

# FlashRunner HS

## High-Speed, Distributed System for In-System Programming and Pre-Programming

### User's Manual

Revision 1.8 — March 2023



Copyright © 2019 SMH Technologies  
DC11508

***We want your feedback!***

*SMH Technologies is always on the lookout for new ways to improve its Products and Services. For this reason, feedback, comments, suggestions or criticisms, however small, are always welcome.*



Our policy at SMH Technologies is to comply with all applicable worldwide safety and EMC/EMI regulations. Our products are certified to comply with the European New Approach Directives and the CE mark is applied on all our products.

This product as shipped from the factory has been verified to meet with requirements FCC as a CLASS A product.



In a domestic environment, this product may cause radio interference in which case the user may be required to take adequate prevention measures.

Attaching additional wiring to this product or modifying the product operation from the factory default as shipped may affect its performance and cause interference with other apparatus in the immediate vicinity. If such interference is detected, suitable mitigating measures should be taken.

**SMH Technologies**

E-mail (general information): [info@smh-tech.com](mailto:info@smh-tech.com)

E-mail (technical support): [support@smh-tech.com](mailto:support@smh-tech.com)

Web: <http://www.smh-tech.com>

---

**Important**

SMH Technologies reserves the right to make improvements to FlashRunner, its documentation and software routines, without notice. Information in this manual is intended to be accurate and reliable. However, SMH Technologies assumes no responsibility for its use; nor for any infringements of rights of third parties which may result from its use.

SMH TECHNOLOGIES WILL NOT BE LIABLE FOR DAMAGES RESULTING FROM LOSS OF DATA, PROFITS, USE OF PRODUCTS, OR INCIDENTAL OR CONSEQUENTIAL DAMAGES, EVEN IF ADVISED OF THE POSSIBILITY THEREOF.

**Trademarks**

SMH Technologies, SMH Technologies Logo are trademarks of SMH Technologies.

All other product or service names are the property of their respective owners.

# Contents

|          |   |           |
|----------|---|-----------|
| <b>1</b> | <b>BEFORE STARTING .....</b>                                  | <b>5</b>  |
| 1.1      | IMPORTANT NOTICE TO USERS.....                                | 5         |
| 1.2      | SAFETY.....   | 5         |
| 1.3      | EMC IMMUNITY AND FAIL-SAFE RECOVERY.....                      | 6         |
| 1.4      | GETTING TECHNICAL SUPPORT.....                                | 7         |
| 1.5      | ADDITIONAL DOCUMENTATION.....                                 | 7         |
| <b>2</b> | <b>OVERVIEW.....</b>  | <b>8</b>  |
| 2.1      | WHAT IS FLASHRUNNER HS? .....                                 | 8         |
| 2.1.1    | <i>FlashRunner HS Control Unit</i> .....                      | 9         |
| 2.1.2    | <i>FlashRunner HS Active Module</i> .....                     | 12        |
| 2.1.3    | <i>FlashRunner HS Control Unit link</i> .....                 | 19        |
|          | PACKAGE CHECKLIST .....                                       | 20        |
| 2.2      | HARDWARE OVERVIEW .....                                       | 21        |
| 2.2.1    | <i>Power Supply</i> .....                                     | 21        |
| 2.2.2    | <i>Control Connector</i> .....                                | 21        |
| 2.2.3    | <i>LAN Connector</i> .....                                    | 22        |
| 2.2.4    | <i>USB Connector</i> .....                                    | 22        |
| 2.2.5    | <i>ISP Connectors</i> .....                                   | 22        |
| 2.2.6    | <i>LEDs</i> .....   | 22        |
|          | PROGRAMMING DRIVERS AND LICENSES .....                        | 23        |
| 2.2.7    | <i>Installing New Licenses</i> .....                          | 23        |
| 2.3      | UPGRADING THE FIRMWARE .....                                  | 24        |
| <b>3</b> | <b>SYSTEM SETUP.....</b>                                      | <b>25</b> |
| 3.1      | OVERVIEW .....  | 25        |
| 3.2      | SOFTWARE SETUP .....  | 25        |
| 3.3      | HARDWARE SETUP .....  | 25        |
| 3.3.1    | <i>Interfacing with your Test/Programming equipment</i> ..... | 26        |
| 3.3.2    | <i>Connecting Control unit to Active Module</i> .....         | 26        |
| 3.3.3    | <i>Connecting to the Host PC System</i> .....                 | 26        |
| 3.3.4    | <i>Powering Up</i> .....                                      | 26        |

|          |   |           |
|----------|---|-----------|
| 3.3.5    | Setting Up LAN Settings .....                           | 27        |
| <b>4</b> | <b>CONNECTORS .....</b>                                 | <b>28</b> |
| 4.1      | OVERVIEW .....  | 28        |
| 4.2      | CONTROL CONNECTOR .....                                 | 29        |
| 4.3      | USB CONNECTOR.....                                      | 31        |
| 4.4      | ISP/PP CONNECTOR.....                                   | 32        |
| 4.4.1    | Active Module eMMC/OSPI/NAND.....                       | 32        |
| 4.4.2    | Active Module GP2/GP4 General Purpose.....              | 38        |
| 4.4.3    | Active Module CAN4.....                                 | 43        |
| <b>5</b> | <b>TECHNICAL SPECIFICATIONS.....</b>                    | <b>46</b> |
| 5.1      | ABSOLUTE MAXIMUM RATINGS .....                          | 46        |
| 5.2      | DC CHARACTERISTICS AND FUNCTIONAL OPERATING RANGE ..... | 47        |
| 5.3      | AC CHARACTERISTICS .....                                | 49        |
| 5.4      | PHYSICAL AND ENVIRONMENTAL SPECIFICATIONS .....         | 51        |

