TEXAS INSTRUMENTS

MSP430 Family
Serial Programming Adapter

User's Guide

2006

Mixed Signal Products

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Preface

Read This First

About This Manual

This document describes the MSP430-family hardware, operation, and software installation and setup.

How to Use This Manual

This document contains the following chapters:

❑ Chapter 1 − Installation and Setup

❑ Chapter 2 − Operation

❑ Chapter 3 − Hardware

❑ Appendix A − Hex Object Format

❑ Appendix B − Schematics

Notational Conventions

This document uses the following conventions.

❑ Program code and program examples are shown in a `special typeface` similar to a typewriter’s.

Here is an example of programming code:

```
long int VerifyFile(char* lpszFileName, long int
iFileType)
```

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Chapter 1

Installation and Setup

This chapter describes the process of installing and programming the hardware and software for the MSP430-PRGS430 programming adapter used with the MSP430 family of microcontrollers.

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1.1 Installing the Software

To install the MSP-PRGS430 software, perform the following steps:

1) Insert the MSP-PRGS430 CD-ROM in the computer's CD drive. It should start automatically. A setup routine checks if you have an HTML browser installed on your computer. The MSP430 start page is then displayed. (Alternatively, use a browser to open the file *index.htm* that is located in the root directory of the MSP430 CD-ROM. The MSP430 start page is then displayed.)

2) Select *Software*

3) Select *Serial Programming Adapter*

4) Select *Save it to disk*. A *Save As* dialog is displayed.

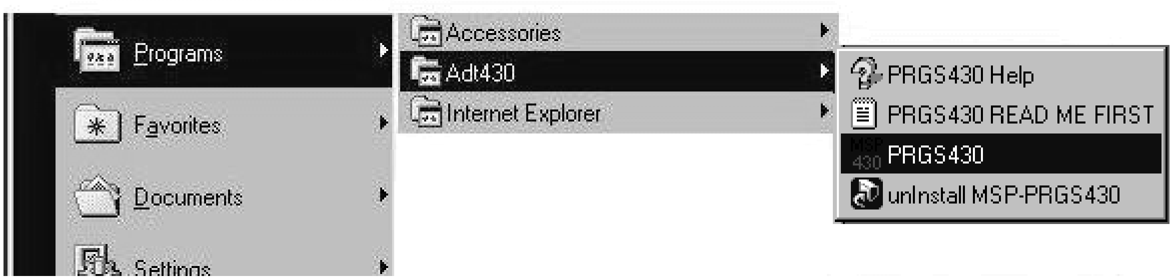
5) Use the Save As dialog to save *PRGS430_Rxxx.exe* to the computer. Note the directory path to this saved file.

6) Navigate to this saved file (PRGS430_Rxxx.exe) and execute it. A welcoming message is displayed.

7) Follow the setup instructions on the screen. The setup program guides you through the installation process.

8) After you run setup, the MSP430 program icons are installed in the selected folder. Click on the PRGS430 Read Me First icon, shown in Figure 1−1, to obtain important information about the program device hardware and software.

Figure 1−1. ADT430 Program Icons



9) The appropriate program group and icons are added to the Windows program manager.

10) To start the programming adapter software, click the PRGS430 icon in the selected program group (default: ADT430).

1.2 Installing the Hardware

To install the programming adapter hardware, perform the following steps:

1) Using the 9-pin SUB-D connector, connect the programming adapter to the serial port (COM1−COM4) of the PC.

2) Connect an external power supply to the programming adapter. The voltage of the power supply must be between 14 V and 20 V dc and must provide a minimum of 200 mA of power. The center terminal of the supply connector at the programming adapter is the plus pole.

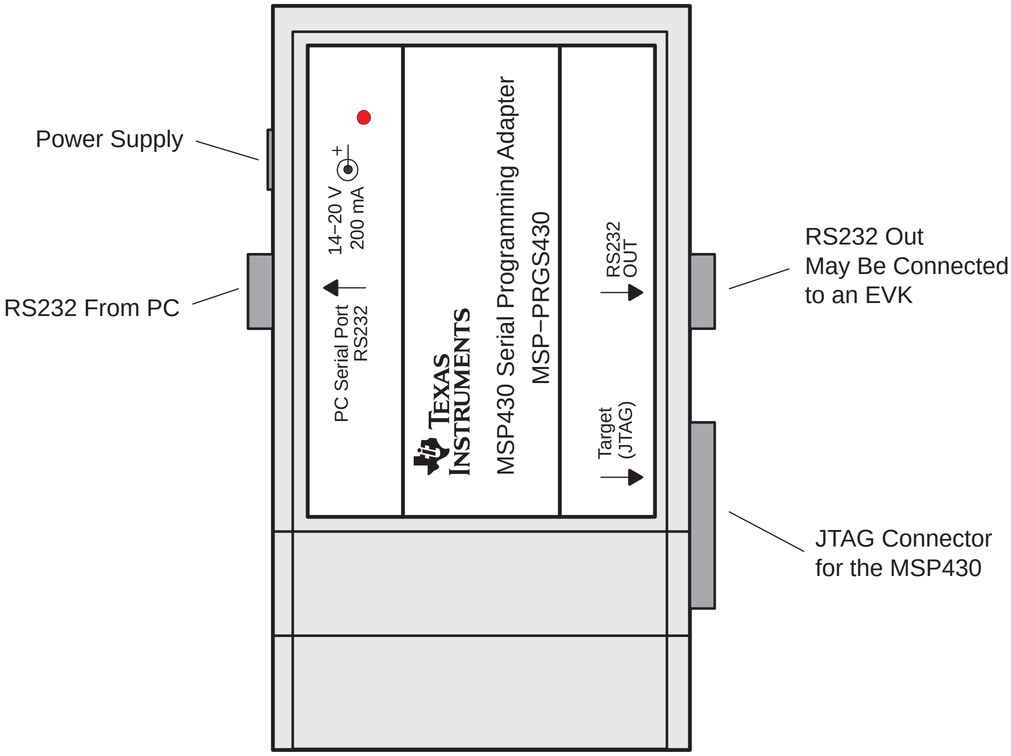
3) The red LED on the programming adapter lights if the power supply is properly connected. If the LED does not light and the power supply is properly connected, check the F1 fuse on the programming adapter printed-wire board (PWB).

4) The MSP430 devices, in a socket or on a PWB, should be connected to the programming adapter through the 14-pin cable.

   The programming adapter provides the selected supply voltage V_{CC} at pin 14 of the 25-pin SUB-D connector, or at pin 2 of the 14-pin connector to supply the MSP430 device. The signal name is VCC_MSP.

   If an external supply voltage V_{CC} is used for the MSP430, the internal voltage VCC_MSP must be set to the same voltage level.

Figure 1−2. Serial Programming Adapter



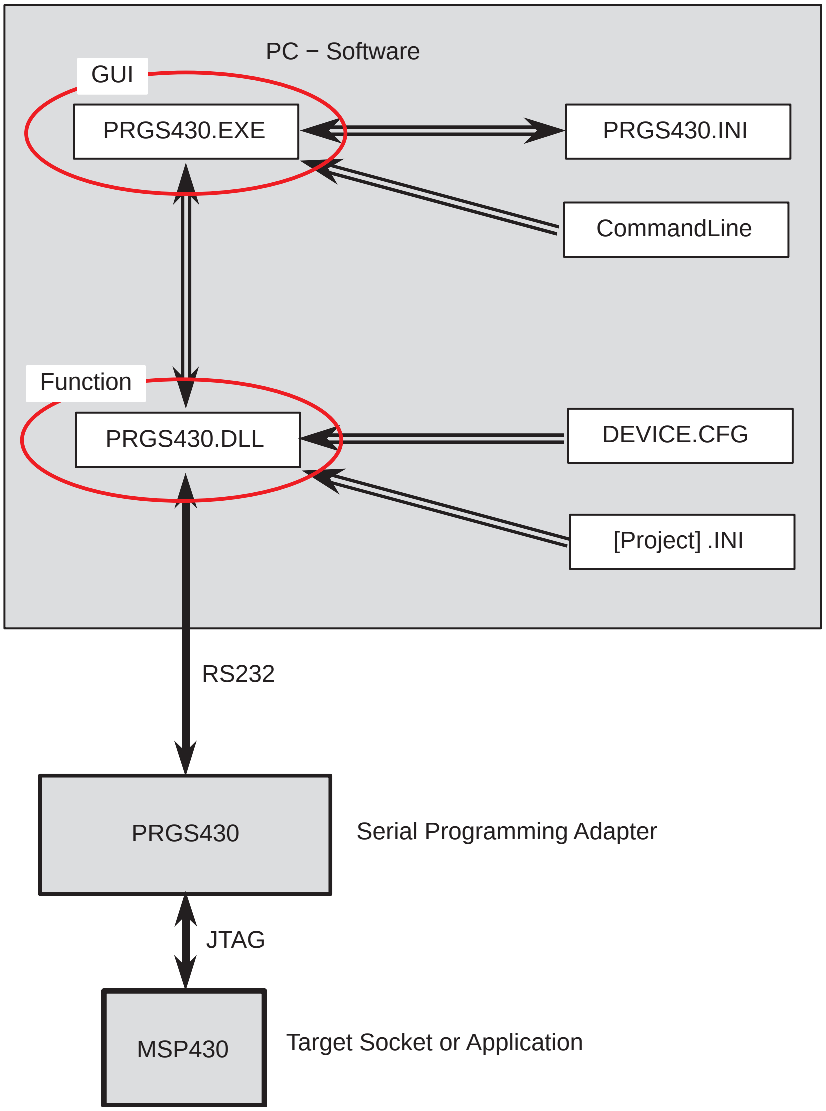
Chapter 2

Operation

This chapter describes the programming procedure for MSP430 devices and the error messages you may encounter during the procedure.

