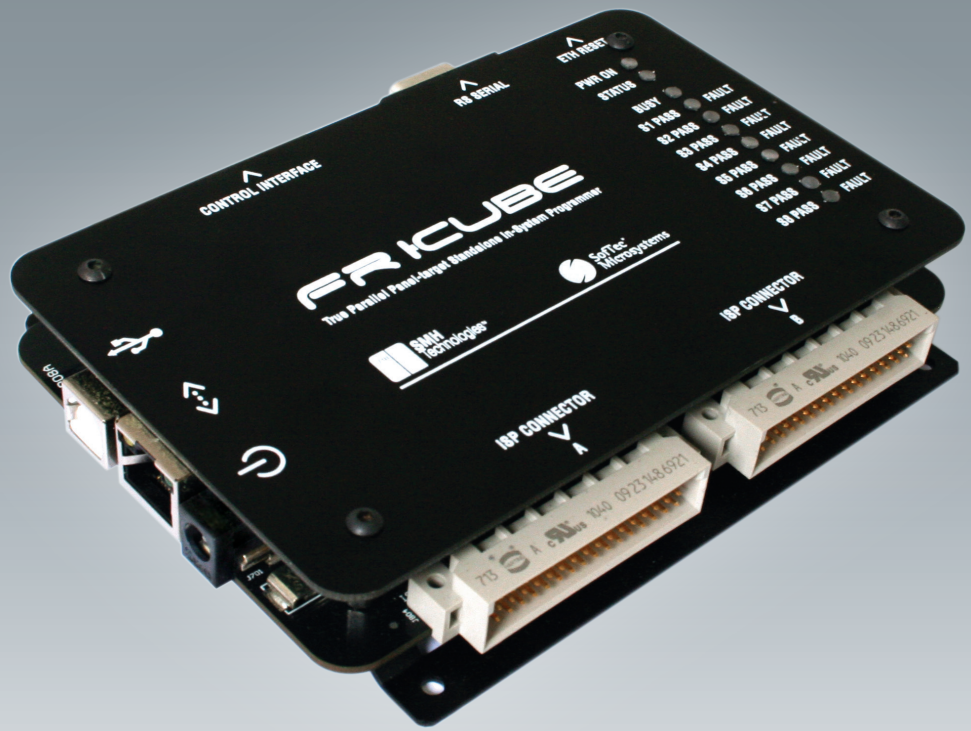
FR ICUBE

True Parallel Panel-target Standalone In-System Programmer

FlashRunner Cube Series

User's Manual



SofTec™ Microsystems

SMH Technologies™

SMH Systein

FR ICUBE

True Parallel Panel-target Standalone In-System Programmer

FlashRunner Cube Series

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Revision. 1.3 - April 2012

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SofTec Microsystems

SMH Technologies

SMH Systein

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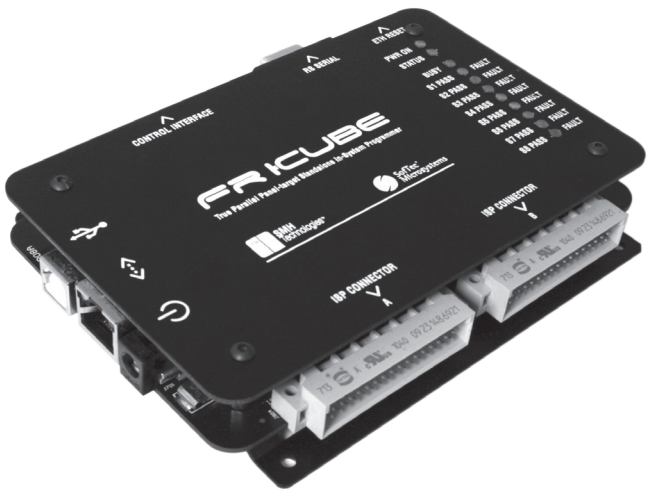
1. FR CUBE-At a Glance

Overview

Congratulations for purchasing a FR CUBE In-System Programmer.
The FR CUBE Series of In-System Programmers are a breakthrough in the Programming industry. The programmers support a large number of devices (microcontrollers, memories, CPLDs and other programmable devices) from various manufacturers and have a compact size for easy ATE/ fixture integration. They work in standalone or connected to a host PC (RS-232, LAN and USB connections are built-in), and are provided with easy-to-use software utilities



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Features

- Support of microcontrollers, serial and parallel memories, CPLDs and other programmable devices
- High-speed, parallel programming
- Compact size (fixture friendly)
- Standalone operations or host controlled
- Designed for easy ATE interfacing
- Robust and reliable
- Support of several programming interfaces (JTAG, BDM, SPI, I^2C, UART, etc.)
- Large built-in internal memory for projects, images, etc.
- Programmable power supply output (1.5-13V)
- Programmable I/O voltage (1.6-5.5V)
- High-speed I/O
- USB, LAN (isolated), RS-232 (isolated) and low-level interface (isolated)
- ISP I/O relay barrier (only available on the single-site model)
- I/O protection
- Wide range power supply (12-24V)

The shortest possible programming times are guaranteed due to a combination of highly optimized programming algorithms, local storage of programming data and high slew rate line driver circuitry.

Model Comparison

The following table summarizes the main features of the various FR CUBE family models.

FR CUBE Model Comparison

Feature	FR CUBE GP02	FR CUBE GP04	FR CUBE GP08
General Features			
Programming Sites	2	4	8
Power Supply	12-24V	12-24V	12-24V
Device Type Support	Microcontrollers, CPLDs, Serial Memories	Microcontrollers, CPLDs, Serial Memories	Microcontrollers, CPLDs, Serial Memories, Parallel Memories
Programming Protocols	UART, SPI, JTAG, I^2C, BDM, SWD, etc.	UART, SPI, JTAG, I^2C, BDM, SWD, etc.	UART, SPI, JTAG, I^2C, BDM, SWD, etc.
Relay Barrier	No	No	No
ISP Lines			
Adj. Voltage Range	1.6-5.5V	1.6-5.5V	1.6-5.5V
Adj. Voltage Resolution	100mV	100mV	100mV
Bidirectional Lines	12	24	48
Prog. Clock Out Lines	2	4	8
Programmable Power Supply (PPS)			
Range	1.5-15V	1.5-15V	1.5-15V
Resolution	100mV	100mV	100mV
Channels	2	4	8
Host Interface			
RS-232 (Isolated)	Yes	Yes	Yes
LAN (Isolated)	Yes, 100Mbit/s	Yes, 100Mbit/s	Yes, 100Mbit/s
USB	Yes, Full Speed	Yes, Full Speed	Yes, Full Speed
Low-Level Interface (Isolated)	START, START_ENA[1..2], PASS/FAULT[1..2], BUSY, PRJ_SEL[0..5]	START, START_ENA[1..4], PASS/FAULT[1..4], BUSY, PRJ_SEL[0..5]	START, START_ENA[1..8], PASS/FAULT[1..8], BUSY, PRJ_SEL[0..5]

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Package Checklist

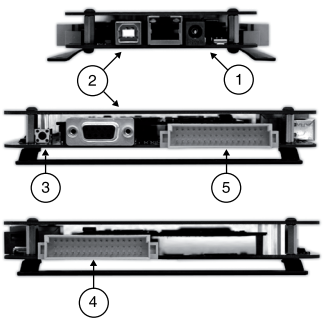
The FR CUBE package includes the following items:

1. FR CUBE unit.
2. 15V power supply.
3. Serial and USB cables.
4. FR CUBE test board.
5. 48-way, female wire-wrap DIN41612 connector.
6. Software CD.

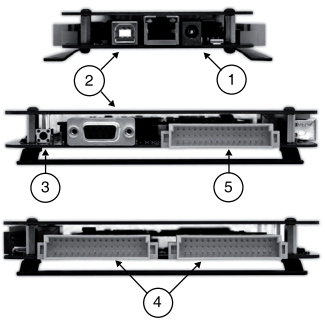
Connectors Overview

FR CUBE has several connectors for interfacing to a host PC, to an Automatic Test Equipment (ATE), and to the target system(s) to be programmed. The following pictures show where, depending on the model, the various connectors are located.

FR CUBE GP 02/04



FR CUBE GP 08



1. The POWER connector accepts a DC voltage between 12V and 24V.
2. The USB connector, LAN, and RS-232 connectors are used to interface the instrument to a PC.
3. The ETH RESET push button is used to reset LAN settings to their factory settings.
4. The ISP connector(s) are used to interface to the target system(s) to be programmed.
5. The LOW-LEVEL INTERFACE connector is used to interface the instrument to an ATE or other systems.

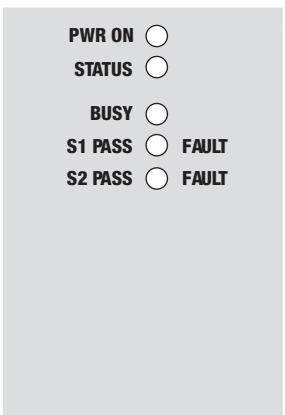
For details and pinout of the various connectors, see the "Connectors" chapter on page 59.

LEDs

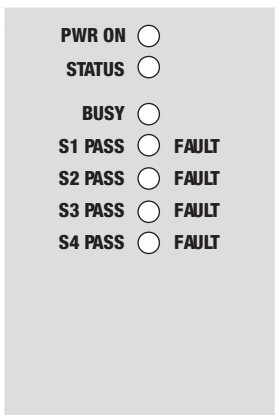
The LEDs on the top cover of the instrument, from top to bottom, indicate:

1. POWER: the instrument is turned on.
2. STATUS: indicates system warnings. Normally off, blinks if the system needs user action (to retrieve detailed error information, see "Status Commands" on page 34)
3. BUSY: turns on when programming (when a programming project is being executed).
4. PASS/FAULT: result of programming. Each programming site has an PASS/FAULT LED, which turns green if programming on that site has been successful, red otherwise.