# 1 Before Starting



**Note:** *updated version of FlashRunner HS Software is available on SMH Technologies website. ([www.smh-tech.com](http://www.smh-tech.com)). Please check it out before continuing reading this documentation.*

## 1.1 Important Notice to Users

While every effort has been made to ensure the accuracy of all information in this document, SMH Technologies assumes no liability to any party for any loss or damage caused by errors or omissions or by statements of any kind in this document, its updates, supplements, or special editions, whether such errors are omissions or statements resulting from negligence, accidents, or any other cause.

## 1.2 Safety



**Note:** *Keep FlashRunner HS always in a well-ventilated area in order to prevent product overheating, which could affect product performances and, if maintained for long time, it could damage product hardware components.*

FlashRunner HS is a low-voltage device. However, when integrating it inside an automatic test equipment or when interfacing it with other systems, take all precautions in order to avoid electrical shocks due to, for example, different ground references.

Make all connections to the target system before applying power to the instrument.

To protect FlashRunner HS against electrostatic discharge (ESD), always connect yourself to ground (e.g. via wrist straps) when handling the instrument.

Always store FlashRunner HS inside an antistatic bag when not in use.



**Disclaimer:** *when integrating FlashRunner HS please pay attention to place it in a well-ventilated area to avoid overheating related damages.*

*FlashRunner HS has been designed to reach 90 °C (194 °F) in normal operating conditions over its ends.*

## 1.3 EMC immunity and Fail-safe Recovery

FlashRunner HS has been designed to be immune to electromagnetic interference. FlashRunner HS functionalities include operating with external target devices (e.g. *serial memories, microprocessors...*).

To avoid any issue during the interaction with target devices and to guarantee task reliability, FlashRunner HS is able to correctly detect **critical fault conditions** and take suitable mitigating measures such as *fail-safe state* and *functional reset procedure*.

## 1.4 Getting Technical Support

SMH Technologies is continuously working to improve FlashRunner HS firmware and to release programming algorithms for new devices. SMH Technologies offers a fast and knowledgeable technical support to all of its customers and is always available to solve specific problems or meet specific needs.

To get in touch with SMH Technologies, please refer to the contact information below.

Phone: +39 0434 421111

Fax: +39 0434 639021

Technical Support: [support@smh-tech.com](mailto:support@smh-tech.com)

## 1.5 Additional Documentation

This user's manual provides information about how to setup FlashRunner HS and its hardware characteristics.

For information about FlashRunner HS commands and their syntax, please refer to the FlashRunner Programmer's Manual, included (in PDF format) in FlashRunner setup.

## 2 Overview

### 2.1 What is FlashRunner HS?

FlashRunner HS is a multi-board distributed system designed for high-speed multi-device true-parallel Pre-Programming and In-System Programming. It represents the natural evolution of the FlashRunner 2.0 technology. FlashRunner HS has been designed to program eMMC memories, NAND memories, microcontrollers and serial memories. This means:

- extremely fast programming (the fastest in-system programming system on the market);
- standalone operations for easy integration;
- brand new Graphical User Interface focused on Setup, Production and Security features;
- multi-board distributed system to guarantee programming signal integrity even in case of high-speed operations.

FlashRunner HS is composed by a single-board central unit named FlashRunner HS Control Unit (FR HS CU) and by up to 8 single-board peripheral units named FlashRunner HS Active Module (FR HS AM). The peripheral units are intended to be placed in the near proximity of the target device. Control Unit provides data, commands and power supply to Active Module through an USB type-C cable.

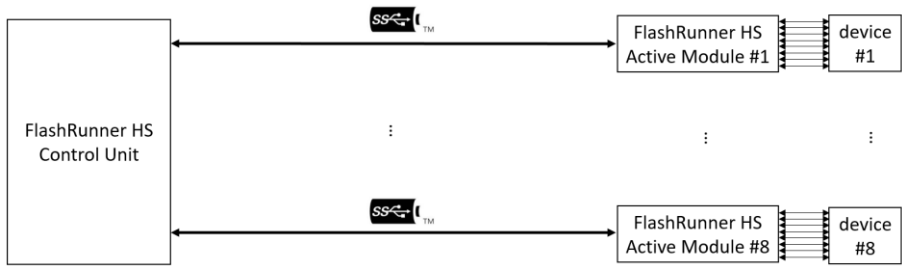


Figure 1: FlashRunner HS Control Unit-Active Module architecture

2.1.1 FlashRunner HS Control Unit



Figure 2: FlashRunner HS Control Unit

FlashRunner HS Control Unit is equipped with 8 USB type-C ports to connect up to 8 FlashRunner HS Active Modules.