Topic **Page**

2.1 Software/Hardware Layers of the PRGS430 Environment



There are three ways to handle and communicate with the PRGS430 hardware:

- Using the graphical user interface (see Section 2.2)
- Using command line parameters (see Section 2.3)
- Using the PRGS430.dll (see Section 2.4)
  Note: this is the fastest way if the PRGS430 should be used in an in-system program and test environment.

2.2 Programming MSP430 Devices With the GUI

2.2.1 Basic Procedure

The following steps should be used to program the MSP430 devices:

1) Click on the Program Device icon during the installation-selected program group (default: ADT430). The MSP430 programmer dialog box appears.

   The status line at the bottom of the window shows the actual or the most recent activity (see Figure 2−1).

   The status line displays the message *Connecting to adapter...* until the programming adapter is detected and the baud rate is set.

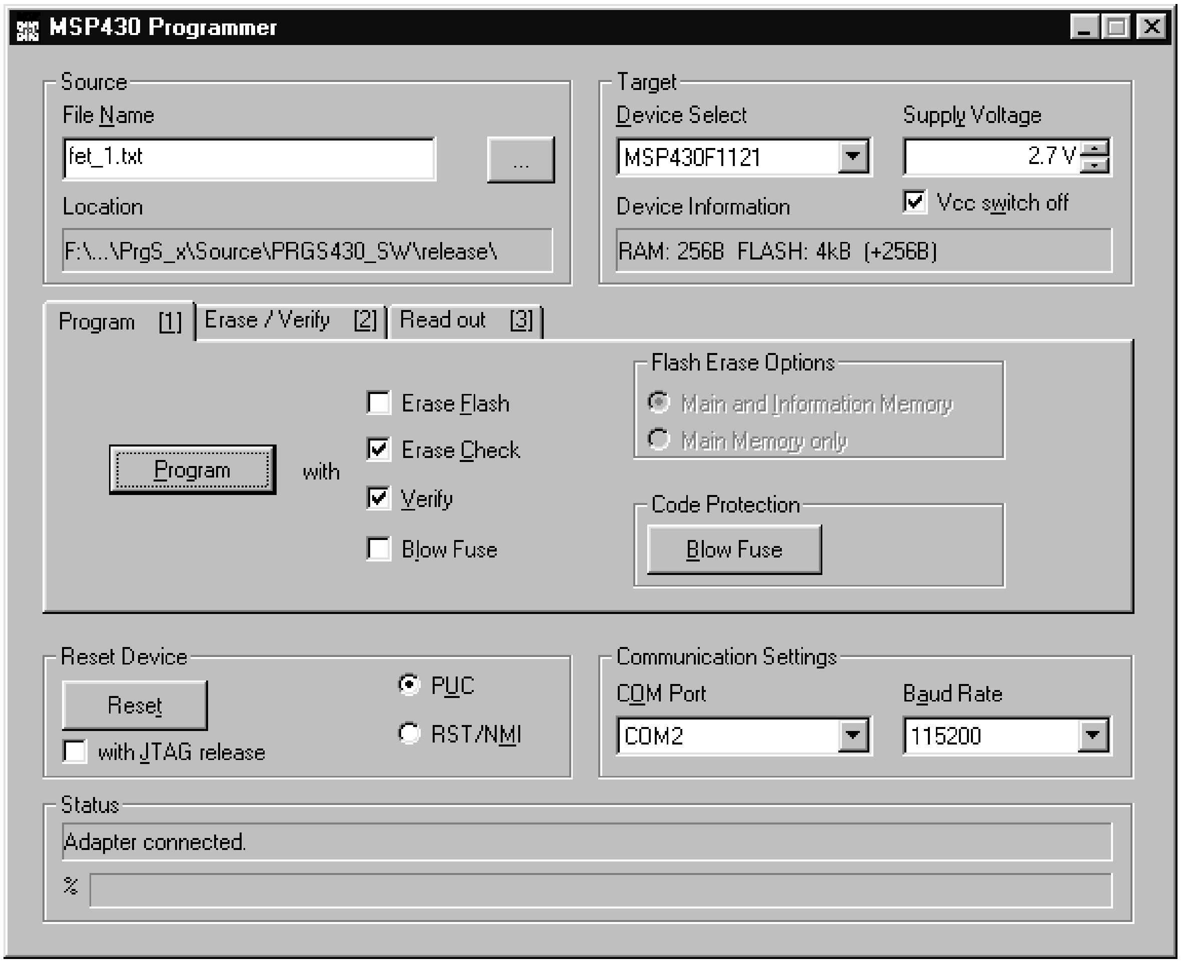
2) Select the correct device and supply voltage.

3) Select the name of the object file (TI-TXT (.txt) or Intel-hex (.a43) format).

4) Select the additional options to program, if necessary using Erase Flash, Erase Check, or Verify (see Note 1 at the end of Table 2−1).

5) Click on the *Program* button to start programming.
   The status line at the bottom of the window shows the actual or most recent activity (see Figure 2−1).

Figure 2−1. MSP430 Programmer Dialog Box



MSP430 Programmer

Source

File Name: fet_1.txt

Location: F:\...\PrgS_x\Source\PRGS430_SW\release\

Target

Device Select: MSP430F1121

Supply Voltage: 2.7 V

☑ Vcc switch off

Device Information: RAM: 256B FLASH: 4kB (+256B)

□ Erase Flash

☑ Erase Check

☑ Verify

□ Blow Fuse

Flash Erase Options

● Main and Information Memory

○ Main Memory only

Reset Device

● PUC

○ RST/NMI

□ with JTAG release

Communication Settings

COM Port: COM2

Baud Rate: 115200

Status

Adapter connected.

%

2.2.2 Description of the MSP-PRGS430 GUI

An MSP430 device is commonly programmed as follows:

1) Select the file that contains the data to program from the MSP430 programmer dialog box (see Figure 2−1).
2) Select the device. An error message appears on the screen if the device selected is different or not connected.
3) Set the required supply voltage, communication port COMx, and baud rate. The device configuration and memory type are selected automatically according to the selected device.
4) Use the program button to start the programming operation (see Note 1 at the end of Table 2−1).

Table 2−1 describes the function of the buttons for different options and combinations for the MSP430 programmer dialog box.

Table 2−1. MSP430 Function Buttons and Descriptions

Button Name	Sub-Functions	Description
File Name		Selects the name of the file to program (Intel-hex or TI-TXT format)
Device Select		Selects the MSP430 device type to program via pulldown menu
Supply Voltage		Selects the supply voltage for the MSP430
	V_{CC} switch off	If selected (default), the supply voltage is switched off after each MSP430 access; otherwise, the supply voltage remains connected.
Program		An object code is programmed to the on-chip memory using the select options.
	With Erase Flash	Memory is erased before programming (only with flash devices). The following options are possible: − Main and information memory − Main memory only
	With Erase Check	Erase check is performed before programming operation is executed.
	With Verify	Each section is verified after it is programmed, or an error message is displayed if verification fails.
	With Blow Fuse	The code-protection fuse is blown after the entire object code, with verify, is programmed. This action is irreversible and disables future on-chip memory access (reading or programming). This step is not performed if verify is disabled or verify fails. A warning is displayed.
Erase Flash		Erase operation can be done only with flash devices, according to the selected option.
	By file	Only the memory locations corresponding to the selected object file are erased. All other memory locations keep their old data (*smart erase*).
	By device	The entire flash memory of the device is erased.
	By range	An erase is performed depending on the values entered in the range fields.
Erase Check		Checks if memory locations are erased.
	By file	Checks only the memory locations used by the selected object file.
	By device	Checks the entire programmable memory of the device. (No RAM is checked.)
	By range	An erase check is performed according to the range of memory locations in the range for Erase Check/Readout field.

Table 2−1. MSP430 Function Buttons and Descriptions (Continued)

Button Name	Sub-Functions	Description
Verify		Verify the data in the MSP430 device according to the selected option.
	By file	A verification of the memory locations vs the selected object file is performed. (By file and by device are the same functions.)
	By device	
	By range	Verify memory locations defined in the *range field* vs the data in the selected file. The defined range should not contain memory locations outside the data stored in the selected file, otherwise an error is reported.
Blow Fuse		The on-chip security fuse is irreversibly disabled and any access, such as reading or programming of the MSP430, is impossible via JTAG. Access via bootstrap loader interface is possible for devices that support that interface.
Read Out		Read out data from MSP430 device. When this function is executed, a dialog box appears; the file name for the data to store should be selected.
	By device	Read out the entire memory of the device and store the data into the file selected in the file name field.
	By range	Read out the memory locations selected by the *range field* and store the data in the file selected in the file name field.
Reset		The reset of a MSP430 can be performed in two ways. After reset, the MSP430 may remain under JTAG control or can be released to operate normally and execute the program.
	PUC	A software reset of the chip is generated.
	RST/NMI	Generates a hardware reset by applying a low pulse on RST/NMI pin.
	With JTAG-release	JTAG is released after the execution of the reset (via JTAG or RST/NMI).
COM Port		Selects the COM port to which the programming adapter is connected
Baud Rate		Selects the baud rate for communication with the programming adapter hardware
Help		Help is available for programming MSP430 devices, command buttons, selectors, and the object file format used. The Help menu can be found in the system menu of the serial programming adapter software (right click on the symbol at the upper-left corner of the program window) or with the F1 function key.

Note 1: For some MSP430 family members, e.g., MSP430F2xxx devices, portions of flash information memory are factory preprogrammed with calibration data. Depending on which method is used for erasing the flash memory, this calibration data may be erased. Should the calibration data be conserved, it must be read out prior to the information memory erase or a flash erase method that does not affect the calibration data memory locations must be used. See the respective device data sheet for further information on preprogrammed calibration data memory locations.