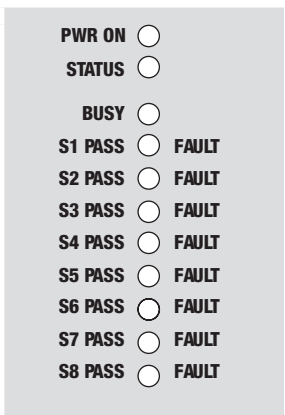
FR CUBE GP02 LEDs



FR CUBE GP04 LEDs



FR CUBE GP08 LEDs



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Programming Drivers and Licenses

FR CUBE comes with preinstalled programming drivers (algorithms) that support common microcontrollers and memories. When you purchase a new programming driver, you are supplied with a new driver file (.wnd) and an updated license file (.wnl). The license file enables the use of all of your purchased drivers on your specific FR CUBE unit.
You must copy these files to the unit's internal memory: the driver file must be copied to the unit's **\drivers** folder, and the license file to the unit's **\sys** folder.
Please refer to "FR CUBE File System" on page 53 for more information.

2. Getting Started

Guided Tutorial

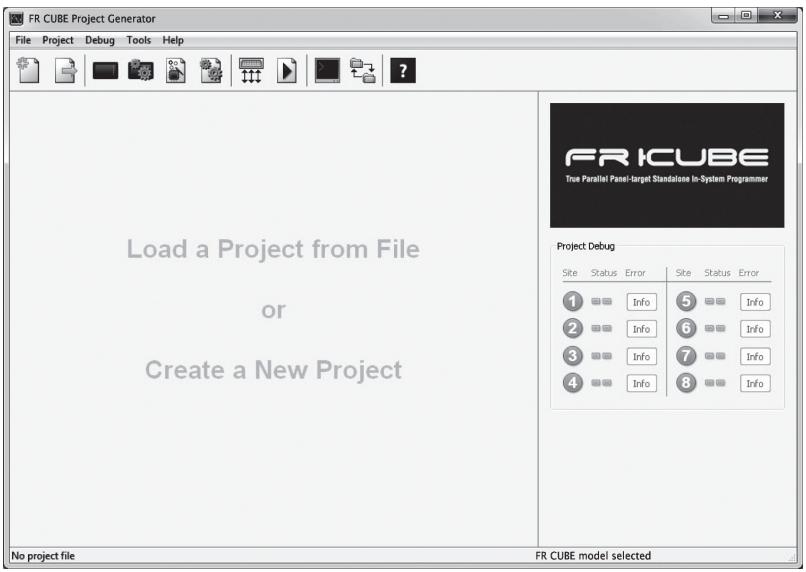
The following tutorial will guide you through the steps required to set up your FR CUBE programmer and create your first programming project.

1. Install Software

Insert the Setup CD into your PC and install the FR CUBE software.

2. Launch the Project Generator

Launch the Project Generator application, that is located under **Programs > Systein > FR CUBE Software > Project Generator.**



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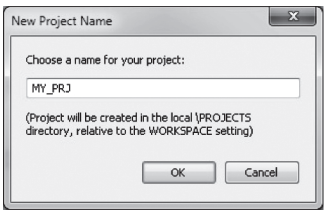
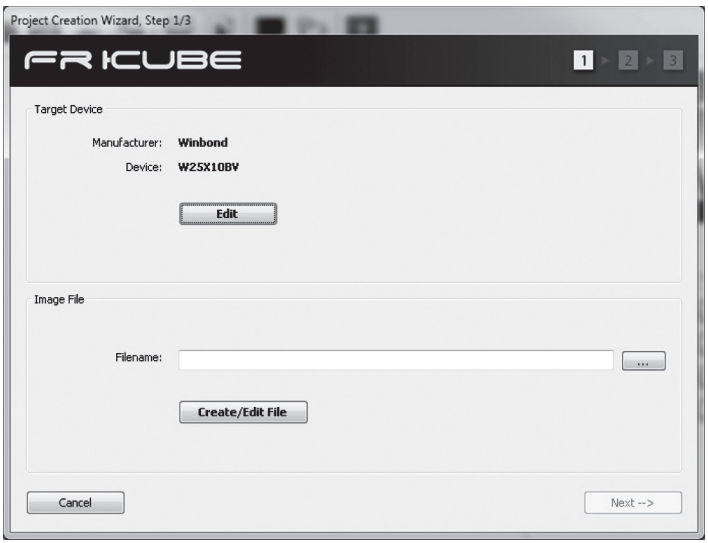
3. Create a New Project

Select **File > New Project**, give a name to your programming project, and then follow the Project Creation Wizard steps.

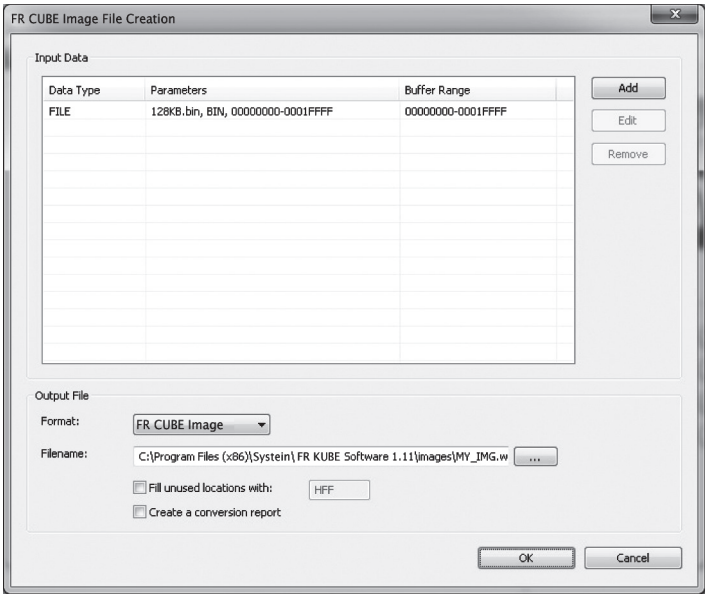


4. Create a New Project, Step 1 of 3

In the first Wizard step, specify the target device, by clicking the **"Edit"** button.



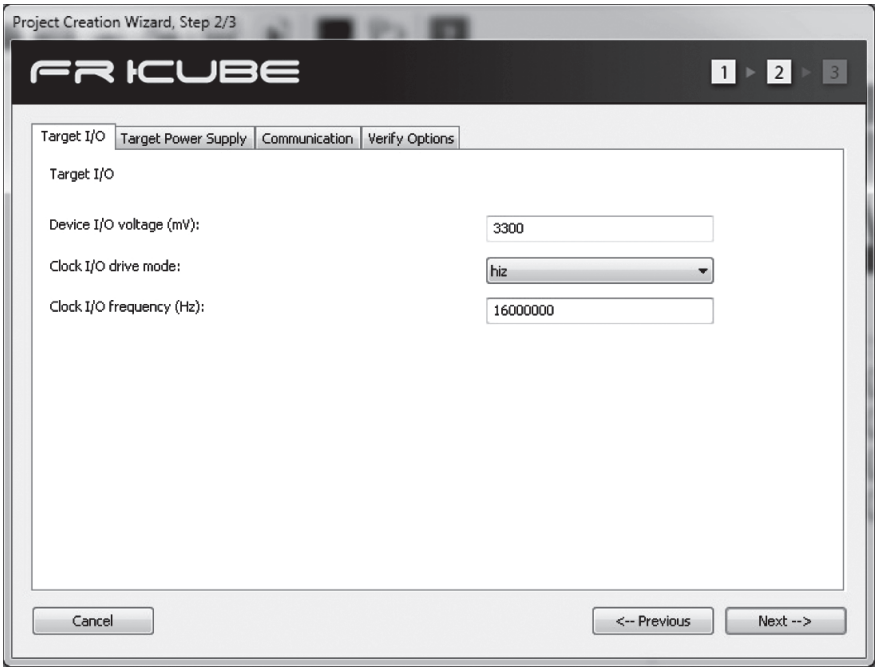
Next, specify the file to be programmed (image file). To create an image file, click the **"Create/Edit File"** button. A dedicated window will open.



In the Output File section, specify the output filename by clicking the **"..."** button.
Use the **"Add"** button to compose the data that will compose the Image file. Use the **"..."** button to specify the name of the Image file. When done, click **"OK"** to return to the Wizard, and proceed to Step 2.