### General features

- up to 8 USB-C connection to as many Active Modules;
- easy integration;
- standalone operations;
- controllable by host system through LAN, USB, or parallel control lines;
- support most ISP/PP protocols (BDM, JTAG, DAP, SPI, QSPI, OSPI, eMMC, SWD, I2C, MON, ICC, SCI, UART, CAN etc.);
- highly modular, flexible, fully configurable;
- robust design for production environments.

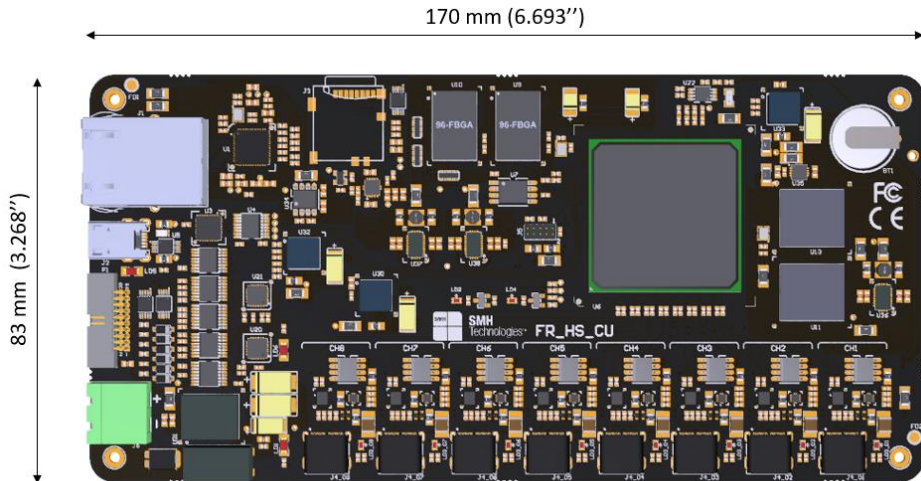


Figure 3: FlashRunner HS Control Unit (top view)

## Hardware features

- LAN Communication Interface (10/100/1000Mbps IEEE 802.3-compliant Ethernet transceiver);
- Digitally isolated<sup>1</sup> USB-UART communication interface;
- Digitally isolated parallel interface for standalone operations;
- 8 USB type-C ports to connect as many peripheral boards;
- Intel SOC FPGA with 800MHz dual-core ARM Cortex-A9 hard processor system (HPS) with support for symmetric and asymmetric multiprocessing;
- 1 GB on-board RAM DDR3 memory;
- Micro SD Card reader (up to 256 GB);
- 256 GB on-board eMMC memory;
- On-board timekeeper and calendar for time-stamped log file;

## Software features

- Linux based operating system;
- FlashRunner HS WorkBench: friendly Graphical User Interface (Windows, Linux and Mac compatible)
- Controllable by any host system through a terminal utility and simple ASCII protocol;
- Up to 32 hardware-selectable projects in Standalone Mode, unlimited software-selectable projects in Host Mode;
- Interface Library DLL to control the instrument from within user written applications;
- Optional customer binary file cryptography to ensure antipiracy protection;
- Log file and production report file;
- Erase, blank check, program, read, verify, oscillator trimming, etc.

---

<sup>1</sup> performance characteristics, in terms of isolation, superior to optocoupling

### 2.1.2 FlashRunner HS Active Module

FlashRunner HS Active Module board is intended as a peripheral unit of FlashRunner HS Control Unit. Its compact and very small form factor allows to place it in the near proximity of the target device. Data, commands and power supply are provided by Control Unit through a single USB type-C cable.

FlashRunner HS Active Module is composed by:

- USB type-C port to be connected with FlashRunner HS Control Unit;
- powerful logic functionalities to implement all the communication protocols needed to interface target devices;
- one, two or four ISP/PP device connectors to communicate with the devices to be programmed;
- power conversion section to supply the board and to provide programmable voltages to the output.

FlashRunner HS Active Modules are available in several different models:

- FlashRunner HS eMMC1 Active Module;
- FlashRunner HS OSPI1 Active Module;
- FlashRunner HS eMMC2 Active Module;
- FlashRunner HS OSPI2 Active Module;
- FlashRunner HS NAND Active Module;
- FlashRunner HS GP2 General Purpose Active Module;
- FlashRunner HS GP4 General Purpose Active Module;
- FlashRunner HS CAN4 Active Module.

Any combination of the above listed FlashRunner HS Active Modules may be connected to a FlashRunner HS Control Unit to obtain a mixed programming system.