If it should be saved, the following erase options must not be used as the Info memory will be entirely erased:

− Program with Erase Flash (flash-erase options: Main and Info Memory)

or

− Erase Flash by Device

Instead, Erase Flash by File or by Range should be used.

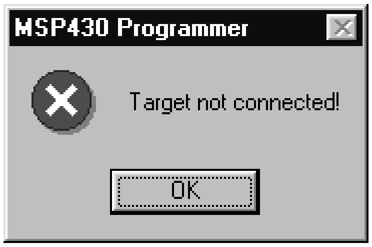
2.2.3 Error Messages

One of the following messages may show up if JTAG communication is not established correctly:

If the MSP430 device to program can not be found, the message shown in Figure 2−2 appears. This problem can be caused by the PRGS430 not being connected to the hardware, the device not inserted or incorrectly inserted into the socket, or the device not powered.

The problem could be that the PRGS430 is not connected to the hardware, the device is not inserted or is incorrectly inserted into the socket, or the device is not powered.

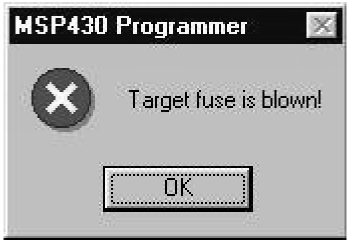
Figure 2−2. Communication Error Box



Target not connected!

If the fuse is already blown, the error message shown in Figure 2−3 appears.

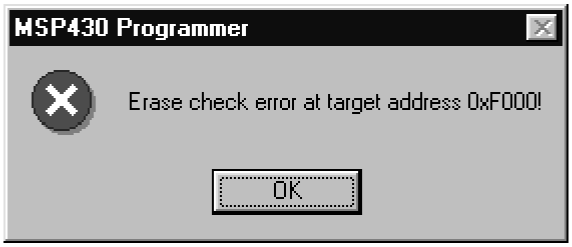
Figure 2−3. Communication Error Box for Blown Fuse



Target fuse is blown!

Additional message boxes appear for general error messages, such as erase check (see Figure 2−4).

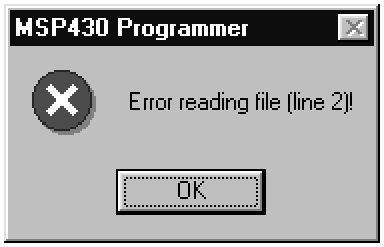
Figure 2−4. Erase Check Error Message



Erase check error at target address 0xF000!

When a read error is detected in the input file, such as a format error, the following message is displayed (see Figure 2−5).

Figure 2−5. Data Error



MSP430 Programmer

Error reading file (line 2)!

Table 2−2. Error Messages

Error Type	Error Message
Communication	Communication failed!
Communication	Adapter not connected!
Communication	Synchronization with adapter failed!
Communication	The present adapter is not an MSP-PRGS430!
Communication	Missing setting of V_{CC}!
MSP430	Target not connected!
MSP430	Wrong JTAG version!
MSP430	PUC failed!
MSP430	Wrong target!
MSP430	Target fuse is blown!
MSP430	Blown fuse failed!
MSP430	Supply voltage to low!
MSP430	Fuse not released for this device!
Setting	Unknown target!
Setting	No target selected!
Setting	Wrong V_{CC} selected!
Setting	Wrong baud rate!
Setting	Communication port error!
Setting	The selected range is invalid!
Setting	Wrong argument!
Setting	Error at target address (during erase check or verify)
Setting	Unknown command line option
Setting	Command line option out of valid range
System	DEVICE.CFG corrupted
System	General error!
System	File type could not be detected!
System	Unexpected end of file!
System	PROJECT.INI corrupted!
System	Filename mismatch
System	Error in DEVICE.CFG
Windows	Error during file I/O

2.2.4 Content of PRGS430.ini File

The last settings of the PRGS430 graphical user interface (GUI) are stored in the .ini file before exiting the program. This information is stored under the *Program Device System* section.

Additionally, the following parameters are in the [Options] section and may be modified:

[Options]

\BlowFuse = 1 → The blow fuse button in the GUI is disabled to prevent accidental blow of the irreversible fuse.

LastResult = 0 → If the program is called with command-line parameter, the error code which is returned to the system when exiting the program is also stored here.

2.2.5 Use of a [Project].ini File

Some default options could be changed within a [Project].ini file. This file has to be in the same directory as the object code file. The following variables could be defined or redefined there.

The name of the file should have the same name as the object file with the extension .ini.

```
[ProgramDevice]
UserMemProtect = Start, Size
UserMemProtect2 = Start, Size
UserMemProtect3 = Start, Size
UserMemProtectn = Start, Size
DisableTIMemProtect = 0
```

Memory ranges defined in the UserMemProtect and UserMemProtect [n] option are read out and reprogrammed after erase (flash device only). [n] could be a number ≥2 and be in ascending order.

If a memory protection is activated in the device definition file from Texas Instruments, it could be switched off with the DisableTIMemProtect = 1 option.

2.3 Command Line Options

2.3.1 General Definitions

0: Off 1: First selectable option
1: On 2: Second selectable option
3: Third selectable option

The PRGS430.ini file options are used if they are not specified in the command line. The command line option overwrites the .ini file options.

The program exits automatically if a command is passed via the command line and the command was executed. There is only a small status window opened during the execution.

Only one command identifier (/cmd:) is allowed within the command line. Otherwise, the execution is canceled and an error is returned.

If an error in the command line parameter is detected, the program exits with an error message.

The *filename* may also contain a path. If special characters are used, the string has to be inside quotes (for example, \\server\adt430\PRG files\test.txt).
If an error is detected within the *filename*, the operation is canceled and an error is returned.

Table 2−3. Command Line Options

Commands:	
/cmd:PRG	*Program* command
/cmd:VFY	*Verify* command
/cmd:ERS	*Erase* command
/cmd:CHK	*Erase check* command
/cmd:READ	*Read out* command
/cmd:RST	*Reset* command
/cmd:BLOW	*Blow fuse* command
Options:	
/COM:x	Specifies the serial port: /COM:1, /COM:2, /COM:3, or /COM:4
/BR:xxxxxx	Sets baud rate to be used: 9600/19200/38400/57600/115200, e.g., /BR:57600
/Dev:	Selects the device according to the name in the device.cfg file, e.g., /Dev:MSP430F1121
/SVolt:x.x	Selects supply voltage MSP_VCC of the programming adapter. The voltage is supplied between GND and MSP VCC, e.g., /Svolt: 3.0.
/SVoff:{0,1}	Switches off supply voltage MSP_VCC after execution 0: Disable (do not switch off) 1: Enable (switch off)
filename	Specifies name of the object file to be programmed or verified
/FILE filename	(Second way to define the filename − space separated)

Table 2−3. Command Line Options (Continued)

Options for Program Command:	
/PE:{0,1,2}	Option program with erase (flash only) 0: Without erase 1: Main and Info memory 2: Main memory only
/PC:{0,1}	Option program with erase check 0: Disable 1: Enable
/PV:{0,1}	Option program with verify 0: Disable 1: Enable
/PB:{0,1}	Option program with blow fuse (only valid with verify successful) 0: Disable 1: Enable
Options for Erase/Erase Check and Verify Command	
/E:{1,2,..}	Option erase/erasecheck/verify by file/device/range 1: File 2: Device 3: Range
/ERange:0xXXX, 0xYYYY	Option erase/erasecheck/verify range (start: 0xXXXX, length: 0xYYYY)
Options for Read Out Command:	
/RO:{1,2}	Option read out by device/range 1: Device 2: Range
/RRange:0xXXXX, 0xYYYY	Option read out range (start: 0xXXXX, length: 0xYYYY)
/Rfile:filename,{1,2}	Specifies read out file name 1: TI-TXT 2: Intel-hex (Default directory should be the last object file directory)
Log Options:	
/Log:filename	Specifies Log file name (Default directory should be the PRGS430.exe directory)
/ALog:{0,1}	Option accumulative Log file 0: Disable 1: Enable

Example:

```
PRGS430.exe ”C:\adt430\test\test.txt” /Dev:MSP430F1121
/cmd:PRG /PE:1 /PC:0 /PV:1 /COM:2
```

This command programs the file test.txt, located in the directory C:adt430\test, into a MSP430F149 device. The device is erased before programming. The erase check is disabled. The code is verified after programming. The programming adapter is connected to ComPort 2. The baud rate is not passed with the command line, so the setting in the *PRGS430.ini* file is used.

2.3.2 Return Values/Error Codes in .ini File

The error code is returned to the PC operating system and also is stored in PRGS430.ini.

File in the [Options] section:

LastResult=0

0	Ok
2	Communication failed!
3	Target not connected!
4	Adapter not connected!
5	Wrong JTAG version!
6	PUC failed!
7	Synchronization with adapter failed!
8	The present adapter is not an MSP−PRGS430!
9	Unknown target!
10	Wrong target!
11	No target selected!
12	Target fuse is blown!
13	Blow fuse failed!
14	Missing setting of V_{CC}!
15	Wrong V_{CC} selected!
16	Wrong baudrate!
17	Communication port error!
18	DEVICE.CFG corrupted!
19	General error!
20	The selected range is invalid!
21	Wrong argument!
22	Error during file I/O
23	File type could not be detected!
24	Unexpected end of file!
25	PROJECT.INI corrupted!
26	Vcc voltage too low for selected function!
27	Fuse not release for this device!
101	Error at target address (during erase check or verify)
102	Unknown command line option
103	Command line option out of valid range
104	Filename mismatch
105	Error in device.cfg

2.4 PRGS430.DLL—Description

The PRGS430.dll is used to communicate with the MSP−PRGS430 hardware and the connected MSP430 device.