5. Create a New Project, Step 2 of 3

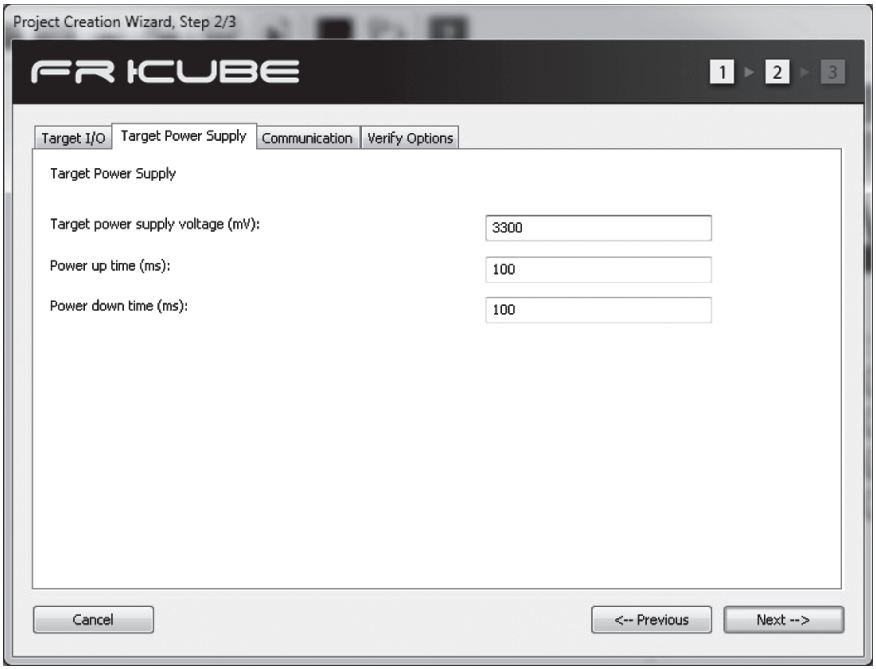
In this step, specify target parameters and connection values. The Wizard will automatically fill all data with typical values for the selected target device.



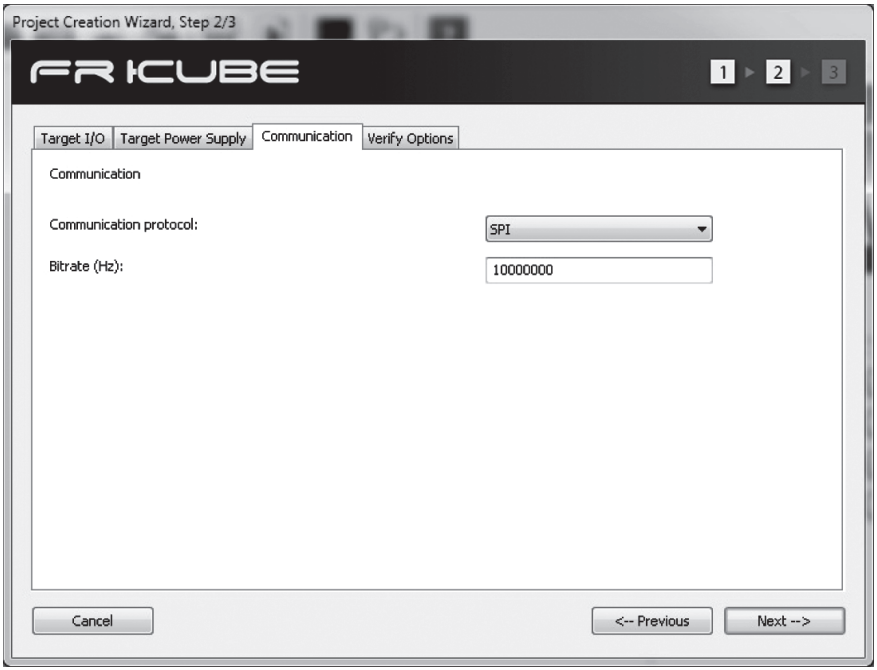
The number of tabs displayed in this window depends on the selected target device; however, three tabs (**"Target I/O"**, **"Target Power Supply"** and **"Communication"**) are always present and will be briefly discussed below.

The first tab is **"Target I/O"**. The **"Device I/O voltage"** setting specifies the voltage of the ISP lines. You should check the target board schematics, or ask the board developer about this value. The allowed voltage also depends on the selected target device.

The **"Clock I/O drive mode"** setting allows you to decide how the SxL04 ISP line is driven (the x index refers to the programming site; see "ISP Connectors" on page 59). This line can be used as an auxiliary ISP line (to provide a clock to the target device), as a generic I/O line, or as a high-impedance output (no electrical driving). When used as output line (set to high or low), it could be used, for example, to disable the external watchdog circuit in the target board. When used as clock out, you can specify the output frequency in the **"Clock I/O frequency"** field. We suggest leaving this line floating (HiZ) when not used, in order to decrease electrical noise on other ISP lines.



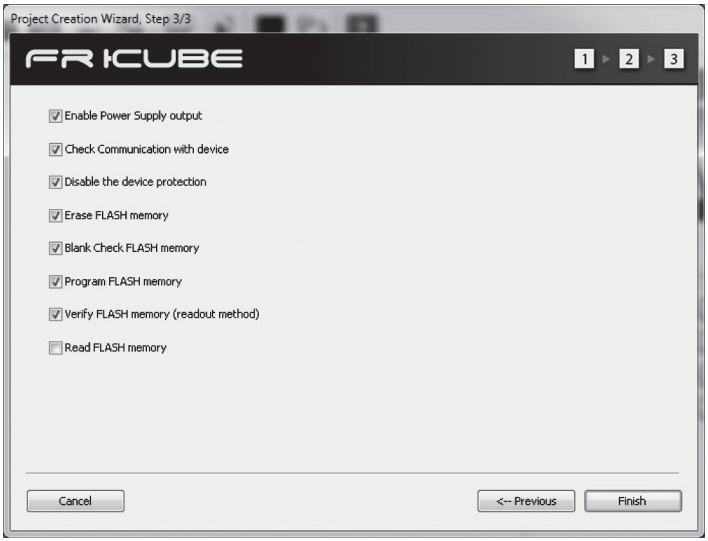
If you decide to power the target board through the FR CUBE power supply line (SxPPS), specify in the **"Target Power Supply"** tab the electrical and timing parameters of the target power supply line. FR CUBE is able to power the target board through a dedicated programmable power supply output line per site. The voltage of the programmable power supply line (**"Target power supply voltage"** setting) can be in the range 1700mV to 13000mV. Each programmable power supply line features an internal voltage limiter that cuts the voltage output in case of short circuits or overloads. The current output is limited to about 400mA.
The **"Power up time"** setting specifies the delay between the programmable power supply line turning on and the first operation on the ISP lines. The purpose of this parameter is to wait for the power supply to become stable, before starting ISP programming. This parameter is useful when large capacitors are mounted in the target board's power line.
The **"Power down time"** setting acts in similar way: it sets the delay between the programmable power supply line turning off and subsequent operations.



The content of the **"Communication"** tab depends on the selected target device. It allows you to select the communication protocol that will be used for programming (some target devices may provide more than one communication protocol) and its related settings, usually the communication speed and other parameters. Usually, the higher the communication speed, the shorter/better the ISP cabling must be.
After carefully checking all of the parameters values, proceed to Step 3.

6. Create a New Project, Step 3 of 3

In this step you select which programming operation to perform on the target.



Click **"Finish"** to end the Wizard. At this point, a FR CUBE Programming Project will be created in the **\Projects** directory, relative to the Project Generator application location.

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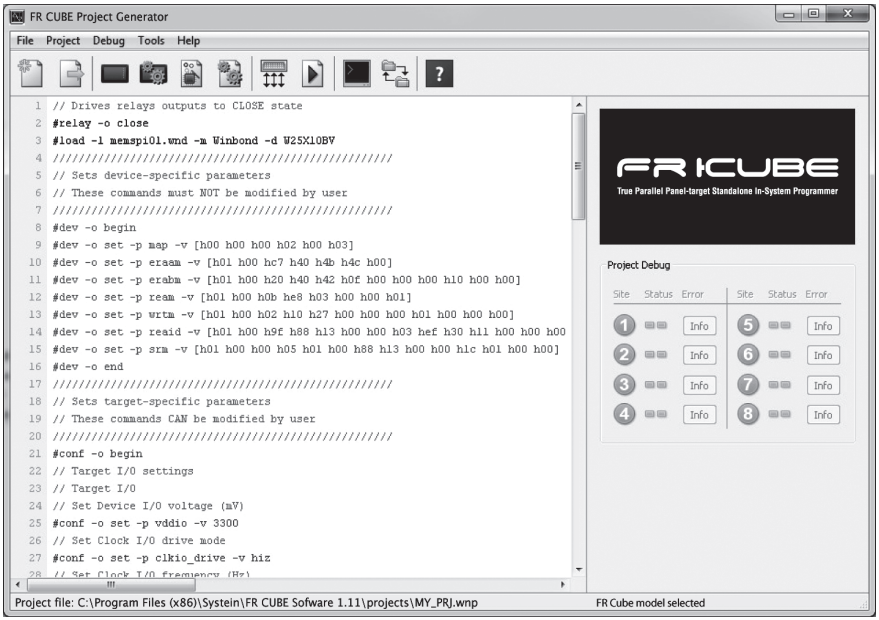
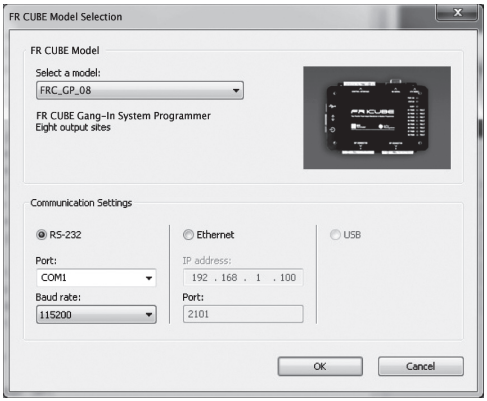