### FlashRunner HS eMMC1/OSPI1 Active Module

FlashRunner HS eMMC1/OSPI1 Active Module has been specifically designed for eMMC memory device programming (1-bit, 4-bit and 8-bit data bus supported) or Octo-SPI memory device programming (8-bit data bus supported) and is characterized by the following features:

- very small form factor:
  - 32mm x 63mm x 9mm without case;
  - 32mm x 67mm x 15mm with case;
- USB type-C port to be connected with FlashRunner HS Control Unit;
- one ISP/PP device connector (Right-Angle or Vertical, 30-position, 2-row, 1.27mm) to communicate with the target device:
  - 12 digital bidirectional communication lines (with 6 ground reference lines);
  - cutting-edge digital line driver to improve performance;
  - programmable IOs voltage and main power line VPROG0 (range 1.2V – 3.3V @ up to 300mA);
  - programmable auxiliary power line VPROG1 (range 1.2V – 5.5V @ up to 300mA);
  - external power line (15V) and command line;
- power conversion section to supply the board and to provide programmable voltages to the output;
- output power lines voltage and current continuous monitoring.



Figure 4: FlashRunner HS eMMC1/OSPI1 Active Module with right-angle device connector

### FlashRunner HS eMMC2/OSPI2 Active Module

FlashRunner HS eMMC2/OSPI2 Active Module has been specifically designed for eMMC memory device programming (two devices at the same time, 1-bit, 4-bit and 8-bit data bus supported) or Octo-SPI memory device programming (two devices at the same time, 8-bit data bus supported).

It is characterized by the following features:

- very small form factor:
  - 64mm x 63mm x 9mm without case;
  - 64mm x 67mm x 15mm with case;
- USB type-C port to be connected with FlashRunner HS Control Unit;
- 2 ISP/PP device connectors (2 Right-Angle connectors or 2 Vertical connectors, 30-position, 2-row, 1.27mm) to communicate in parallel with two eMMC target device;
- for each target device:
  - 12 digital bidirectional communication lines (with 6 ground reference lines);
  - cutting-edge digital line driver to improve performance;
  - programmable IOs voltage and main power line (range 1.2V – 3.3V @ up to 300mA);
  - programmable auxiliary power line (range 1.2V – 5.5V @ up to 300mA);
  - external power line (15V) and command line;
- power conversion section to supply the board and to provide programmable voltages to the output;
- output power lines voltage and current continuous monitoring.

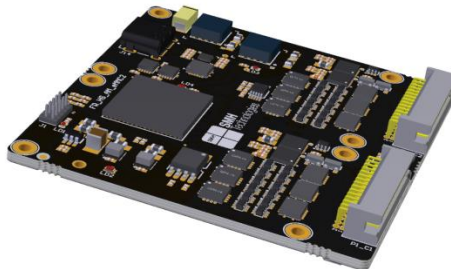


Figure 5: FlashRunner HS eMMC2/OSPI2 Active Module with right-angle device connector

## FlashRunner HS NAND Active Module

FlashRunner HS NAND Active Module has been specifically designed for NAND flash memory device programming (8-bit, 16-bit data bus supported). It is characterized by the following features:

- very small form factor:
  - 64mm x 63mm x 9mm without case;
  - 64mm x 67mm x 15mm with case;
- USB type-C port to be connected with FlashRunner HS Control Unit;
- ISP/PP device connector (divided into 2 Right-Angle connectors or 2 Vertical connectors, 30-position, 2-row, 1.27mm) to communicate with one Parallel NAND target device;
- for each target device:
  - 24 digital bidirectional communication lines (with 12 ground reference lines);
  - cutting-edge digital line driver to improve performance;
  - programmable IOs voltage and main power line (range 1.2V – 3.3V @ up to 300mA);
  - programmable auxiliary power line (range 1.2V – 5.5V @ up to 300mA);
  - external power line (15V) and command line;
- power conversion section to supply the board and to provide programmable voltages to the output;
- output power lines voltage and current continuous monitoring.



Figure 6: FlashRunner HS NAND Active Module with right-angle device connector

### FlashRunner HS GP2 General Purpose Active Module

FlashRunner HS GP2 General Purpose Active Module has been designed for general purpose devices programming (up to 4-bit data bus) and is characterized by the following features:

- very small form factor:
  - 40mm x 66mm x 9mm without case;
  - 40mm x 66mm x 15mm with case;
- USB type-C port to be connected with FlashRunner HS Control Unit;
- Two ISP/PP device connectors (Right-Angle or Vertical, 20-position, 2-row, 1.27mm) to communicate with the device to be programmed;
- for each one of them:
  - 8 digital bidirectional communication lines (with 4 ground reference lines);
  - programmable IOs voltage and main power line (range 1.65V – 5.5V @ up to 300mA);
  - programmable auxiliary power line (range 5.5V – 13.5V @ up to 300mA);
  - external power line and command line;
- power conversion section to supply the board and to provide programmable voltages to the output;
- output power lines voltage and current continuous monitoring.