The initialization of the PRGS430 should be done with the following sequence:

InitCom
SetDeviceType
SetV$_{CC}$
. InitTarget
. ...
. ReleaseTarget
ReleaseCom

Several examples showing how the DLL could be used are located in the “DLL_Usage_Examples” subdirectory of the PRGS430 system.

This dll could be used separately using the following conventions:

/FN0001/ InitCom

long int InitCom(char* lpszComPort, long int lBaudRate)

InitCom initializes (opens) the given communications port, establishes communication with the PRGS430 hardware, and sets the baud rate of the MSP−PRGS430. If successful, the MSP−PRGS430 is reset and V$_{CC}$ is set to 0.0 V (the voltage should be set after the first user action to validate the correct value).

lBaudRate: valid baud rates are: 9600, 19200, 38400, 56800, and 115200 baud. The default baud rate after installation is 115200 baud.

lpszComPort: the name of the communication port—COM1, COM2, COM3, or COM4.

Example: `lFuncReturn =` InitCom(”COM1” 115200)

/FN0002/ ReleaseCom

long int ReleaseCom (void)

This new function is the counterpart to InitCom. It allows to close a communication with the MSP-PRGS430 hardware.

V$_{CC}$ is set to 0 and all outputs are set to the Hi-Z state.

Example: `IFuncReturn = ReleaseComm()`

/FN0003/ SetDeviceType

Example:
`lFuncReturn = SetDeviceType(char* lpszDeviceName)`

Selects the device type.

lpszDeviceName: name of the device in file device.cfg

Example: `lFuncReturn = SetDeviceType(”MSP430F1121”)`

/FN0004/ InitTarget

long int InitTarget(char* lpszDeviceName)

Initializes the JTAG access to the target device, detects the device type, and reports when the detected device does not match the parameter DeviceName passed.

lpszDeviceName: name of the device in file device.cfg

Example: `lFuncReturn = InitTarget (”MSP430F1121”)`

/FN0005/ ReleaseTarget

long int ReleaseTarget(void)

This function performs a PUC and releases the JTAG access to the target device. All JTAG signals from the serial programming adapter are switched to Hi-Z. The device starts program execution if it is still connected to V_{CC}.

Example: `lFuncReturn = ReleaseTarget()`

/FN0006/ Erase

long int Erase(long int wStart, long int wLength, long int Flags)

This function erases flash memory (if available). The protection of areas can be disabled by setting the DISABLE_TI_MEM_PROTECT−Bit in Flags.

wStart: start address of the area to be erased. Allowed values : 0x0000−0xFFFE (see memory map of the corresponding device)

wLength: length of the area. Allowed values : 0x0000−0xFFFE (see the memory map of the corresponding device)

If erasing information and main memory segments, first erase the information memory segments, then erase the main memory segments.

The mass erase sequence then would be:

Erase(InfoStart,InfoLength,0);
Erase(MainStart,MainLength,0);

The function invokes a mass erase for information or main memory if the start address and the complete memory range of the information or main memory is specified. If the range specified is not complete for that device, a segment erase of the individual segments is performed.

Flags

DISABLE_TI_MEM_PROTECT (0x01)

If this bit is set, the memory protection settings in device.cfg are ignored.

Example:

```
lFuncReturn = Erase(long:0xF000, long:0x1000, long:1)
```

Note: For some MSP430 family members, e.g., MSP430F2xxx devices, portions of flash information memory are factory preprogrammed with calibration data. Depending on which method is used for erasing the flash memory, this calibration data may be erased. Should the calibration data be conserved, it must be read out prior to the information memory erase or a flash erase method that does not affect the calibration data memory locations must be used. See the respective device data sheet for further information on preprogrammed calibration data memory locations.

/FN0007/ EraseFile

long int EraseFile(char* lpszFileName, long int iFileType, long int Flags, char* lpszProjectIni)

EraseFile() erases all addresses used in the specified file.

iFileType:

FILETYPE_AUTO	(0x00) − Autodetection of file type (Intel-hex or TI-TXT)
FILETYPE_TI_TXT	(0x01) − File type is TI-TXT
FILETYPE_INTEL_HEX	(0x02) − File type is Intel-hex

Flags:

DISABLE_TI_MEM_PROTECT (0x01)

If this bit is set, the memory protection setting device.cfg is ignored.

lpszProjectIni: name of the {project}.ini file, if protection settings from this file shall be used. If there is no protection, replace lpszProjectIni with NULL.

Example:

```
lFuncReturn = EraseFile(”text.txt”, long:0, long:0,
NULL)
```

Note: For some MSP430 family members, e.g. MSP430F2xxx devices, portions of flash information memory are factory preprogrammed with calibration data. Depending on which method is used for erasing the flash memory, this calibration data may be erased. Should the calibration data be conserved, it must be read out prior to the information memory erase or a flash erase method that does not affect the calibration data memory locations must be used. See the respective device data sheet for further information on preprogrammed calibration data memory locations.

/FN0008/ EraseCheck

long int EraseCheck(long int wStart, long int wLength)

Performs an erase check of an area of the target memory

wStart: Start address of the memory area. Allowed values : 0x0000−0xFFFE (see memory map of the corresponding device).

wLength: Size of the area. Allowed values : 0x0000−0xFFFE (see memory map of the corresponding device)

The function EraseCheck() simply uses PatternCheck(), with 0xFFFF as pattern.

```
EraseCheck(long int wStart, long int wLength)
{
return PatternCheck(wStart, wLength, 0xFFFF);
}
```

Example:

```
lFuncReturn = EraseCheck(long:0xF000, long:0x1000)
```

/FN0009/ EraseCheckFile

long int EraseCheckFile(char* lpszFileName, long int iFileType)

This function checks if all memory addresses, which are in the file, are erased.

lpszFilName: Name of the file

iFileType:

FILETYPE_AUTO	(0x00) − autodetection of file type (Intel-hex or TI-TXT)
FILETYPE_TI_TXT	(0x01) − file type is TI-TXT
FILETYPE_INTEL_HEX	(0x02) − file type is Intel-hex

Function returns success or first address with mismatching data.

Example:

```
lFuncReturn = EraseCheckFile(”test.txt”, long:0)
```

/FN00010/ PatternCheck

long int PatternCheck(long int wStart, long int wLength, long int wPattern)

Checks a memory range with word pattern passed

wStart: Start address of the memory area. Allowed values : 0x0000−0xFFFE (see memory map of the corresponding device)

wLength: Size of the area. Allowed values : 0x0000−0xFFFE (see memory map of the corresponding device)

wPattern: Word pattern for check

Function returns success or first address with mismatching data.

Example: `lFuncReturn = PatternCheck(long:0xF000, long:0x1000, long:0xFFFF)`

/FN00011/ VerifyData

long int VerifyData(long int wStart, long int wLength, void* lpData)

This function verifies the content of the device with the data stored at passed pointer to data.

wStart: Start address of memory area. Allowed values : 0x0000−0xFFFE (see memory map of the corresponding device)

wLength: Length of the memory area to be checked. Allowed values : 0x0000−0xFFFE (see memory map of the corresponding device)

lpData: Pointer to buffer with data bytes in it

Function returns success or first address with mismatching data.

Example:
lFuncReturn = VerifyData(long:0xF000, long:0x1000, void* lpData)

/FN00012/ VerifyFile

long int VerifyFile(char* lpszFileName, long int iFileType)

This function checks if the memory contents of the target device are equal to the file contents.

lpszFileName: Name of the file

iFileType

FILETYPE_AUTO	(0x00) − autodetection of file type (Intel-hex or TI-TXT)
FILETYPE_TI_TXT	(0x01) − file type is TI-TXT
FILETYPE_INTEL_HEX	(0x02) − file type is Intel-hex

Function returns success or first address with mismatching data.

Example: `lFuncReturn = VerifyFile(”test.txt”, long:0)`

/FN00013/ VerifyFileRange

long int VerifyFileRange(char* lpszFileName, long int iFileType, long int wStart, long int wLength)

This function evaluates if the memory contents of the target device are equal to the file contents in a passed range.

lpszFileName: Name of the file

iFileType:

FILETYPE_AUTO	(0x00) − autodetection of file type (Intel-hex or TI-TXT)
FILETYPE_TI_TXT	(0x01) − file type is TI-TXT
FILETYPE_INTEL_HEX	(0x02) − file type is Intel-hex

wStart: Start address of memory area. Allowed values : 0x0000−0xFFFE (see memory map of the corresponding device)

wLength: Length of the memory area to be checked. Allowed values : 0x0000−0xFFFE (see memory map of the corresponding device)

Function returns success or first address with mismatching data.

Example: `lFuncReturn = VerifyFileRange(”test.txt”, long:0`, long:0xF000, long:0x1000)

/FN0014/ ProgramData

long int ProgramData(long int wStart, long int wLength, void* lpData

This function writes data into an MSP430 device. Protection of ranges of memory locations defined in the DEVICE.CFG file can be disabled by setting the DISABLE_TI_MEM_PROTECT−Bit in Flags.

wStart: Start address of the range that is to be erased. Allowed values : 0x0000−0xFFFE (see memory map of the corresponding device)

wLength: Length of the range

Allowed values : 0x0000−0xFFFE (see memory map of the corresponding device)

lpData: Pointer to the Data to be programmed

Flags: The bits in Flags control the operation of ProgramData().

Example: `lFuncReturn = ProgramData(long:0xF000, long:0x1000, void* lpData`)

/FN0015/ ProgramFile

long int ProgramFile(char* lpszFileName, long int iFileType,

long int iFlags, char* lpszProjectIni)

This function writes data from the file to the MSP430 device. The protection of ranges of memory locations defined in the DEVICE.CFG file can be disabled by setting the DISABLE_TI_MEM_PROTECT−Bit in Flags.

If the PGM_WITH_ERASE option are not selected the program data is preserved. This means that the data is read from the flash and replaced with the new data. All other information is restored automatically. The handling of the information memory works with the same mechanism.