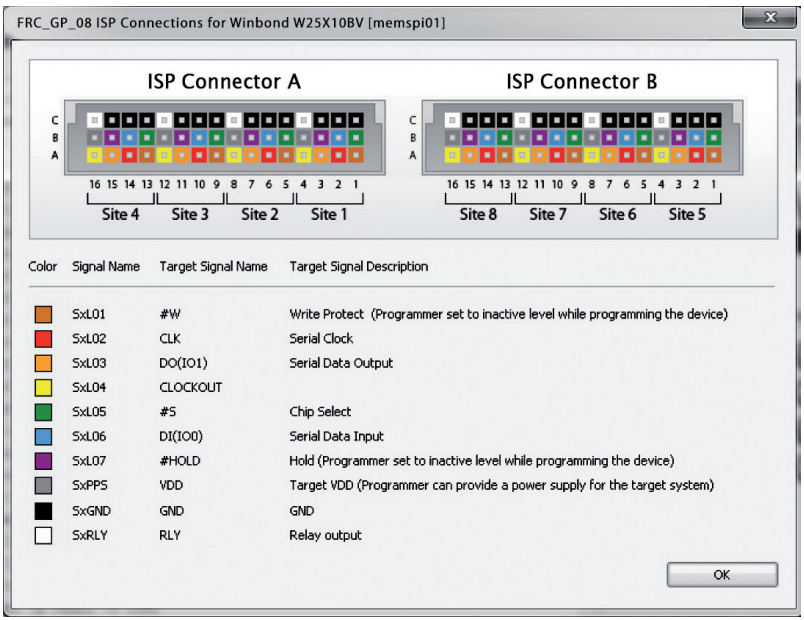
7. Configure your FR CUBE Instrument

Choose **Project > Select FR CUBE Model**, and specify your FR CUBE model and communication settings with the PC.
Currently, FR CUBE can be connected only through a serial port.
FR CUBE communicates at **115,200** bps by default.
LAN and USB connections will be supported soon through a free software upgrade.



8. Connect to Target Device

Connect FR CUBE to your target system through the ISP connector(s). To view the connections for your selected target device, select **Debug > Show ISP Connections**.



See the table on page 60 for more details

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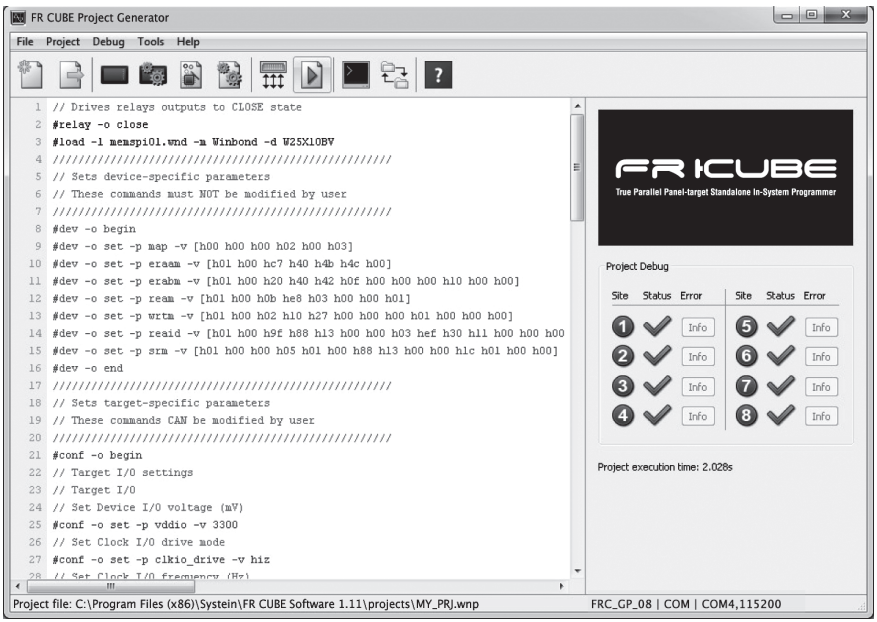
9. Startup FR CUBE

Connect FR CUBE to your PC through the provided serial cable. Finally, power up FR CUBE using the provided power supply.

10. Program the Target Device

Select **Debug > Run** Project. The Project file (.wnp) and Image file (.wni) will be automatically uploaded to FR CUBE and the project will be executed. Your target device(s) will be programmed.



In case of programming errors, or to change programming parameters/ operations, you can relaunch the Project Wizard and review the project settings.

Manual Project Editing

The Project file created by the Project Wizard is located, by default, in the **\Projects** directory, relative to the Project Generator application location (this location can be changed by specifying a different "workspace" path: to do so, in the Project Generator, select **Project > Edit Miscellaneous Settings** and modify the **Workspace** setting).
The generated project file is a text file and, if necessary, can be edited using any text editor. Please note, however, that once the file is modified by the user, it can be opened by the Project Generator but the Project Wizard will not be available.

Where to Go from Here

In this chapter, you have learnt how to use the Project Generator to create and execute a typical programming project. Additionally, FR CUBE can be controlled in three other ways:

1. By manually sending commands and receiving answers, using the Project Generator Terminal or any other terminal application (for more information, see "Commands" on page 27);
2. By configuring the instrument so that it can work in standalone, that is without a connection to a PC (for more information, see "Standalone Mode" on page 39);
3. By building your own PC software that interfaces to the instrument (for more information, see "FR CUBE API" on page 43).

3. Commands

Overview

FR CUBE is a slave unit and is always awaiting for a new command incoming from the master (PC).
When the programmer receives a SOF (Start Of Frame) character (**#**), indicating the start of a new command, it loads all incoming characters in a buffer until the reception of the return character (**\n**, ASCII code **h0A**).
Maximum command length is 256 characters.
After reception of the return character, the programmer interprets and executes the received command; depending on the execution of the received command the protocol will answers to the master in three different ways.

1. If the command is correctly executed, the programmer answers with an OK frame.
2. If the command execution generates errors, the programmer answers with an ERR frame.
3. If the command takes long to execute, the programmer periodically answers with a BUSY frame, until command execution is over and an OK or ERR frame is answered.

All commands and answers are case-insensitive.

Command Syntax

A FR CUBE command begins with the SOF character (**#**), followed by the command name, followed by zero or more command switches, and ends with the return character (**\n**).
This is an example of a FR CUBE valid command:
#status -o ping{\n}

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OK Answer

An OK answer is composed of zero or more characters, followed by the **>** character, followed by the return character (**\n**).
This is an example of a FR CUBE OK answer:
pong>{\n}

ERR Answer

An ERR answer is composed of zero or more characters (usually the hexadecimal error code), followed by the **!** character, followed by the return character (**\n**).
This is an example of a FR CUBE ERR answer:
h40000103!{\n}

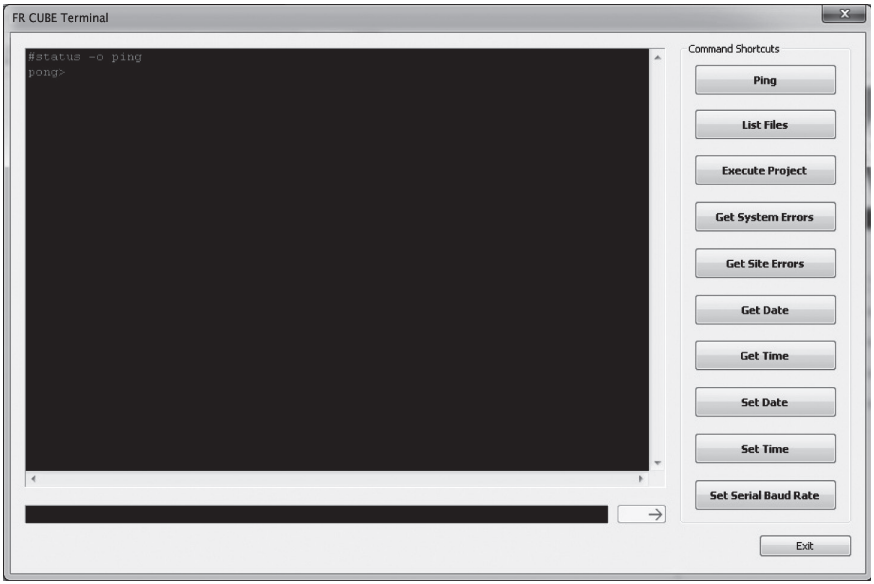
BUSY Answer

A BUSY answer is sent by the programmer to the PC if a command take some time to execute. A BUSY answer is sent at most every 3 seconds. If no OK, ERR or BUSY answer is sent within 3 seconds from the last command sent to the programmer, a communication error has probably occurred.
A BUSY answer is composed of zero or more characters, followed by the ***** character, followed by the return character (**\n**).
This is an example of a FR CUBE BUSY answer:
***{\n}**

A valid answer always ends with two characters: >{\n}, !{\n} or *{\n}, depending on whether an OK, ERR or BUSY frame is sent to the host. Additional return characters (\n) may be present in the answer, but they don't signal the end of the answer.

FR CUBE Terminal

Commands can be sent (and answers received) using any terminal application. For your convenience, the Project Generator application includes a Terminal window that will simplify the communication with the instrument. Just select **Tools > FR CUBE Terminal** to open the Terminal window.



Command Reference

The following pages list all of the FR CUBE commands, grouped by function, together with their syntax and usage examples.

3

Data In/Out Commands

Syntax

#data –o set –c <direction> -t file –f <filename>
#data –o set –c <direction> -t volatile

Parameters

<direction> **in** or **out**.
<filename> Filename on the instrument's file system.

Description

Specify the source and destination of the programming data.

Examples

Sets the input image file to be programmed, and subsequently programs it:

```
#data -o set -c in -t file -f \images\myfile.wni
>
#prog -o cmd -c program -m flash -s h8000 -t h8000 -l h8000
>
```

Sets the output file to receive binary data, and subsequently reads data from the target device:

```
#data -o set -c out -t file -f \images\dump.bin
>
#prog -o cmd -c read -m flash -s h8000 -t h8000 -l h8000
>
```

Execution Command

Syntax
#exec -o prj -f <project> -s <sites>

Parameters

<project> The Project filename to execute.
<sites> A 8 bit value indicating the programming sites to be enabled.

