit,
- protocol type Half Duplex Master/Slave - Tx message or Tx message and Rx message,
- Tx message size - 1 to 50 bytes
- Rx message size - 0 to 50 bytes

F_Custon_Function

F_Custom_Function - Custom Function eg. UART transferring message from/to data buffer to external device via BSL pins with baud rate 9.6 kb/s or 57.6 kb/s.

VALID FPA index - (1 to 64) or 0 (ALL FPAs) executed simultaneously.

Syntax:

```
MSPPRG_API      INT_X  F_Custom_Function( INT_X type );
```

type = 1 - UART- transferring message from/to data buffer to external device via BSL pins with baud rate 9.6 kb/s.

type = 2 - UART- transferring message from/to data buffer to external device via BSL pins with baud rate 57.6 kb/s

other type value reserved for the future.

Prepared definitions in header file

```
#define      CUSTOM_FUNCTION_UART_9600          1
#define      CUSTOM_FUNCTION_UART_38K4          2
#define      UART_TX_SIZE_ADDR                  0
#define      UART_RX_SIZE_ADDR                  1
#define      UART_BUFFER_START_ADDR             0x10
#define      UART_BUFFER_SIZE                   50
```

Return value:

```
0 - FALSE
1 - TRUE
-1 (0xFFFFFFFF)   - UART not supported
```

```
-2 (0xFFFFFFFE)   - FPA_INVALID_NO
```

The FPA adapter (FlafhPro430 - USB-MSP430-FPA only) can provide UART communication via BSL-Tx and BSL-Rx pins (#12 and #14). Message to be send should be located in the data buffer using instruction ***F_Put_Byte_to_Buffer(addr, data)***. Received result via UART is located in the buffer and can be taken from it using instruction ***data = F_Get_Byte_from_Buffer(addr)***.

Note: Make sure that the Vcc (external or from FPA) is not OFF, because the UART communication uses the BSL-Tx/Rx inteffaces and the high level of the data I/O is following the Vcc level. If the Vcc is OFF then the high level will be 0V and of course no data can be transmitted and received to/from external device.

Following data should be placed in the data buffer before the UART instruction is used using instruction ***F_Put_Byte_to_Buffer(addr, data)***

Tx message size	- at buffer address location	0x0000	(value from 1 to 56)
Rx message size	- at buffer address location	0x0001	(value from 0 to 56)
Tx message data	- starting at buffer address location	0x0010	(1-st byte)
Tx message data	- next address	0x0011	(2-st byte)
.....			
Tx message data	- last address	0x0047	(56-th byte)

Received message from via UART are placed in the buffer at location and can be read using instruction ***data = F_Get_Byte_from_Buffer(addr).***

Rx message data	- starting at buffer address location	0x0010	(1-st byte)
Rx message data	- next address	0x0011	(2-st byte)
.....			
Rx message data	- last address	0x0047	(56-th byte)

Receiving message must be send from the device to FPA no later then the specified timeout (30 ms) counted from the time when the last byte of the Tx message has been sent.

Example:

```
int    TxRx_via_UART( int speed, int Tx_size, int Rx_size, BYTE *TxData, BYTE *RxData)
{
 int k, response;
    if(( Tx_size < 1 ) || ( Tx_size > UART_BUFFER_SIZE)) return(FALSE);
    if(( Rx_size < 0 ) || ( Rx_size > UART_BUFFER_SIZE)) return(FALSE);
```

```
  //make sure the Vcc is ON -place required instruction to supply the Vcc

//put UART Tx message to data buffer
       for(k=0; k<Tx_size; k++ )         //max TX size - 56
          F_Put_Byte_to_Buffer(  UART_BUFFER_START_ADDR+k, *(TxData+k));

//put Tx_size and Rx_size to data buffer
       F_Put_Byte_to_Buffer(  UART_TX_SIZE_ADDR, Tx_size );
       F_Put_Byte_to_Buffer(  UART_RX_SIZE_ADDR, 0 );

//Send/Receive message via UART
       if ( speed == CUSTOM_FUNCTION_UART_9600 )
         response = F_Custom_Function( CUSTOM_FUNCTION_UART_9600 );
       else
         response = F_Custom_Function( CUSTOM_FUNCTION_UART_57K6 );

// get Rx message
       if ( Rx_size > 0 )
       {
        for(k=0; k<Rx_size; k++ )
         *(RxData+k) = (BYTE)(0xFF & F_Get_Byte_from_Buffer( UART_BUFFER_START_ADDR+k ));
       }

 return(response);
}
```