For the fastest programming speed, select the PGM_WITH_ERASE and PGM_ERASE_INFO options.

lpszFileName: Name of the file to be written into the target

iFileType:

FILETYPE_AUTO	(0x00) − autodetection of file type (Intel-hex or TI-TXT)
FILETYPE_TI_TXT	(0x01) − file type is TI-TXT
FILETYPE_INTEL_HEX	(0x02) − file type is Intel-hex

iFlags:

DISABLE_TI_MEMPROTECT	(0x01)
PGM_WITH_ERASE	(0x02) // Erases the main memory before programming
PGM_ERASE_INFO	(0x04) // Erases the info memory before programming
PGM_WITH_ERASECHECK	(0x08) // Erase check by device and the programs the device
PGM_WITH_Verify	(0x10) // Read out device, merge with file to be programmed, and write back to device

Note: Use PGM_ERASE_INFO only together with the PGM_WITH_ERASE flag.

lpszProjectIni

Name of the {project}.ini file, if protection settings from this file are used. If no protection is required, replace lpszProjectIni with NULL.

The added features do not need to be used—for ProgramFile according to older specification, just call ProgramFile(FileName, FileType, 0, NULL); if no {project}.ini file or erase check is used, just call:

Example: `lFuncReturn =` ProgramFile(FileName, 0, 0, NULL); // with autodetect file type

Note: If an erase or erase-check function reports an error, the function ProgramFile() is aborted before programming is started.

/FN0016/ BlowFuse

long int BlowFuse(void)

This function blows the security fuse of the target device.

Example: `lFuncReturn = BlowFuse(void)`

/FN0017/ SetVcc

long int SetVcc(long int iVoltage)

This function sets the VCC_MSP voltage of the programming adapter to the given value.

iVoltage: V_{CC} in mV. (3000 −> 3 V)

The correct MSP430 device should be selected before using this function.

The voltage range is limited to the voltage range allowed for the selected MSP430 device.

Example: `lFuncReturn = SetVcc(Long:3000)`

/FN0018/ ReadOutData

long int ReadOutData(long int wStart, long int wLength, void* lpBuffer)

Reads out data from the device and writes it to the buffer passed

wStart: Start address of the area to be read out. Allowed values : 0x0000−0xFFFE (see memory map for the corresponding device)

wLength: Length of the area. Allowed values : 0x0000−0xFFFE (see memory map for the corresponding device)

lpBuffer: Pointer points to a buffer that receives the data. The buffer must be large enough to hold the entire data; otherwise, a fatal error of the operating system may occur.

Example: `lFuncReturn = ReadOutData(long:0xF000, long:0x1000, void* lpBuffer)`

/FN0019/ ReadOutFile

long int ReadOutFile(long int wStart, long int wLength, char* lpszFileName, long int iFileType)

Reads out data from the device and writes it to a file

wStart: Start address of the area to be read out. Allowed values : 0x0000−0xFFFE (see memory map of the corresponding device)

wLength: Length of the area. Allowed values : 0x0000−0xFFFE (see memory map of the corresponding device)

lpszFileName: Name of the file to receive data. If the file does not exist, it is created; If the file already exists, it is overwritten.

iFileType:

FILETYPE_TI_TXT	(0x01)	− file type is TI-TXT
FILETYPE_INTEL_HEX	(0x02)	− file type is Intel-hex

Example: `lFuncReturn = ReadOutFile(long:0xF000, long:0x1000, ”test.out”, long:1)`

/FN0020/ Reset

long int Reset(long int Flags)

This function provides the reset functionality for the target.

Flags: Flags is a bitmap and determines the type of reset.

PUC	0x01
RST_NMI	0x02
WITH_RELEASE	0x04

Reset | PUC means that the JTAG sends the command to the MSP430.

Reset | RST_NMI performs a reset via the RST/NMI pin of the MSP430. The JTAG is also reset.

If the WITH_RELEASE option is selected, the device is released from the JTAG access after the reset.

Example: `lFuncReturn = Reset(long:5)`

/FN0022/ SetNotificationWnd

LONG SetNotificationWnd(LONG hWnd, LONG lMessageID)

SetNotificationWnd() enables the status notification of a window. hWnd passes a window handle and lMessageID passes a message identifier. Each time a notification of the status window is necessary, the DLL sends a lMessageID message to the hWnd window. The execution status of an operation is passed in the WParam of this message. Completion status of the current operation is passed (0..100) in the LParam.

The following status codes are defined:

Status	WParam	Current Operation
STATUS_CONNECTSPA	1	Connecting to SPA430
STATUS_CONNECTTARGET	3	Connecting to target
STATUS_RELEASETARGET	5	Releasing target
STATUS_RELEASESPA	7	Releasing SPA430
STATUS_RESETTARGET	9	Resetting target
STATUS_ERASE	11	Erasing target
STATUS_ERASECHECK	13	Erase checking target
STATUS_PATTERNCHECK	15	Pattern checking target
STATUS_VERIFY	17	Verifying target
STATUS_PROGRAM	19	Programming target
STATUS_READOUT	21	Reading target out
STATUS_BLOWFUSE	23	Blowing fuse

/FN0023/ GetDeviceCfgInfo

long int GetDeviceCfgInfo(long int InfoCmd, long int InfoIdx, void* lpBuf)

InfoType:

DEVICE_COUNT (0x01)
GetDeviceCfgInfo returns number of devices in Device.cfg; InfoIdx and lpBuf are ignored.

SELECT_DEVICE (0x02)
Selects the given device for further commands (device number in InfoIndex, first device is number 0; lpBuf is ignored).

DEVICE_NAME (0x03)
Fills the name of the selected device into lpBuf; InfoIdx is ignored.

DEVICE_ID (0x04)
Fills the DeviceID into lpBuf, InfoIdx is ignored.

DEVICE_DEFAULTOPTIONS (0x05)
Fills the default options into lpBuf, InfoIdx is ignored.

DEVICE_MEMDEF_COUNT (0x06)
GetDeviceCfgInfo() returns the number of memory definitions for selected device; lpBuf and InfoIdx are ignored.

DEVICE_MEMDEF (0x07)
Fills the definition of a memory definition (index passed by InfoIdx) into lpBuf.

DEVICE_MEMPROTECT_COUNT(0x08)
GetDeviceCfgInfo() returns the number of memory-protection definitions for the selected device; lpBuf and InfoIdx are ignored.

DEVICE_MEMPROTECT (0x09)
Fills the definition of a memory protection definition (index passed by InfoIdx) into lpBuf.

DEVICE_VCC (0x0A)
GetDeviceCfgInfo() returns the Vcc setting for selected device in mV; lpBuf and InfoIdx are ignored.

DEVICE_VPP (0x0B)
GetDeviceCfgInfo() returns the Vpp setting for selected device in mV; lpBuf and InfoIdx are ignored.

DEVICE_VFUSE (0x0C)
GetDeviceCfgInfo() returns the blow-fuse setting for the selected device; lpBuf and InfoIdx are ignored.

/FN0024/ AccessSFR

long int AccessSFR(LONG wAddr, void *IpData, LONG iFlags);

This function writes or reads data into the special function registers of the MSP430 device. (implemented in PRGS320.dll versions 1.05 and higher).

wAddr: SFR address that should be accessed. Allowed values:
0x0000−0x1FE (see the memory map of the corresponding device)

IpData: Pointer to the data to be written, or buffer which should receive the read data

Flags: The bits in Flags control the operation of AccessSFR()

iFlags:

SFR_READ	(0x00)
SFR_Write	(0x01)

Example: `IFuncReturn = AccessSFR(long:0x0020, &IpData, 0)`

2.4.1 Return Values/Error Codes From PRGS430.DLL

Status	Return Value	Comment
OK	0	
SUCCESS	−1	Operation OK
ERR_COMMUNICATION	−2	Communication error (SSP)
ERR_TARGET_NOT_CONNECTED	−3	No target connected
ERR_SPA430_NOT_CONNECTED	−4	No SPA430 connected
ERR_WRONG_JTAG_VERSION	−5	JTAG version above 3
ERR_PUC_FAILED	−6	PUC did not succeed
ERR_SPA430_SYNC_FAILED	−7	Could not sync SPA430
ERR_NO_SPA430	−8	Adapter is not SPA430
ERR_UNKNOWN_TARGET	−9	Target type unknown
ERR_WRONG_TARGET	−10	Target type does not match
ERR_NO_TARGET_SELECTED	−11	No target selected (missing SetDeviceType() call)
ERR_TARGET_FUSE_BLOWN	−12	No target access because of blown fuse
ERR_BLOW_FUSE_FAILED	−13	Blown-fuse command failed
ERR_VCC_NOT_SET	−14	No V_{CC} selected (missing SetVolt() call)
ERR_WRONG_VCC	−15	V_{CC} out of allowed range
ERR_WRONG_BAUDRATE	−16	Invalid baud rate
ERR_COMPORT	−17	Error accessing the communications port
ERR_DEVICE_CFG	−18	Device.cfg corrupted
ERR_GENERAL	−19	General error (should not occur!)
ERR_RANGE	−20	Wrong range specified
ERR_ARGUMENT	−21	Wrong argument
ERR_FILE_IO	−22	Error during file I/O
ERR_FILE_DETECT	−23	File type could not be detected
ERR_FILE_END	−24	Unexpected end of file
ERR_PROJECT_INI	−25	Error reading {project}.ini
ERR_VCC_BELOW_VCCMINPROG	−26	V_{CC} to low for selected function
ERR_FUSE_NOT_RELEASED	−27	Fuse not release for this device
STATUS_CONNECTSPA	1	Connecting to SPA430
STATUS_CONNECTTARGET	3	Connecting to target
STATUS_RELEASETARGET	5	Releasing target
STATUS_RELEASESPA	7	Releasing SPA430
STATUS_RESETTARGET	9	Resetting target
STATUS_ERASE	11	Erasing target
STATUS_ERASECHECK	13	Erase checking target
STATUS_PATTERNCHECK	15	Pattern checking target
STATUS_VERIFY	17	Verifying target
STATUS_PROGRAM	19	Programming target
STATUS_READOUT	21	Reading out target
STATUS_BLOWFUSE	23	Blowing fuse
ERR_READOUT_LOCKED	−28	Read out prohibited

Chapter 3

Hardware

This chapter describes the hardware for the MSP430 family of microcontrollers, including specifications, components of the programming adapters, and connection of the programming adapter to the MSP430 device families.