Description

Executes the specified Project over the specified programming sites.
In case of error, a 32 bit value is returned. This value indicates whether the error is site-specific (bit 29 = 1) or system-specific (bit 29 = 0). If the error is site-specific, the 8 least significant bits (bits from 7 to 0) signal whether programming in the corresponding programming site (bit 7 = programming site 8, bit 0 = programming site 1) was successful (bit = 0) or not (bit = 1).
To retrieve error messages, use the **#status –o get -p err -v <site> -l <errlevel>** command, where **<site>** is **1** to **8** to retrieve a specific programming site error, or **0** to retrieve a system error. **<errlevel>** is the error detail information that is returned and can be **1**, **2**, **3**.

Examples

Executes the Project "myprj.wnp" on programming sites 1, 2, 3, 4:

#exec –o prj –f \projects\myprj.wnp -s h0f
h20000003!

In this case, the returned error indicates that there are site-specific errors (bit 29 = 1) and that the sites where errors occurred are sites 1 and 2.
To retrieve detailed error information about site 1, for example, the following command can be sent:

#status –o get -p err -v 1 -l 2
h5000001,23,"Error: Timeout occurred"
>

The answers indicates that Project line 23 issued a **h5000001** error, and the text between quotes explains the error.

File System Commands

Syntax

#fs –o rmdir –d <directory>
#fs –o mkdir –d <directory>
#fs –o dir –d <directory>
#fs –o del –f <filename>
#fs –o send –d <filename>
#fs –o receive –d <filename>

Parameters

<directory> Full path of a directory.
<filename> Full path of a filename.

Description

Allow to perform various operations on the programmer's file system.

Examples

Shows the contents of the programmer's root directory:

```
#fs –o dir –d \
2010/06/21  16:35:06  [DIR]          projects
2010/06/21  16:35:16  [DIR]          sys
2010/06/21  16:35:20  [DIR]          images
2010/06/21  16:35:26  [DIR]          drivers
>
```

Programming Commands

Syntax

#load –l <driver> -m <manufacturer> -d <device>
#dev –o begin
#dev –o end
#dev –o set –p <parameter> -v <value>
#conf –o begin
#conf –o end
#conf –o set –p <parameter> -v <value>
#prog –o begin
#prog –o end
#prog –o cmd –c pps -v <pps value>
#prog –o cmd –c connect
#prog –o cmd –c disconnect
#prog –o cmd –c unprotect
#prog –o cmd –c erase –m <mem type> -t <tgt addr> -l <len>
#prog –o cmd –c blankcheck –m <mem type> -t <tgt addr> -l <len>
#prog –o cmd –c program –m <mem type> -s <src addr> -t <tgt addr> -l <len>
#prog –o cmd –c verify –v <ver mode> –m <mem type> -t <tgt addr> -l <len>
#prog –o cmd –c read –m <mem type> -s <dst addr> -t <tgt addr> -l <len>

Parameters

<driver>	Filename of the .wnd driver.
<manufacturer>	Target device's silicon manufacturer.
<device>	Target device code.
<parameter>	Target parameter to set.
<value>	Value of the corresponding parameter.
<pps value>	**on** or **off**.
<mem type>	Target memory type.
<tgt addr>	Target start address.
<len>	Data length.
<src addr>	Source (buffer) start address.
<ver mode>	Verify mode: **read** or **chks**.
<dst addr>	Destination start address.

Description

Perform various programming settings and operations on the target device.

Status Commands

Syntax

#status –o ping
#status –o get –p err –v <site> –l <errlevel>

Parameters

<site> **1** to **8** to get programming site errors. Use **0** to return system errors.
<errlevel> **1** to **3**.

Description

Get instrument status or error information.
When retrieving error information, one or more error lines (depending on the **<errlevel>** parameter) are returned. Each line begins with a 32-bit code, which codifies the following information:

Bit 31:	Reserved
Bit 30:	If 1, an error message in text format is available.
Bit 29:	If 1, the error is programming site specific.
Bit 28:	If 1, the error is driver (programming algorithm) specific.
Bit 27:	If 1, the error is a system fatal error.
Bits 26 to 24:	Reserved.
Bits 23 to 0:	Error code. If bit 29 is 1, then bits 7 to 0 signal whether programming in the corresponding programming site (bit 7 = programming site 8, bit 0 = programming site 1) was successful (bit = 0) or not (bit = 1).

Examples

Pings the instrument to check if communication is OK:

```
#status –o ping
pong>
```

Retrieves the last generated errors, on programming site 1, with different error levels:

```
#status -o get -p err -v 1 -l 1
H50000023
>
#status -o get -p err -v 1 -l 2
H50000023,71,"Connection Error."
>
#status -o get -p err -v 1 -l 3
H50000023,71,"Connection Error.","algo_api",337
H10000000,71,"","st701_cmds",432
H10000000,71,"","st701_entry",287
H10000000,71,"","st701_icc",208
H10000001,71,"","hal_icc1",144

>
```

System Commands

Syntax

#sys –o set –p br –v <baud rate>
#sys –o get –p br
#sys –o get –p sn
#sys –o get –p ver –v <code>
#sys –o set –p lliop –s <prj sel> -f <prj filename>
#sys –o get –p lliop –s <prj sel>

Parameters

<baud rate>	**9600**, **19200**, **38400**, **57600**, **115200**, or **230400**.
<code>	**sys** or **driver**.
<prj sel>	Project number, as selected by the PRJ_SEL[5..0] lines on the Low-Level Interface connector.
<prj filename>	Project file associated to **<the prj sel>** setting.

Description

Set or get instrument's internal parameters.

Examples

Sets a new serial baud rate:

#sys -o set –p br –v 115200
>

Retrieves the instrument's serial number:

#sys -o get -p sn
00100>

Associates the project **test.wnp** to the project number 1:

#sys –o set –p lliop –s 1 -f \projects\test.wnp
>

Time Commands

Syntax

#time –o set –p date –d <date>
#time –o set –p time –d <time>
#time –o get –p date
#time –o get –p time

Parameters

<date>	A date in the format **yyyy/mm/dd**.
<time>	A time in the format **hh:mm:ss**.

Description

Set or get the instrument's date and time. Once set, the date and time are maintained even when the instrument is powered off.

Examples

Sets the date/time to February 1st, 2011, at noon:

```
#time –o set –p date –d 2011/02/01
>
#time –o set –p time –d 12:00:00
>
```

Retrieves the instrument's date and time:

```
#time –o get –p date
2011/02/01>
#time –o get –p time
12:02:05>
```

Volatile Memory Commands

Syntax

#volatile –o write –s <site> -a <start address> - l <len> -d <data>
#volatile –o read –s <site> -a <start address> - l <len>

3

Parameters

<site>	Programming site. **1** to **8** to set specific site data, **0** to set the same data for all sites.
<start address>	Volatile memory starting address.
<len>	Data length.
<data>	A data array.

Description

Read and write data from/to the instrument's volatile memory.

Examples

Uses the volatile memory on site 1 to store the target board's MAC address:

#volatile –o write –s 1 -a h0 -l 6 -d [h00 h90 h96 h90 h48 h85]
>

Retrieves data from site 1 volatile memory:

#volatile -o read -s 1 -a h0 -l 6
1,[h00 h90 h96 h90 h48 h85]>

4. Standalone Mode

Overview

FR CUBE can work with no connection to a PC (standalone mode). In standalone mode, the instrument is controlled through a low-level connection interface.

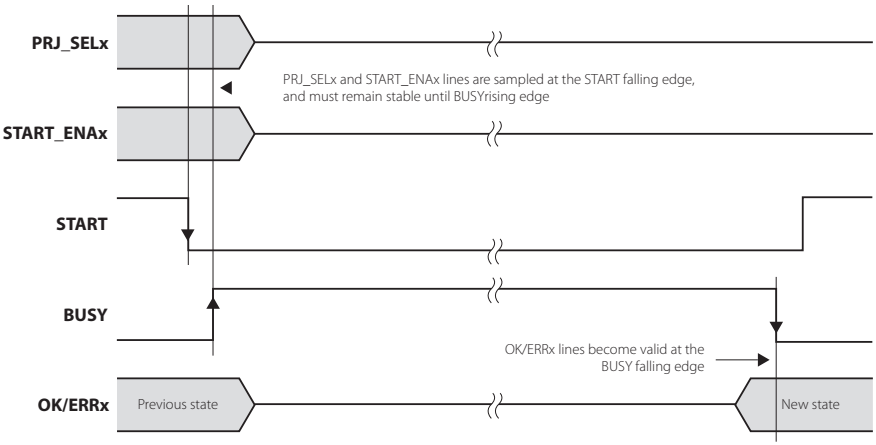
Signals

Signals needed to control the instrument in standalone mode are located in the "Low-Level Interface" connector (see "Connectors" on page 59 for the connector pinout on the various FR CUBE models) and are explained below.

Signal level is 0-5V. All lines are isolated (referenced to GNDI).

PRJ_SELx lines (input):	Define which project to execute (see "Project Assignment" later on this chapter).
START_ENAx lines (input):	Select which programming site(s) to enable. Active low.
START line (input):	Executes the project specified by PRJ_SELx lines on the programming site(s) enabled by START_ENAx lines. Active low.
BUSY line (output):	Indicates that a project is being executed. Active high.
PASS/FAULTx lines (output):	Valid at the end of project execution (when BUSY is low). Indicate, for each programming site(s), the success state of the programming project. (OK = high, ERR = low).