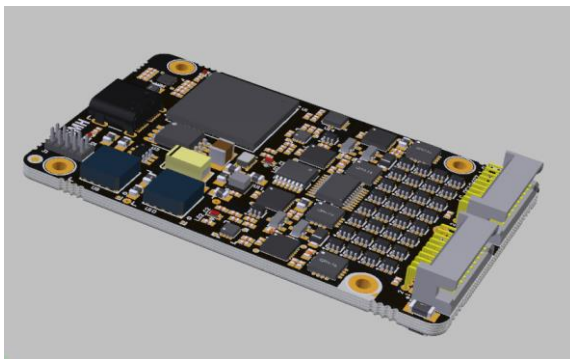


Figure 7: FlashRunner HS GP2 Active Module with right-angle device connectors

### FlashRunner HS GP4 General Purpose Active Module

FlashRunner HS GP4 General Purpose Active Module has been designed for general purpose devices programming (up to 4-bit data bus) and is characterized by the following features:

- very small form factor:
  - 80mm x 66mm x 9mm without case;
  - 80mm x 66mm x 15mm with case;
- USB type-C port to be connected with FlashRunner HS Control Unit;
- Four ISP/PP device connectors (Right-Angle or Vertical, 20-position, 2-row, 1.27mm) to communicate with the device to be programmed;
- for each one of them:
  - 8 digital bidirectional communication lines (with 4 ground lines);
  - programmable IOs voltage and main power line (range 1.65V – 5.5V @ up to 300mA);
  - programmable auxiliary power line (range 5.5V – 13.5V @ up to 300mA);
  - external power line (15V) and command line;
- power conversion section to supply the board and to provide programmable voltages to the output;
- output power lines voltage and current continuous monitoring.



Figure 8: FlashRunner HS GP4 Active Module with right-angle device connectors

### FlashRunner HS CAN4 Active Module

FlashRunner HS CAN4 Active Module has been designed for interfacing CAN/CAN FD devices and is characterized by the following features:

- very small form factor:
  - 80mm x 66mm x 9mm without case;
  - 80mm x 66mm x 15mm with case;
- USB type-C port to be connected with FlashRunner HS Control Unit;
- Four ISP/PP device connectors (Right-Angle or Vertical, 20-position, 2-row, 1.27mm) to communicate with the device to be programmed;
- for each one of them:
  - CANH/CANL Input/Output differential CAN bus **galvanically isolated** from Active Module power supply;
  - reference ground GND\_ISO;
  - external power line (15V) and command line;
- power conversion section to supply the board and to provide an isolated 5V voltage to the CAN/CAN FD transceiver.



Figure 9: FlashRunner HS CAN4 Active Module with right-angle device connectors

### 2.1.3 FlashRunner HS Control Unit link

FlashRunner HS Control Unit and FlashRunner HS Active Modules are connected through a USB 3.1 Gen1 SuperSpeed type-C cable with the following features:

- USB type-C symmetric flippable connector at both side;
- bidirectional high speed differential link (up to 2.5 Gbps);
- cable length up to 6 meters;
- power supply line (up to 20V, up to 3A);



Figure 10: USB type C connectors

## Package Checklist

FlashRunner HS Control Unit package include the following items:

Table 1: FlashRunner HS Control Unit Package Checklist

| Qty. | Description                                      |
|------|--|
| 1    | FlashRunner HS Control Unit                      |
| 1    | Ethernet cross cable 2 meter RJ45                |
| 1    | USB 2.0 cable 1.8 meter (type-A to type-B micro) |
| 1    | 15V 120W AC/DC Wall Switching Power Adapter      |
| 1    | 3-Year Warranty Sheet                            |
| 1    | FR_HS_CU Pinout Reference                        |
| 1    | FR_HS_CU Quick Start Guide                       |
| 1    | FR_HS_CU Connection Reference Document           |
|      |  |

FlashRunner HS Active Module package include the following items:

Table 2: FlashRunner HS Active Module Package Checklist

| Qty. | Description  |
|------|--|
| 1    | FlashRunner HS Active Module                               |
| 1    | USB 3.1 Gen1 SuperSpeed cable 1.5 meter (type-C to type-C) |
| 1    | 3-Year Warranty Sheet                                      |
| 1    | FR_HS_AM Pinout Reference                                  |
| 1    | FR_HS_AM Quick Start Guide                                 |
| 1    | FR_HS_AM Connection Reference Document                     |

## 2.2 Hardware Overview

### 2.2.1 Power Supply

FlashRunner HS Control Unit is powered through 15V power supply connected to DC power jack. FlashRunner HS Active Module is powered by Control Unit through a USB type-C cable.

### 2.2.2 Control Connector

Control Connector, on FlashRunner HS Control Unit, is used by an host system in order to control FlashRunner HS instead of communicating with USB port or LAN port.

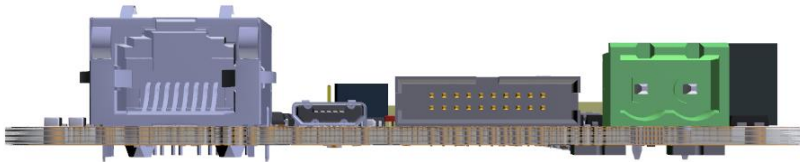


Figure 11: side view of FlashRunner HS Control Unit with LAN connector, USB-UART control port, control connector and power jack.