Appendix A

FlashPro430 Command Line interpreter

The **Multi-FPA API-DLL** can be used with the command line interpreter shell. This shell allows to use the standard Command Prompt windows to execute the API-DLL functions. All required files are located in the directory

C:\Program Files\Elprotronic\MSP430\USB FlashPro430\CMD-line

and contains

FP430-commandline.exe	-> command line shell interpreter
MSP430FPA.dll	-> standard API-DLL files
MSP430FPA1.dll	-> ----,,,,,--------

All API-DLL files should be located in the same directory where the **FP430-commandline.exe** is located. To start the command line interpreter, the **FP430-commandline.exe** should be executed.

Command Syntax:

instruction_name (parameter1, parameter2, ...)

parameter:

1. string (file name etc.) - "filename"
2. numbers

	integer decimal	eg. **24**
or	integer hex	eg. **0x18**

Note: Spaces are ignored

Instructions are not case sensitive

F_OpenInstancesAndFPAs("*# *")

and **f_openinstancesandfpas("*# *")**

are the same.

Example-1:

Run the **FP430-commandline.exe**

Type:

F_OpenInstancesAndFPAs("*# *") // open instances and find the first adapter (any SN)

Press ENTER - result ->1 (OK)

Type:

F_Initialization() //initialization with config taken from the config.ini

//setup taken from the FlashPro430 - with defined MSP430 type, code file etc.

Press ENTER - result ->1 (OK)

Type:

F_AutoProgram(0)

Press ENTER - result ->1 (OK)

Type:

F_Report_Message()

Press ENTER - result -> displayed the last report message (from the F_Autoprogram(0))

See figure A-1 for result:

Type **quit()** and press ENTER to close the **FP430-commandline.exe** program.

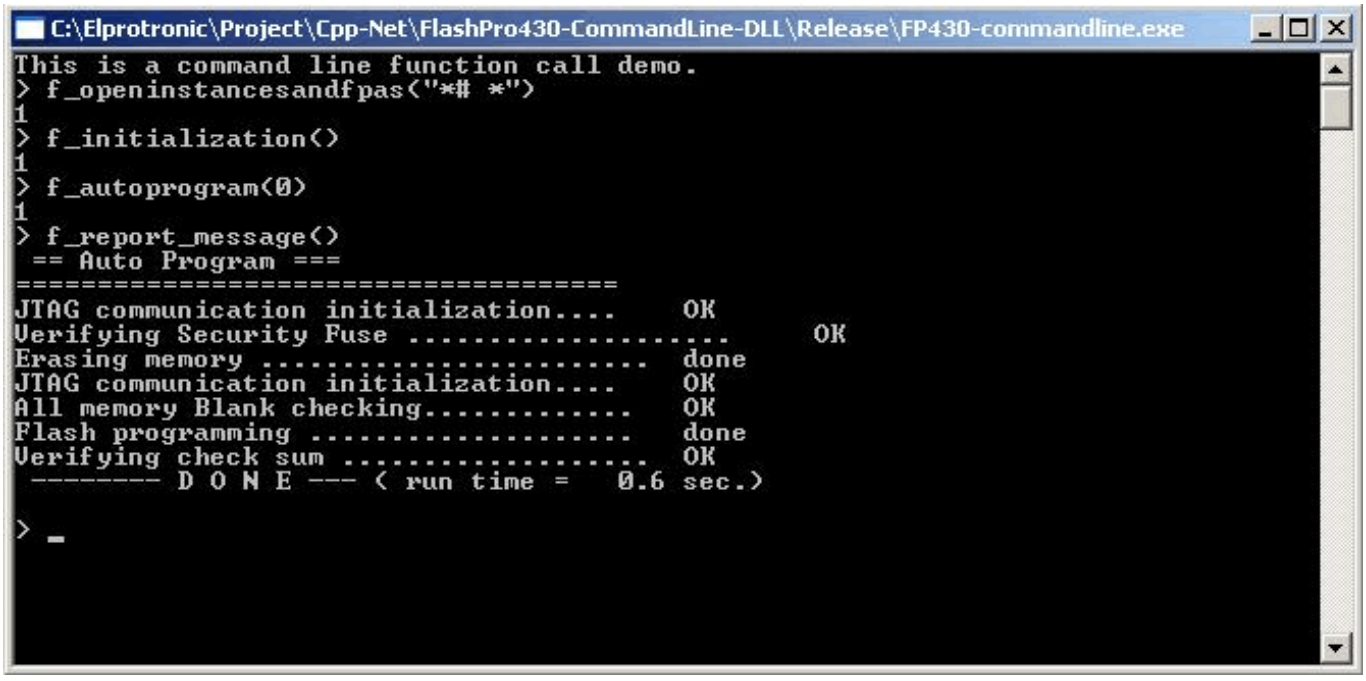


Figure A-1

Example-2:

Run the **FP430-commandline.exe** and type following instructions:

```
F_OpenInstancesAndFPAs( "*# *" )        // open instances and find the first adapter (any SN)
F_Initialization()
F_Report_Message()
F_ConfigFileLoad( "filename" )          //put vaild path and config file name
F_ReadCodeFile( 1, "FileName" )         //put vaild path and code file name (TI.txt format)
F_AutoProgram( 0 )
F_Report_Message()
.....................
F_Put_Byte_to_Buffer( 0x8000, 0x11 )
F_Put_Byte_to_Buffer( 0x8001, 0x21 )
.....................
F_Put_Byte_to_Buffer( 0x801F, 0xA6 )
F_Open_Target_Device()
F_Segment_Erase( 0x8000 )
F_Copy_Buffer_to_Flash( 0x8000, 0x20 )
F_Copy_Flash_to_Buffer( 0x8000, 0x20 )
F_Get_Byte_from_Buffer( 0x8000 )
F_Get_Byte_from_Buffer( 0x8001 )
.....................
F_Get_Byte_from_Buffer( 0x801F )
F_Close_Target_Device()
quit()
```

List of command line instructions

```
quit()                  ;close the command interpreter program
help()                  ;display list below
F_Trace_ON()
F_Trace_OFF()
F_OpenInstances( no )
F_CloseInstances()
F_OpenInstancesAndFPAs( "FileName" )
F_Set_FPA_index( fpa )
F_Get_FPA_index()
F_LastStatus( fpa )
F_DLLTypeVer()
F_Multi_DLLTypeVer()
F_Check_FPA_access(index )
F_Get_FPA_SN( fpa )
F_APIDLL_Directory( "APIDLLpath" )
F_Initialization()
F_DispSetup()
F_Close_All()
F_Power_Target( OnOff )
F_Reset_Target()
F_Report_Message()
F_ReadCodeFile( file_format, "FileName" )
F_Get_CodeCS( dest )
F_ReadPasswFile( file_format, "FileName" )
F_ConfigFileLoad( "filename" )
F_SetConfig( index, data )
F_GetConfig( index )
F_Put_Byte_to_Buffer( addr, data )
F_Copy_Buffer_to_Flash( start_addr, size )
F_Copy_Flash_to_Buffer( start_addr, size )
F_Copy_All_Flash_to_Buffer()
F_Get_Byte_from_Buffer( addr )
F_GetReportMessageChar( index )
F_Clr_Code_Buffer()
F_Put_Byte_to_Code_Buffer( addr, data )
F_Put_Byte_to_Password_Buffer( addr, data )
```

F_Get_Byte_from_Code_Buffer(addr)
F_Get_Byte_from_Password_Buffer(addr)
F_AutoProgram(0)
F_VerifyFuseOrPassword()
F_Memory_Erase(mode)
F_Memory_Blank_Check()
F_Memory_Write(mode)
F_Memory_Verify(mode)
F_Open_Target_Device()
F_Close_Target_Device()
F_Segment_Erase(address)
F_Sectors_Blank_Check(start_addr, stop_addr)
F_Blow_Fuse()
F_Write_Word(addr, data)
F_Read_Word(addr)
F_Write_Byte(addr, data)
F_Read_Byte(addr)
F_Copy_Buffer_to_RAM(start_addr, size)
F_Copy_RAM_to_Buffer(start_addr, size)
F_Set_PC_and_RUN(PC_addr)
F_Synch_CPU_JTAG()
F_Get_Targets_Vcc()

See chapter 4 for detailed description of the instructions listed above.

Note: *Not all instructions listed in the chapter 4 are implemented in the command line interpreter. For example - all instructions uses pointers are not implemented, however this is not limiting the access to all features of the API-DLLs, because all instructions uses pointers are implemented also in the simpler way without pointers.*