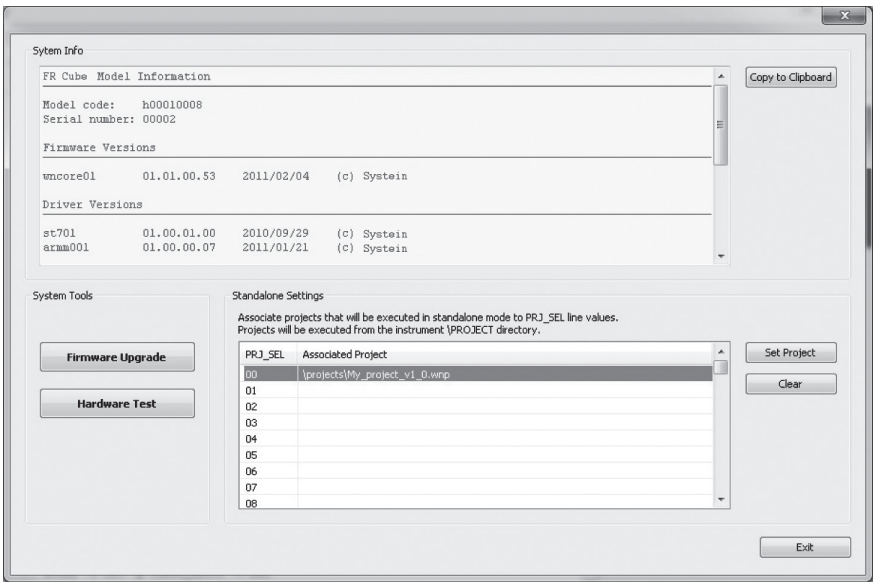
The following diagram illustrates the timing for the Low-Level Interface signals.



Low-Level Interface Signals Timing

Project Assignment

Before working in standalone mode, you must associate PRJ_SELx lines to a Project filename to execute.
To do so, in the FR CUBE Project Generator application select **Project > Hardware Settings**. In the window that will appear, associate PRJ_SEL values to project names by clicking the **"Set Project"** button for each PRJ_SEL configuration you wish you setup.



5. FR CUBE API

Overview

You can build your own PC software that interfaces to the instrument, by using the provided FR CUBE Application Programming Interface (API). The FR CUBE API consists of a series of functions, contained in the **fr_comm** DLL, which allow you to set up and control the programmer.
The **fr_comm** DLL is located in the **\Developer** folder, relative to the FR CUBE software installation path. In the same folder you can find the source code of sample applications, in various programming languages, that use the **fr_comm** DLL.
Additionally, a command line application (**fr_cmds.exe**) is provided, which reads a programming command from the stdin, sends the command to the instrument, and writes the command answer on the stdout.

Including the API in Your Application

To use the FR CUBE API, you must:

- Include the **"fr_comm.lib"** and **"fr_comm.h"** files in your application project (only needed for Visual C++ projects);
- Copy the **"fr_comm.dll"** file in the same folder of your application executable (this file must also be redistributed with your application).

The typical program flow for interfacing with FR CUBE is the following:

1. Open communication (**FR_OpenCommPort()**function)

2. Execute commands(**FR_ExeCommand()**function)

3. Transfer files to/from the instrument's internal memory (**FR_SendFile()andFR_ReceiveFile()**functions)

4. Close communication(**FR_CloseCommPort()**function)

Function Reference

API functions are listed and explained alphabetically in the following pages.

FR_CloseCommPort()

Prototype

FR_COMM_ERR WINAPI FR_CloseCommPortA (FR_COMM_HANDLE handle);

FR_COMM_ERR WINAPI FR_CloseCommPortW (FR_COMM_HANDLE handle);

Description

Closes the communication channel with the instrument.

Return Value

0	The function call was successful.
!=0	The function call was unsuccessful. Call the **FR_GetLastErrorMessage()** function to get error information.

Parameters

handle	Communication handle returned by the **FR_OpenCommPort()** function.

FR_ExeCommand()

Prototype

FR_COMM_ERR WINAPI FR_ExeCommandA (FR_COMM_HANDLE handle, const char *command, char *answer, unsigned long maxlen, unsigned long timeout_ms, FR_ANSWER_TYPE *type);

FR_COMM_ERR WINAPI FR_ExeCommandW (FR_COMM_HANDLE handle, const wchar_t *command, wchar_t *answer, unsigned long maxlen, unsigned long timeout_ms, FR_ANSWER_TYPE *type);

Description

Executes a FR CUBE command. This function automatically sends a command to the instrument and returns the answer read back from the instrument. This function combines the **FR_SendFrame()** and **FR_GetFrame()** function in a single call.

Return Value

0	The function call was successful.
!=0	The function call was unsuccessful. Call the **FR_GetLastErrorMessage()** function to get error information.

Parameters

handle	Communication handle returned by the **FR_OpenCommPort()** function.
command	A valid FR CUBE command.
answer	The answer read back from the instrument in response to the command sent.
maxlen	Maximum length, in characters, of the answer buffer.
timeout_ms	Time (in milliseconds) before the function times out.
type	Type of answer received: can be: **FR_ANSWER_ACK** (an OK frame was received); **FR_ANSWER_NACK** (an ERR frame was received); **FR_ANSWER_TOUT** (command timed out before an answer could be received).

FR_GetFrame()

Prototype

FR_COMM_ERR WINAPI FR_GetFrameA (FR_COMM_HANDLE handle, char *answer, unsigned long maxlen, unsigned long timeout_ms);

FR_COMM_ERR WINAPI FR_GetFrameW (FR_COMM_HANDLE handle, wchar_t *answer, unsigned long maxlen, unsigned long timeout_ms);

Description

Reads the answer to the command sent by the **FR_SendFrame()** function.

Return Value

0	The function call was successful.
!=0	The function call was unsuccessful. Call the **FR_GetLastErrorMessage()** function to get error information.

Parameters

handle	Communication handle returned by the **FR_OpenCommPort()** function.
answer	The answer read back from the instrument in response to the command sent.
maxlen	Maximum length, in characters, of the answer buffer.
timeout_ms	Time (in milliseconds) before the function times out.

FR_GetLastErrorMessage()

Prototype

void WINAPI FR_GetLastErrorMessageA (char *error_msg, unsigned long tring_len);

void WINAPI FR_GetLastErrorMessageW (wchar_t *error_msg, unsigned long string_ len);

Description

Returns a string containing the last FR CUBE error message.

Parameters

error_msg	The string that will receive the error message.
msg_len	Length, in characters, of the error message buffer.

FR_ReceiveFile()

Prototype

FR_COMM_ERR WINAPI FR_ReceiveFileA (FR_COMM_HANDLE handle, const char *protocol, const char *src_filename, const char *dst_path, bool force_transfer, FR_FileTransferProgressProc progress);

FR_COMM_ERR WINAPI FR_ReceiveFileW (FR_COMM_HANDLE handle, const wchar_t *protocol, const wchar_t *src_filename, const wchar_t *dst_path, bool force_transfer, FR_FileTransferProgressProc progress);

Description

Receives a file from the instrument's internal memory and saves it to the PC.

Return Value

0	The function call was successful.
!=0	The function call was unsuccessful. Call the **FR_GetLastErrorMessage()** function to get error information.

Parameters

handle	Communication handle returned by the **FR_OpenCommPort()** function.
protocol	Transfer protocol. Must be **"ymodem"**.
src_filename	The full filename, including path, of the remote file.
dst_path	The PC path where to store the file.
force_transfer	If **TRUE**, file transfer will be executed even if a file with the same name and CRC exists on the PC; if **FALSE**, file transfer will be executed only if necessary.
progress	Address of a callback function that will receive progress information, or **0** if not used.

FR_SendFile()

Prototype

FR_COMM_ERR WINAPI FR_SendFileA (FR_COMM_HANDLE handle, const char *protocol, const char *src_filename, const char *dst_path, bool force_transfer, FR_FileTransferProgressProc progress);

FR_COMM_ERR WINAPI FR_SendFileW (FR_COMM_HANDLE handle, const wchar_t *protocol, const wchar_t *src_filename, const wchar_t *dst_path, bool force_ transfer, FR_FileTransferProgressProc progress);

Description

Sends a file to the instrument's internal memory.

Return Value

0	The function call was successful.
!=0	The function call was unsuccessful. Call the **FR_GetLastErrorMessage()** function to get error information.

Parameters

handle	Communication handle returned by the **FR_OpenCommPort()** function.
protocol	Transfer protocol. Must be **"ymodem"**.
src_filename	The source full filename.
dst_path	The remote instrument file system path where to store the file.
force_transfer	If **TRUE**, file transfer will be executed even if a file with the same name and CRC exists on the instrument; if **FALSE**, file transfer will be executed only if necessary.
progress	Address of a callback function that will receive progress information, or **0** if not used.

FR_SendFrame()

Prototype

FR_COMM_ERR WINAPI FR_SendFrameA (FR_COMM_HANDLE handle, const char *command);

FR_COMM_ERR WINAPI FR_SendFrameW (FR_COMM_HANDLE handle, const wchar_t *command);

Description

Sends a command to the instrument. Use the **FR_GetFrame()** function to retrieve the answer.

Return Value

0	The function call was successful.
!=0	The function call was unsuccessful. Call the **FR_GetLastErrorMessage()** function to get error information.

Parameters

handle	Communication handle returned by the **FR_OpenCommPort()** function.
command	A valid FR CUBE command.