Through the Control Interface, it is possible:

- to select a project (up to 32 selection);
- to start a project;
- to check project state;
- to check channels programmer state.

For further details please refer to chapter 5.

### 2.2.3 LAN Connector

LAN Connector is used to communicate with host PC system. Use provided cross cable to connect FlashRunner HS Control Unit with your PC. For more information, please refer to chapter 2.2.3 and to related documentation on FlashRunner HS Programmer's Manual in order to correctly setup your host PC system.

### 2.2.4 USB Connector

Alternatively, communication with the host PC can be done with the micro-B USB connector. Use the provided USB cable to connect FlashRunner HS Control Unit with your PC. For more information, please refer to chapter 4.3 and to related documentation on FlashRunner HS Programmer's Manual in order to correctly setup your host PC system.

### 2.2.5 ISP Connectors

ISP/PP device connector, on FlashRunner HS Active Module, allows to connect the system programmer to the target device. For further information, please refer to section 4.4.

### 2.2.6 LEDs

On FlashRunner HS Control Unit, the following LEDs are available:

- POWER: the Control Unit is turned on;
- STATUS: shows system status (still yellow: status ok, blinking yellow: error);
- CHANNEL 1 to 8: shows programming result (green: programming done successfully or programming system ready to run, yellow: programming in progress, red: programming failed; off: remote Active Module not recognized).

On FlashRunner HS Active Module, only one LED is available:

- CHANNEL STATUS: shows programming result (green: programming done successfully or programming system ready to run, yellow: programming in progress, red: programming failed).

## Programming Drivers and Licenses

FlashRunner HS includes programming drivers for several devices. In order to program a specific device, however, a specific license file for that device, that family or that silicon producer must be purchased.



**Note:** *FlashRunner HS comes already preinstalled with the license(s) you specified at the moment of purchase. You can purchase additional licenses at any future moment.*

Programming drivers and license files are stored inside FlashRunner HS Control Unit storage memory (see the FlashRunner HS Programmer's Manual for more information).

There are several types of licensing:

- Single device license: only that single device programming is enabled
- Family license: only a single device family programming is enabled
- Silicon Producer license: only a single device silicon producer is enabled

### 2.2.7 Installing New Licenses

When you buy an additional license for a specific device, you will get a license file (.lic);

If you ordered a new device development, you will also receive:

- A driver file (.so)

For detailed information on how to update FlashRunner HS please check FlashRunner HS Programmer's Manual.

## 2.3 Upgrading the Firmware

FlashRunner HS firmware can be easily upgraded using the FlashRunner HS WorkBench software. For more information, please refer to the FlashRunner HS Programmer's Manual.

# 3 System Setup

## 3.1 Overview



**Note:** *Keep FlashRunner HS always in a well-ventilated area in order to prevent product overheating, which could affect product performance and, if maintained for long time, it could damage product hardware components.*

This chapter will explain how to set up FlashRunner HS for the first time. The new FlashRunner HS WorkBench project Wizard allow an easy and fast system setup.

When moving FlashRunner HS to the production environment, you can take full advantage of the FlashRunner HS WorkBench GUI Production Tool (Host mode) or let the instrument to be controlled through the Control interface (Standalone mode). For more information about Standalone mode and Host mode, see the FlashRunner HS Programmer's Manual.

## 3.2 Software Setup

Please refer to “System Setup/Upgrade” chapter of FlashRunner HS Programmer's Manual.

## 3.3 Hardware Setup

To set up FlashRunner HS, you must follow the steps below with the following order:

- Interface FlashRunner HS Active Module with your test/programming equipment;

- Connect FlashRunner HS Active Module to FlashRunner HS Control Unit;
- Connect FlashRunner HS Control Unit to host PC system (if you use it in Host Mode);
- Provide power to FlashRunner HS Control Unit;
- Set up LAN settings (if you use the Ethernet connection);

### **3.3.1 Interfacing with your Test/Programming equipment**

Build one or more ISP/PP cables to connect FlashRunner HS Active Module connector to your target board. Wire up all the required connections (power, oscillator, ISP/PP signals) to target microcontrollers using PinMap tool (for more details please check related chapter on FlashRunner HS Programmer's Manual).

### **3.3.2 Connecting Control unit to Active Module**

Connect at least one FlashRunner HS Active Module to FlashRunner HS Control Unit through the provided USB type-C cable. FlashRunner HS Active Module comes with a proper USB type-C cable.

### **3.3.3 Connecting to the Host PC System**

You can connect FlashRunner HS Control Unit to the host system through either the USB or LAN port.

FlashRunner HS Control Unit comes with a USB cable and an Ethernet cross cable to connect directly to a host PC.

### **3.3.4 Powering Up**

Power up FlashRunner HS Control Unit by connecting included power supply to DC plug connector.

### **3.3.5 Setting Up LAN Settings**

If you connected FlashRunner HS Control Unit to the host PC using the Ethernet connection, you need to set up the FlashRunner HS Control Unit IP address. To learn how to set up the FlashRunner HS Control Unit address, please refer to the FlashRunner HS Programmer's Manual.