Topic **Page**

3.1 Specifications

The specifications for the MSP430 hardware are shown in Table 3−1.

Table 3−1. MSP430 Hardware Specifications

Temperature range	10°C–45°C
Humidity	40%–70%
Power supply	14 V–20 V, 200 mA minimum
Dimensions	150 mm (W) × 30 mm (H) × 95 mm (D)

3.2 Basic Hints

These basic hints are useful for programming MSP430 devices or MSP430 devices on printed-wire boards (PWB).

❑ All V_{CC} pins of an MSP430 device are tied together and connected to the most positive terminal of the supply.

❑ All V_{SS} pins of an MSP430 device are tied together and connected to the most negative terminal of the supply.

❑ The interface should supply the MSP430 with proper conditions according to the device data sheet, in terms of current, voltage levels, and timing conditions.

❑ Make sure the proper signal connections (see Section 3.3) are made.

❑ Short cables to interconnect the interface to the MSP430 device or PWB; less than 20 cm is recommended.

❑ Ensure low-impedance interconnections − especially for the path of the programming and fuse blow voltage.

❑ When a device with a transparent window (MSP430E3xx family) is programmed, the window should be already covered with an opaque label while the device is programmed. Since ambient light contains the correct wavelength for erasure, keep the transparent window covered after the device is programmed.

3.3 Programming Adapter Target Connector Signals

The target connector signals for the programming adapter ensure communication between the programming adapter and MSP430 devices and supply low energy to systems without extra supply sources.

Figure 3−1 and Figure 3−2 show the target connector signals for the programming adapter.

Figure 3−1. 25-Pin Sub-D at Programming Adapter

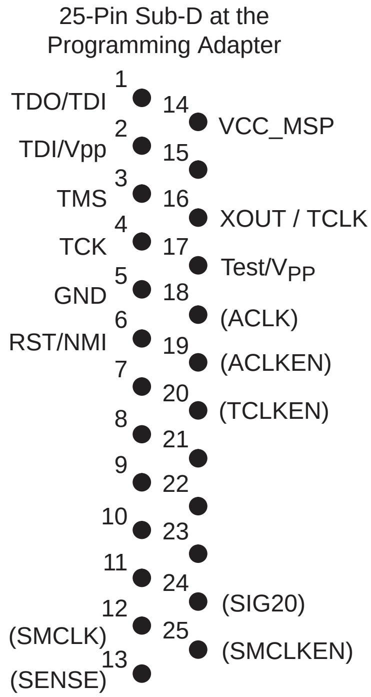


Figure 3−2. 14-Pin Connector at End of Interconnect Cable

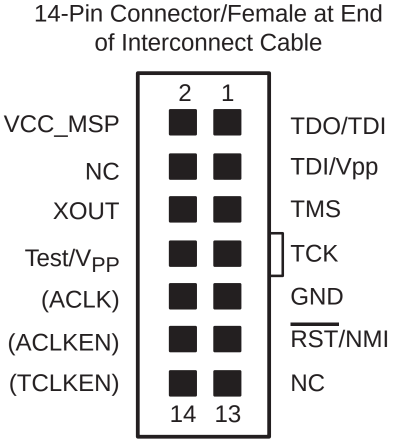


Table 3−2 lists the target connector signals and describes their requirement statuses and functions.

Table 3−2. Target Connector Signal Functions

Signal/Terminal Name	Required	Function/Comment
TMS	Mandatory	Test mode select functions according to IEEE1149.1
TCK	Mandatory	Test clock functions according to IEEE1149.1
TDI/VPP	Mandatory	Test data input functions according to IEEE1149.1, but with additional programming voltage for 3xx devices.
TDO/TDI	Mandatory	Test data output functions according to IEEE1149.1, but additional data input is used when programming voltage is applied by TDI/VPP.
GND	Mandatory	GND is the most-negative terminal.
VCC_MSP	Mandatory (if internal supply voltage is used)	Voltage source is used with MSP430 devices or PWBs. The voltage level is set by software.
XOUT	Mandatory	Signal supplies the MSP430 system with clock signals.
$\overline{\text{RST}}$/NMI	Optional	If not connected, $\overline{\text{RST}}$/NMI must be held high.
Test/VPP	Mandatory (depending on device)	Signal used to select pin or JTAG function or to apply VPP

The output signal levels of the programming adapter are near GND or VCC_MSP.

- The $\overline{\text{RST}}$/NMI terminal of the device must be high; otherwise, the access to the device via JTAG system may fail.

- The programming procedure (handling of the SW) is described in Chapters 1 and 2 of this manual.

- The connections from the MSP430 terminals must follow EMI rules, such as short lines and ground planes. If TMS line receives one negative pulse by EMI strike, the fuse current is activated (with fuse version 1.0). The fuse current flows from TDI(/VPP) pin to GND (or VSS).

Table 3−3. Programming Adapter Signal Levels

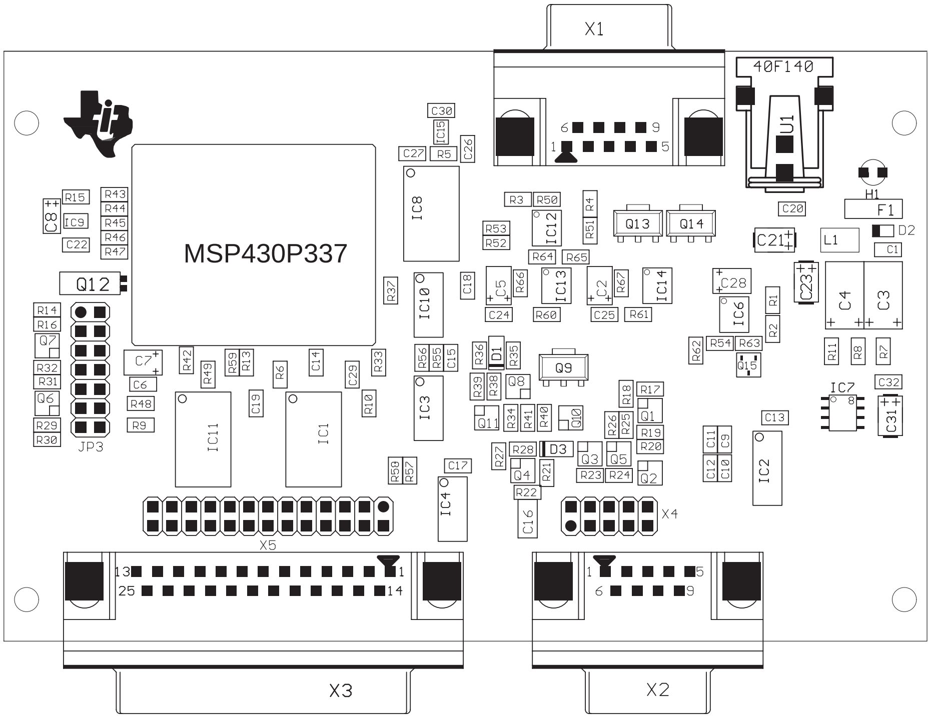
Signal/Pin	Signal/Pin Levels
TMS	VSS or VCC_MSP
TCK	VSS or VCC_MSP
TDI/VPP	VSS or VCC_MSP or VPP
TDO/TDI	VSS or VCC_MSP
XOUT	VSS or VCC_MSP
RST/NMI	VSS or VCC_MSP
Test/VPP	VSS or VCC_MSP or VPP

3.4 MSP-PRGS430 Circuit Diagrams

The MSP-PRGS430 circuit diagrams are found in Appendix B.

3.5 Location of Components − MSP-PRGS430

Figure 3−3. MSP-PRGS430 Components

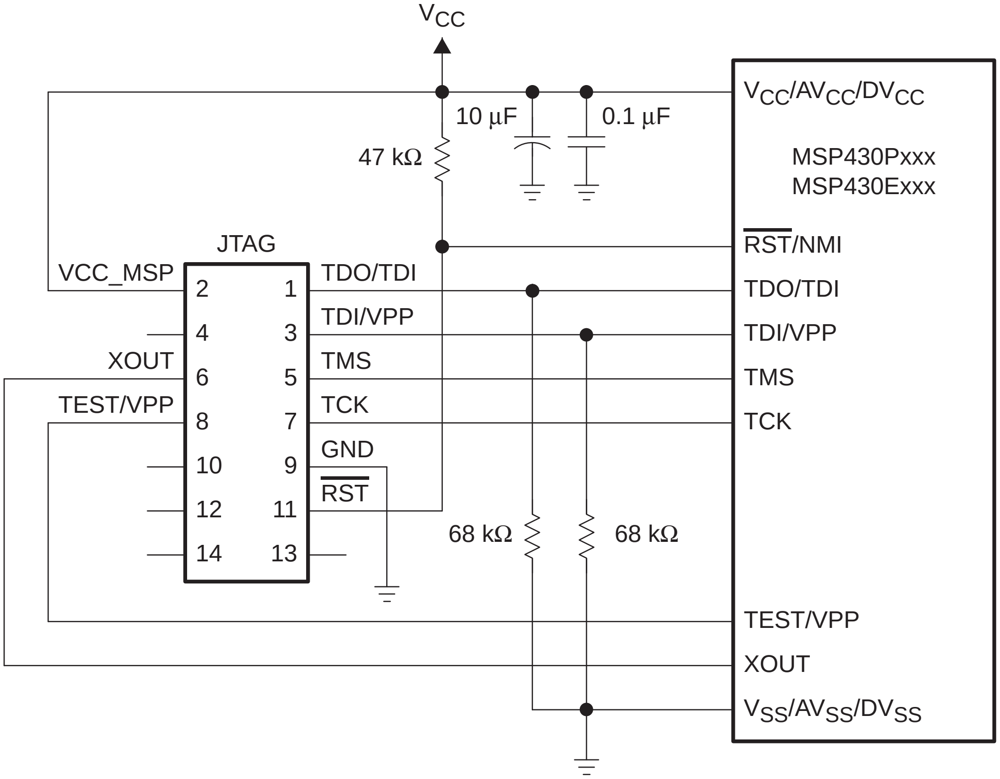


Note: Do not use J2 pin 9 as RST/NMI pullup.