FR_OpenCommPort()

Prototype

FR_COMM_HANDLE WINAPI FR_OpenCommPortA (const char *com_port, const char *com_settings);

FR_COMM_HANDLE WINAPI FR_OpenCommPortW (const wchar_t *com_port, const wchar_t *com_settings);

Description

Opens a RS-232, Ethernet or USB communication channel with the instrument.

Return Value

>0	alid communication handle to use in subsequent functions.
NULL	The function call was unsuccessful. Call the **FR_GetLastErrorMessage()** function to get error information.

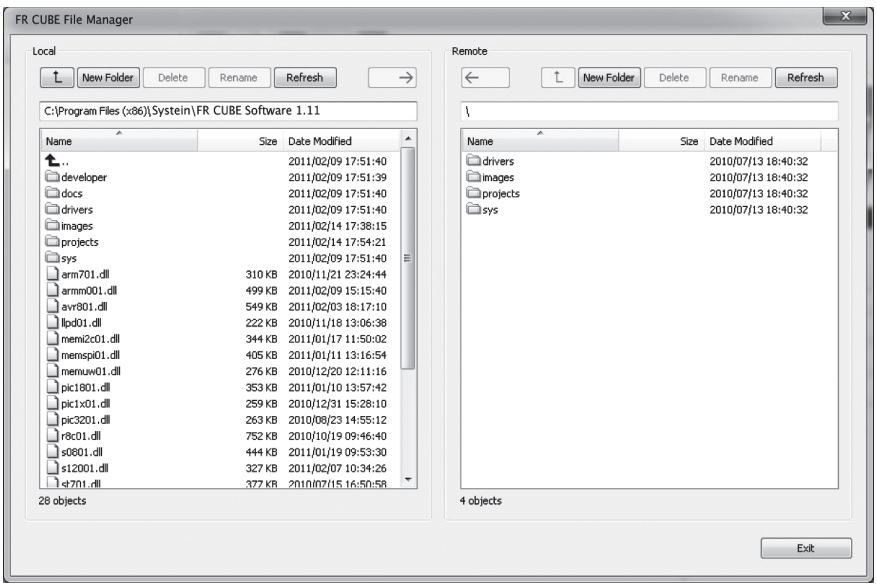
Parameters

com_port	Communication port. Can be **"COM"**, **"LAN"** or **"USB"**.
com_settings	RS-232 settings for **"COM"** port (e.g.: **"COM1,115200"**); Ethernet settings for **"LAN"** port (e.g.: **"192.168.1.100:2101"**); Empty string for **"USB"** port.

6. FR CUBE File System

Overview

FR CUBE has a large, built-in non-volatile memory, used to store the various files required by the instrument: programming projects, image files, etc. This memory is organized by a file system. You can explore the FR CUBE files either by using a Terminal application and sending file-system related commands, or (more simply) by using the File Manager window of the Project Generator application. The File Manager window allows you to easily see the instrument file structure and transfer files with the PC. To open the File Manager, choose **Tools > FR CUBE File Manager** from the Project Generator menu.



File System Structure

The files required by the instrument are organized in various folders, as explained below:

- **\drivers folder:** contains programming algorithms (.wnd files).
  These files are provided by Systein.
- **\sys folder:** contains systems files, such as programming licenses, firmware files, etc.
  These files are provided by Systein.
- **\project folder:** contains programming projects (.prj files).
  You create programming projects using the Project Generator application.
- **\images folder:** contains FR CUBE image files to be programmed to the target (.wni files).
  FR CUBE image files contain all the information needed to program a target device memory. These files are created by the Project Generator application.

You can create additional folders, but the four folders listed above must always be present on the FR CUBE file system and must not be removed. Additionally, do not remove or rename the contents of the \SYS folder.

7. Variable Data Programming

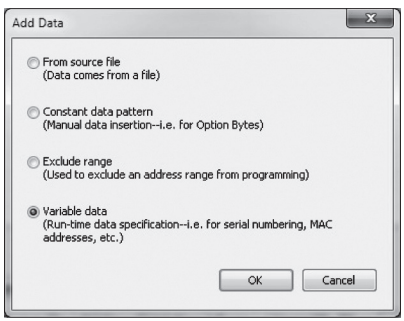
Overview

FR CUBE has built-in, dedicated memory banks for each programming site. This memory can be used to temporarily store variable data that will be written to the target device during programming. This is useful for serial numbering and for any other variable data that needs to be written to the target device at programming time.

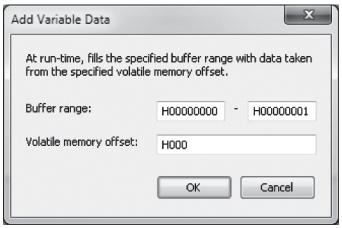
Usage

To implement variable data programming:

1. Use the Project Creation wizard of the Project Generator application to create your programming project. When creating the FR CUBE Image file, add a variable data record to the output file, as shown below.



2. You will then be asked for the target device address range to be programmed and the offset of the memory bank that will contain the variable data.



3. Proceed to the end of the Project Creation wizard. Your programming project is now ready to accept variable data.

4. Before executing the project, you must supply the variable data to each of the programming sites.
To do so, send the **#volatile –o write** command (for more information, see “Volatile Memory Commands” on page 38).

Alternatively, you can skip steps 1 to 3, but you must manually edit your programming project by inserting an appropriate **#data –o set –c out -t volatile** command and subsequent appropriate programming commands (for more information, see “Data In/Out Commands” on page 30).

8. Power and Relay Options

Power Supply Options

FR CUBE can be powered in two ways:

1. With the provided power supply (which supplies 15V DC);
2. By providing a power supply to the PWR pin of the Low-Level Interface connector (see "Low-Level Interface Connector" on page 60).

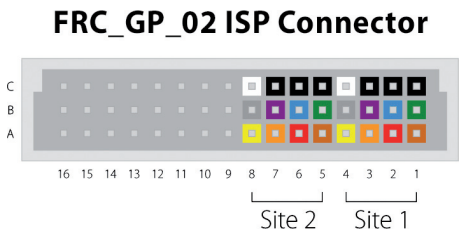
Relays

On all FR CUBE models, a special signal (SxRLY) is present (on the "ISP" connector), on every programming site. If the programming site is enabled, this signal is driven to 0V when **a #relay –o close** command is executed, and driven to 5.5V when a **the #relay –o open** command is executed).
This is useful for driving an external relay barrier.

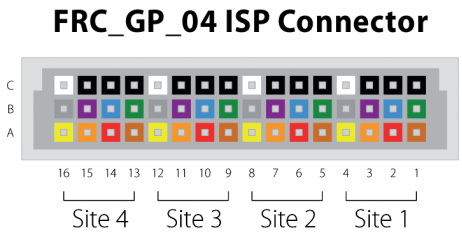
9. Connectors

ISP Connectors

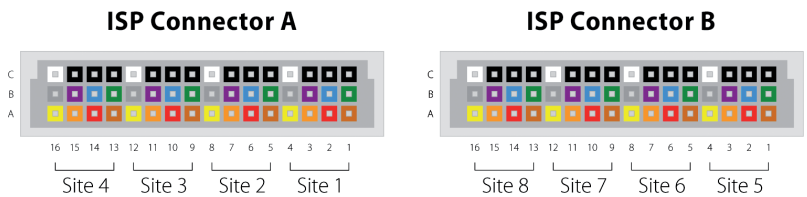
FR CUBE GP02 PASS and FR CUBE GP04 PASS models have one ISP connector; the FR CUBE GP08 PASS model has two ISP connectors.



FRC_GP_02 ISP Connector



FRC_GP_04 ISP Connector



FRC_GP_08 ISP Connectors

ISP Signal Definitions

Color	ISP Connector A Sites				ISP Connector B Sites				FR Signal Name	Target Signal Description
	S1	S2	S3	S4	S5	S6	S7	S8		
Brown	A1	A5	A9	A13	A1	A5	A9	A13	SxL01	#W - Write Protect (programmer set to inactive level while programming the device)
Red	A2	A6	A10	A14	A2	A6	A10	A14	SxL02	CLK - Serial Clock
Orange	A3	A7	A11	A15	A3	A7	A11	A15	SxL03	DO(IO1) - Serial Data Output
Yellow	A4	A8	A12	A16	A4	A8	A12	A16	SxL04	CLOCKOUT
Green	B1	B5	B9	B13	B1	B5	B9	B13	SxL05	#S - Chip select
Blue	B2	B6	B10	B14	B2	B6	B10	B14	SxL06	DI(IO0) - Serial Data Input
Purple	B3	B7	B11	B15	B3	B7	B11	B15	SxL07	#HOLD - Hold (programmer set to inactive level while programming the device)
Grey	B4	B8	B12	B16	B4	B8	B12	B16	SxPPS	VDD - Target VDD (Programmer can provide a power supply for the target system)
Black	C1 C2 C3	C5 C6 C7	C9 C10 C11	C13 C14 C15	C1 C2 C3	C5 C6 C7	C9 C10 C11	C13 C14 C15	SxRLY	GND - GND
White	C4	C5	C12	C16	C4	C5	C12	C16	SxGND	RLY - Relay Output