# 4 Connectors

## 4.1 Overview

FlashRunner HS Control Unit may be connected to the programming system through:

- Control parallel connector (20-position, 2-row, 1.25mm pitch, MALE);
- additionally, a micro type-B USB or an Ethernet connector are available to allow a full control by host system.

FlashRunner HS eMMC, dual eMMC and NAND Active Module may be connected to the target devices to be programmed through:

- ISP/PP connector (30-position, 2-row, 1.27mm pitch, male, vertical or right angle).

FlashRunner HS GP2 and GP4 Active Module may be connected to the target devices to be programmed through:

- ISP/PP connector (20-position, 2-row, 1.27mm pitch, male, vertical or right angle).

## 4.2 Control Connector

Control Connector is used to communicate with the host system and for integration with automatic programming equipment.



**Note:** *all control signals are ground-referenced to GND\_I (separated from HS Control Unit common GND) and power-referenced to 5V\_I\_FUSE (both obtained with an isolated DC/DC converter). This allows a host system to safely communicate with FlashRunner HS Control Unit even when the target boards have different ground reference compared to the host system's (and it's not possible to connect them together).*



Figure 12: Control Interface connector - Right Angle, 20-position, 2-row, 1.27mm pitch – pin numbering

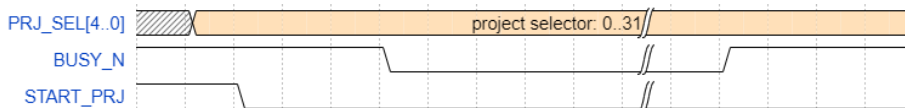


Figure 13: Control Interface: project start timing diagram (100ms/div)

Setting PRJ\_SEL[4..0] allows to select among 32 different projects stored in advance into the programming system (i.e. SDCARD). Selectable projects are named as *project0.prj*, *project1.prj*, ..., *project30.prj*, *project31.prj*.

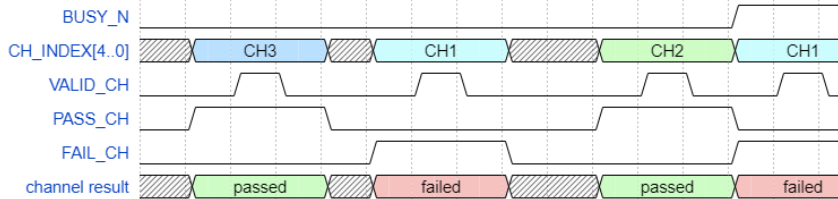


Figure 14: Control Interface: before the overall project end, single channel result is reported when the channel finishes its task - timing diagram (500us/div)

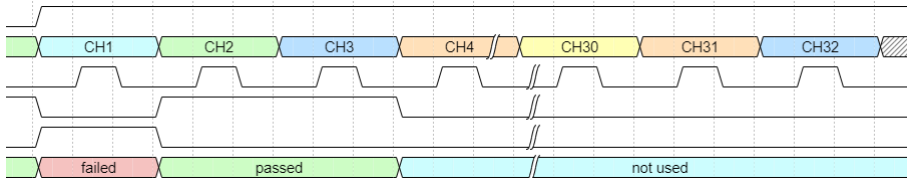


Figure 15: Control Interface: after overall project end, all channel results are reported sequentially - timing diagram (500us/div)

A typical sequence of commands given through the Control Interface is listed in the following:

- drive PRJ\_SEL[4..0] input signals to select up to 32 different projects previously stored into FlashRunner HS;
- if the programmer is not BUSY\_N, drive the START\_PRJ input signal to trigger the project start;
- before the end of the overall project execution, if a single channel finishes its task, the result is reported (figure 14);
- when the last channel terminates its task, the result is reported (figure 14) and the BUSY\_N signal goes high (end of project execution);
- when BUSY\_N signal goes high, the channel results of the entire sequence of channels (CH1..CH32) are reported on CH\_INDEX[4..0], FAIL\_CH, PASS\_CH and VALID\_CH (figure 15).