3.6 Interconnection of MSP-PRGS430 to OTP/EPROM-Based MSP430 Devices

The circuit diagram in Figure 3−4 shows the connections required to program OTP (MSP430Pxxx) and EPROM (MSP430Exxx) based MSP430 devices with the MSP-PRGS430 programming adapter. Consult the device data sheet for the specific device location of the supply and JTAG pins. Ensure that all positive and negative supply pins are connected together.

Figure 3−4. MSP−PRGS430 Used to Program OTP/EPROM-Based MSP430 Devices



The $\overline{\text{RST}}$/NMI terminal on the MSP430 device has to be held high by an external resistor during access of the device through JTAG. In a noisy environment, consider using an additional capacitor from $\overline{\text{RST}}$/NMI to VSS.

Note:

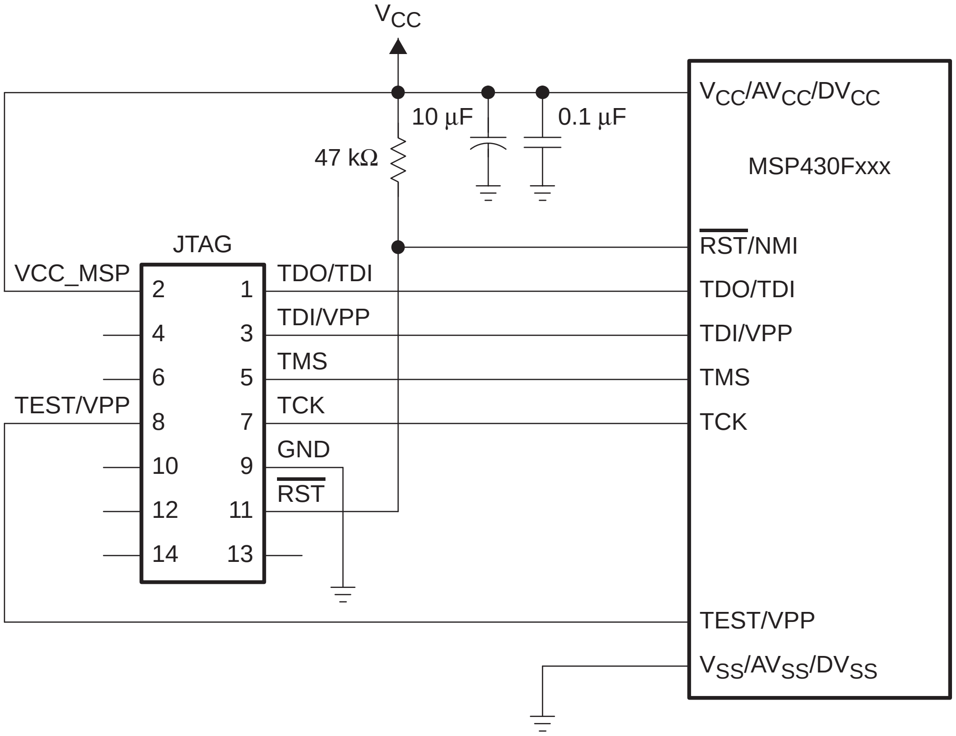
The example schematic shows a system where the target voltage is supplied by the MSP−PRGS430. For in-system programming with an external supply voltage, do not connect pin 2 of the JTAG connector. In this case, the supply voltage setting in the PRGS430 must be adjusted to the external supply voltage level. The TEST/VPP connection is only required on lower pin-count devices with multiplexed JTAG pins.

3.7 Interconnection of MSP−PRGS430 to Flash-Based MSP430 Devices

The circuit diagram in Figure 3−5 shows the connections required to program flash-based MSP430 devices (MSP430Fxxx) with the MSP−PRGS430 programming adapter. Consult the device data sheet for the specific device location of the power supply and JTAG pins. Ensure that all positive and negative power supply pins are connected together.

The signal TEST/VPP is only required on lower pin-count devices with multiplexed JTAG pins. In this case, special attention must be given to the circuit design around the four JTAG pins (TDO/TDI, TDI, TMS, and TCK), since they are shared between the applications hardware and the JTAG interface used by programming adapter.

Figure 3−5. MSP−PRGS430 Used to Program Flash-Based MSP430 Devices



Note:

The example schematic shows a system where the target voltage is supplied by the MSP-PRGS430. For in-system programming with an external supply voltage, do not connect pin 2 of the JTAG connector. In this case, the PRGS430 supply voltage setting must be adjusted to the external supply voltage level. The TEST/VPP connection is only required on lower pin-count devices with multiplexed JTAG pins.

Appendix A

Hex Object Format

This appendix discusses the hex object format.

Topic **Page**

A.1 Intel-Hex Object Format

The Intel-hex object format supports 16-bit addresses and consists of a nine-character (four field) prefix that defines the start of record, byte count, load address, record type, and a two character sumcheck suffix.

The two record types, which are represented in the nine-character prefix, are described below:

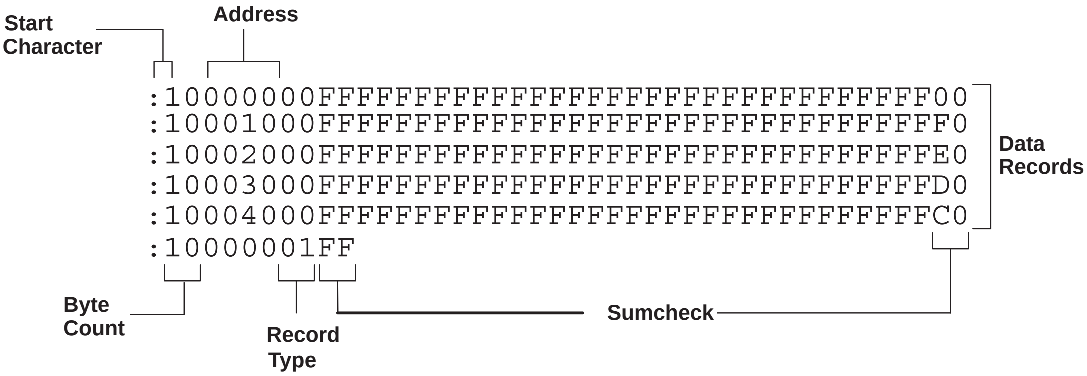
00 = Data record (begins with the colon start character)

01 = End-of-file record

Record type 00, the data record, begins with the colon (:) start character and is followed by the byte count, the address of the first data byte, the record type (00), and the sumcheck. The sumcheck is the 2s complement (in binary) of the preceding bytes in the record, including the byte count, address, and data bytes.

Record type 01, the end-of-file record, also begins with the colon (:) start character. The colon is followed by the byte count, address, record type (01), and sumcheck.

Figure A−1. Intel-Hex Object Format



```
:10000000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF00
:10001000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF0
:10002000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFE0
:10003000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFD0
:10004000FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFC0
:00000001FF
```

A.2 TI-TXT File Format

The TI-TXT file format used by the tool is shown as follows:

```
@ADDR1

DATA01   DATA02   ........  DATA16

DATA17   DATA32   ........  DATA32

              ........

DATAm   ........DATAn

@ADDR2

DATA01   ....................  DATAn

q
```

Whereas:

@ADDR is the start address of a section (hexadecimal)
DATAn represents a data byte (hexadecimal)
q is the termination of the file

For example:

```
@F000

31 40 00 03 B2 40 80 5A 20 01 D2 D3 22 00 D2 E3

21 00 3F 40 E8 FD 1F 83 FE 23 F9 3F

@FFFE

00 F0

Q
```

Restrictions:

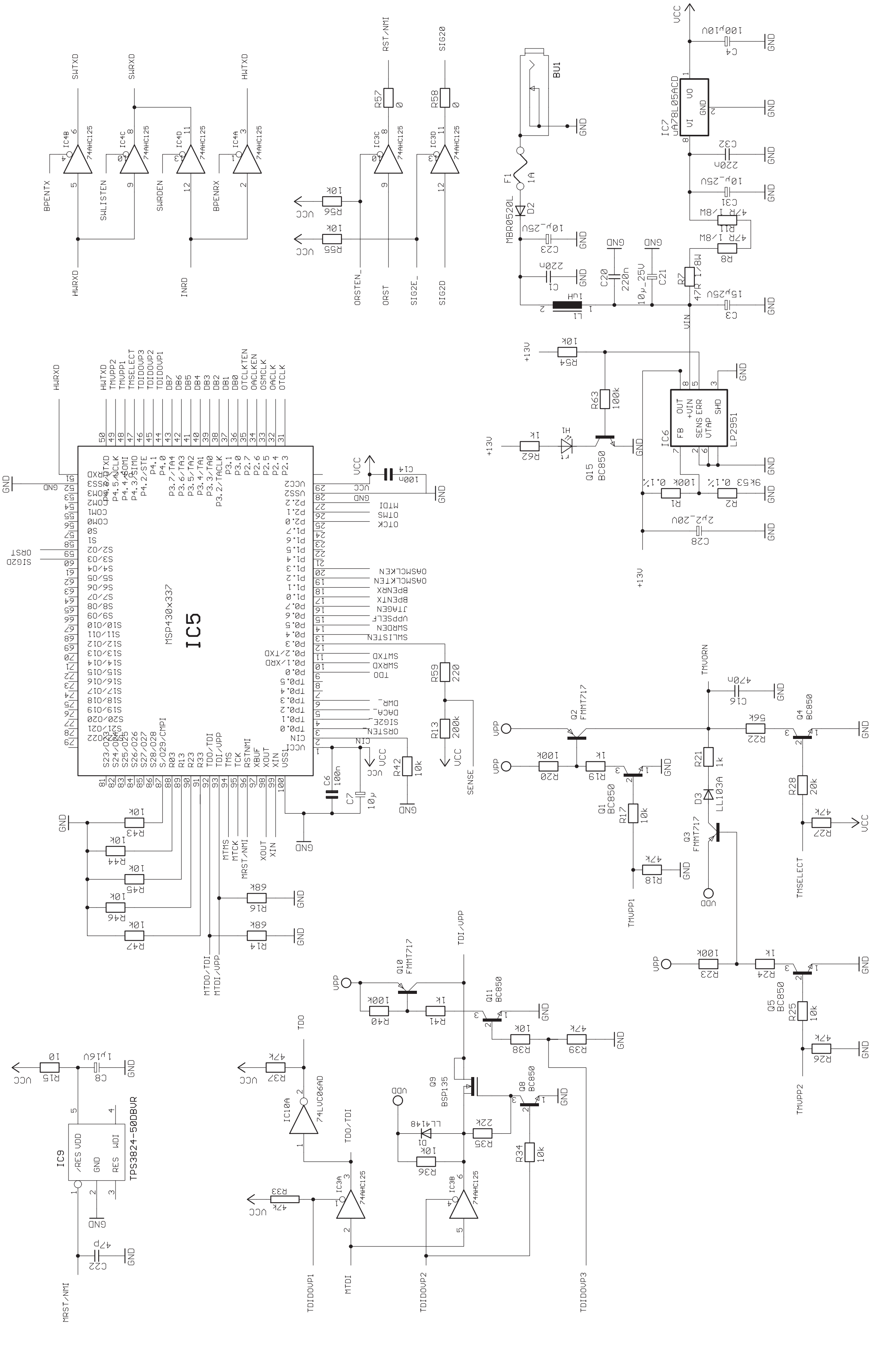
- ❑ The number of sections is unlimited.
- ❑ The start address must be even.
- ❑ Each line must have 16 data bytes, except the last line of a section.
- ❑ Data bytes are separated by a single space.
- ❑ The termination tag q indicates end-of-file is mandatory.

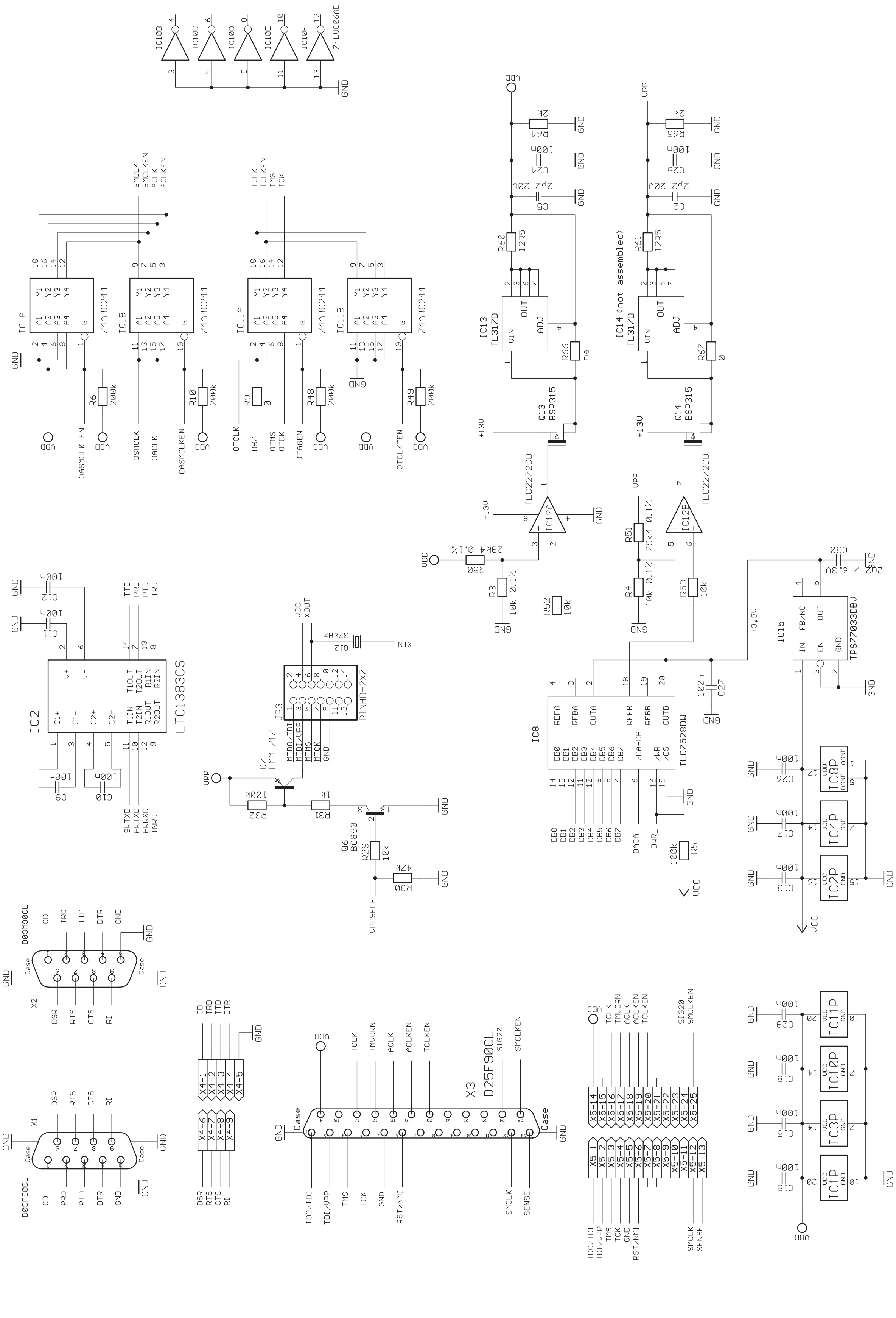
Appendix B

Schematics

This appendix contains the schematic diagrams for the serial programming adapter.

SERIAL PROGRAMMING ADAPTER




IC10B
IC10C
IC10D
IC10E
IC10F
74LVC06AD
GND
IC1A
IC1B
IC11A
IC11B
74AHC244
SMCLK
SMCLKEN
ACLK
ACLKEN
TCLK
TCLKEN
TMS
TCK
R6 200k
R10 200k
R9 0
R48 200k
R49 200k
VDD
OASMCLKTEN
OSMCLK
OACLK
OASMCLKEN
OTCLK
DB7
OTMS
OTCK
JTAGEN
OTCLKTEN
IC13 TL317D
IC14 (not assembled) TL317D
VIN
OUT
ADJ
R64 2k
R65 2k
C24 100n
C25 100n
C5 2µ2_20V
C2 2µ2_20V
R60 12R5
R61 12R5
R66 na
R67 0
Q13 BSP315
Q14 BSP315
+13V
VPP
TLC2272CD
IC12A
IC12B
R50 29k4 0.1%
R3 10k 0.1%
R51 29k4 0.1%
R4 10k 0.1%
R52 10k
R53 10k
C30 2µ2 / 6,3V
IC15
TPS77033DBV
IN
EN
FB/NC
OUT
GND
+3,3V
IC8
TLC7528DW
REFA
RFBA
OUTA
REFB
RFBB
OUTB
DB0
DB1
DB2
DB3
DB4
DB5
DB6
DB7
/DA-DB
/WR
/CS
DACA_
DWR_
C27 100n
R5 100k
VCC
IC2
LTC1383CS
C1+
C1-
C2+
C2-
V+
V-
T1IN
T2IN
R1OUT
R2OUT
T1OUT
T2OUT
R1IN
R2IN
C11 100n
C12 100n
C9 100n
C10 100n
TTD
PRD
PTD
TRD
SWTXD
HWTXD
HWRXD
INRD
JP3
PINHD-2X7
MTDO/TDI
MTDI/VPP
MTMS
MTCK
XOUT
XIN
Q12 32kHz
Q7 FMMT717
Q6 BC850
R32 100k
R31 1k
R29 10k
R30 47k
UPPSELF
X1
D09F90CL
X2
D09M90CL
Case
CD
DSR
RTS
CTS
RI
DTR
X4-1
X4-2
X4-3
X4-4
X4-5
X4-6
X4-7
X4-8
X4-9
X3
D25F90CL
TDO/TDI
TDI/VPP
TMVOORN
SIG20
SENSE
RST/NMI
X5-1
X5-2
X5-3
X5-4
X5-5
X5-6
X5-7
X5-8
X5-9
X5-10
X5-11
X5-12
X5-13
X5-14
X5-15
X5-16
X5-17
X5-18
X5-19
X5-20
X5-21
X5-22
X5-23
X5-24
X5-25
IC1P
IC2P
IC3P
IC4P
IC8P
IC10P
IC11P
C13 100n
C15 100n
C17 100n
C18 100n
C19 100n
C26 100n
C29 100n
AGND
DGND