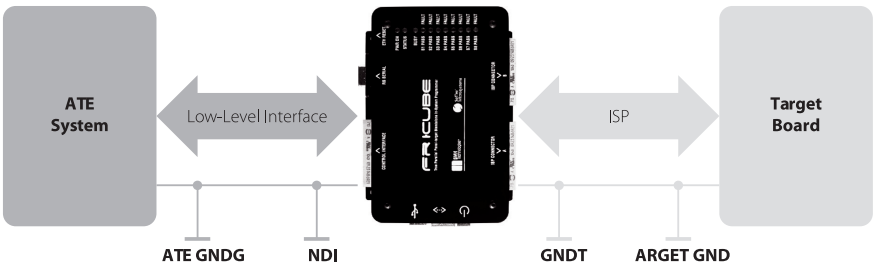
Low-Level Interface Signals

Signal	Description	FR CUBE GP02 Pin	FR CUBE GP04 Pin	FR CUBE GP08 Pin
PWR	Input Power Supply (12-24V)	A5/B5	A5/B5	A5/B5
GND	Power Supply Ground	C5	C5	C5
GNDI	Low-Level Interface Ground	A10/B12/ C15/C16	A10/B12/ C15/C16	A10/B12/ C15/C16
TX_RS232	RS-232 TX (Output)	A16	A16	A16
RX_RS232	RS-232 RX (Input)	B16	B16	B16
PRJ_SEL0	Project Selector 0 (Input, internal pull-up)	B10	B10	B10
PRJ_SEL1	Project Selector 1 (Input, internal pull-up)	C10	C10	C10
PRJ_SEL2	Project Selector 2 (Input, internal pull-up)	A11	A11	A11
PRJ_SEL3	Project Selector 3 (Input, internal pull-up)	B11	B11	B11
PRJ_SEL4	Project Selector 4 (Input, internal pull-up)	C11	C11	C11
PRJ_SEL5	Project Selector 5 (Input, internal pull-up)	A12	A12	A12
START	Project Start (Input, internal pull-up)	A7	A7	A7
START_ENA1	Site 1 Project Start Enable (Input, internal pull-up)	B7	B7	B7
START_ENA2	Site 2 Project Start Enable (Input, internal pull-up)	C7	C7	C7
START_ENA3	Site 3 Project Start Enable (Input, internal pull-up)	-	A8	A8
START_ENA4	Site 4 Project Start Enable (Input, internal pull-up)	-	B8	B8
START_ENA5	Site 5 Project Start Enable (Input, internal pull-up)	-	-	C8
START_ENA6	Site 6 Project Start Enable (Input, internal pull-up)	-	-	A9
START_ENA7	Site 7 Project Start Enable (Input, internal pull-up)	-	-	B9
START_ENA8	Site 8 Project Start Enable (Input, internal pull-up)	-	-	C9
BUSY	Busy (Output, push-pull)	C12	C12	C12
PASS/FAULT1	S1 PASS/FAULT (Output, push-pull)	A13	A13	A13
PASS/FAULT2	S2 PASS/FAULT (Output, push-pull)	B13	B13	B13
PASS/FAULT3	S3 PASS/FAULT (Output, push-pull)	-	C13	C13
PASS/FAULT4	S4 PASS/FAULT (Output, push-pull)	-	A14	A14
PASS/FAULT5	S5 PASS/FAULT (Output, push-pull)	-	-	B14
PASS/FAULT6	S6 PASS/FAULT (Output, push-pull)	-	-	C14
PASS/FAULT7	S7 PASS/FAULT (Output, push-pull)	-	-	A15
PASS/FAULT8	S8 PASS/FAULT (Output, push-pull)	-	-	B15

All low-level interface lines are isolated from system GND (and are referenced to GNDI), except for the PWR line, which is referenced to GND.

Ground Domains

The following diagram illustrates the two ground domains of the programmer.



ATE and Target Ground Domains

In order to avoid undesired current paths between the programmer and the target board, we suggest to use a power supply with a floating output (ground not referenced to the Earth potential).

10. Specifications

Electrical Specifications

Feature	Value
Maximum Ratings	
Power supply voltage	30V
ISP SxL0[1..7] voltage	-0.7-6.5V
ISP SxL0[1..7] current	±60mA
ISP SxPPS voltage	-0.7-18V
ISP SxPPS current(*)	380mA
ISP SxRLY voltage	-1.0-30V
Low level interface PRJ_SELx, START, START_ENAx, BUSY, PASS/FAULTx voltage	-0.7-6.0V
Operating Ranges	
Power supply voltage	12-24V
ISP SxL0[1..7] voltage	0-5.5V
ISP SxPPS voltage	1.5-15V
ISP SxPPS current	300mA
ISP SxRLY voltage	0-28V
Low level interface PRJ_SELx, START, START_ENAx, BUSY, PASS/FAULTx voltage	0-5.0V
Physical and Environmental	
Operating conditions	0-40°C, 90% humidity max (without condensation)
Storage conditions	-10-60°C, 90% humidity max (without condensation)
EMC (EMI/EMS)	CE, FCC

(*) Current limited, recovers automatically after fault condition is removed.

ISP Connectors

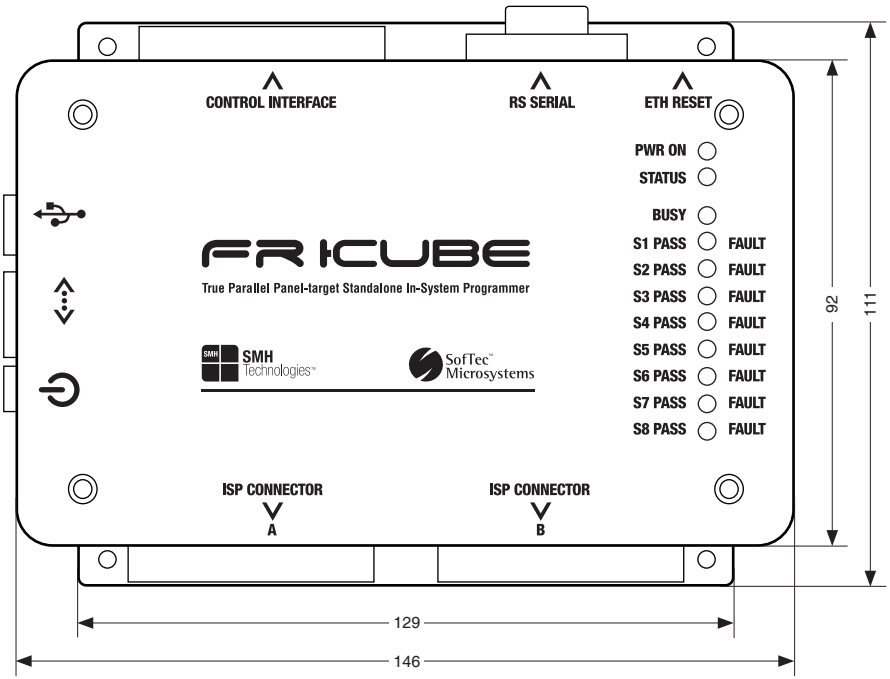
ISP and Low-Level Interface connectors are DIN48 male connectors.
We suggest using the following compatible female connectors.

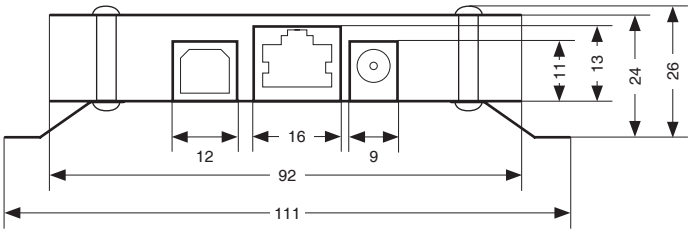
For wire wrapping:
DIN41612 connector, 3 rows, 48 pins, 180° female, C style
Manufacturer: Conec
Manufacturer Part Number: 122A10619X
Catalog Part Number: Mouser 706-122A10619X

For soldering:
DIN41612 connector, 3 rows, 48 pins, female, R/A C style
Manufacturer: FCI
Manufacturer Part Number: 86093488613755E1LF
Catalog Part Number: Mouser 649-8693488637E1L

Mechanical Specifications

The following drawings detail the mechanical dimensions of the various FR CUBE models.

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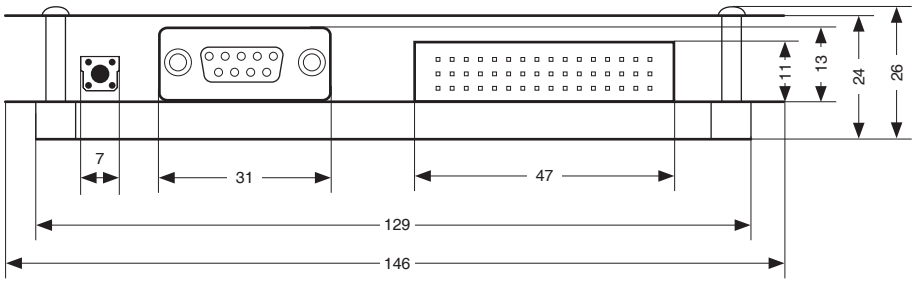
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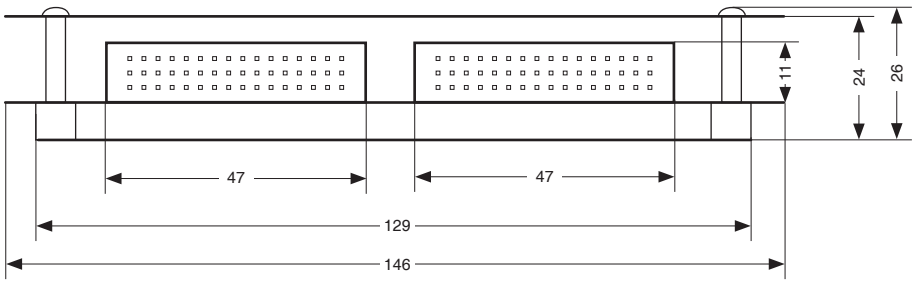
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