Table 3: Control Connector Signals

| Pin # | Signal Name | Input/Output | Description   |
|-------|-------------|--------------|---|
| 1     | PRJ_SEL[0]  | I            | Project selection 0 (referenced to GND_I)                     |
| 2     | CH_INDEX[0] | O            | Channel Index 0 (referenced to GND_I)                         |
| 3     | PRJ_SEL[1]  | I            | Project selection 1 (referenced to GND_I)                     |
| 4     | CH_INDEX[1] | O            | Channel Index 1 (referenced to GND_I)                         |
| 5     | PRJ_SEL[2]  | I            | Project selection 2 (referenced to GND_I)                     |
| 6     | CH_INDEX[2] | O            | Channel Index 2 (referenced to GND_I)                         |
| 7     | PRJ_SEL[3]  | I            | Project selection 3 (referenced to GND_I)                     |
| 8     | CH_INDEX[3] | O            | Channel Index 3 (referenced to GND_I)                         |
| 9     | PRJ_SEL[4]  | I            | Project selection 4 (referenced to GND_I)                     |
| 10    | CH_INDEX[4] | O            | Channel Index 4 (referenced to GND_I)                         |
| 11    | START_PRJ   | I            | Selected Project START (referenced to GND_I, active low)      |
| 12    | FAIL_CH     | O            | FAIL on selected channel (referenced to GND_I)                |
| 13    | GND_I       | -            | Isolated GND  |
| 14    | PASS_CH     | O            | PASS on selected channel (referenced to GND_I)                |
| 15    | BUSY_N      | O            | Selected Project BUSY_N (referenced to GND_I, active low)     |
| 16    | VALID_CH    | O            | Channel PASS and PASS/FAIL valid signal (referenced to GND_I) |
| 17    | GND_I       | -            | Isolated GND  |
| 18    | GND_I       | -            | Isolated GND  |
| 19    | 5V_I_FUSE   | -            | 5V output (output, fuse-protected, referenced to GND_I)       |
| 20    | 5V_I_FUSE   | -            | 5V output (output, fuse-protected, referenced to GND_I)       |

## 4.3 USB Connector

The USB micro type-B connector can be used to communicate with the host system.



*Note: USB signals are ground-referenced to GND\_USB (separated from HS Control Unit common GND and from GND\_I).*

## 4.4 ISP/PP Connector

### 4.4.1 Active Module eMMC/OSPI/NAND

ISP/PP connector, on FlashRunner HS Active Module, is featured by several input/output communication lines, power lines (15V) and command lines. On FlashRunner HS eMMC1/OSPI1 Active Module is available in vertical male (Samtec TFM-115-11-L-D) and right-angle format (Samtec TFM-115-01-L-D-RA). On FlashRunner HS eMMC2/OSPI2/NAND Active Module is available in vertical female (Samtec SFM-115-01-L-D) and right-angle format (Samtec TFM-115-01-L-D-RA).

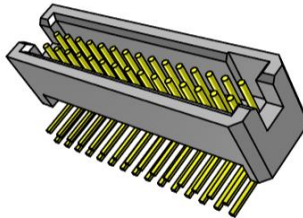


Figure 16: ISP/PP connector – Right Angle, 30-pos, 2-row, 1.27mm pitch (TFM-115-01-L-D-RA)

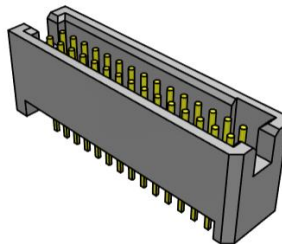


Figure 17: ISP/PP connector - Vertical male, 30-pos, 2-row, 1.27mm pitch (TFM-115-11-L-D)

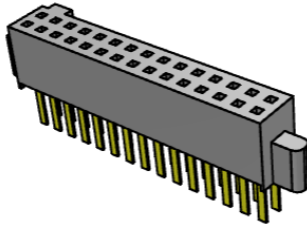


Figure 18: ISP/PP connector – Vertical female, 30-pos, 2-row, 1.27mm pitch (SFM-115-01-L-D)

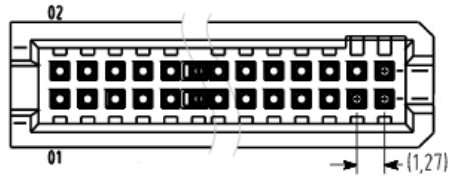


Figure 19: ISP/PP connector – pin numbering

Table 2: ISP/PP Connector Signals for FlashRunner HS eMMC/OSPI/NAND Active Module

| Pin # | Signal Name   | Description                 |
|-------|---------------|-----------------------------|
| 30    | VPROG0        | Programmable voltage 0      |
| 29    | GND           | Ground                      |
| 28    | VPROG1        | Programmable voltage 1      |
| 27    | GND           | Ground                      |
| 26    | GND           | Ground                      |
| 25    | GND           | Ground                      |
| 24    | DIO_0         | Digital IO 0 Signal         |
| 23    | DIO_1         | Digital IO 1 Signal         |
| 22    | DIO_GND_0_1   | Ground DIO_0, DIO_1         |
| 21    | DIO_2         | Digital IO 2 Signal         |
| 20    | DIO_3         | Digital IO 3 Signal         |
| 19    | DIO_GND_2_3   | Ground DIO_2, DIO_3         |
| 18    | DIO_4         | Digital IO 4 Signal         |
| 17    | DIO_5         | Digital IO 5 Signal         |
| 16    | DIO_GND_4_5   | Ground DIO_4, DIO_5         |
| 15    | DIO_6         | Digital IO 6 Signal         |
| 14    | DIO_7         | Digital IO 7 Signal         |
| 13    | DIO_GND_6_7   | Ground DIO_6, DIO_7         |
| 12    | DIO_8         | Digital IO 8 Signal         |
| 11    | DIO_9         | Digital IO 9 Signal         |
| 10    | DIO_GND_8_9   | Ground DIO_8, DIO_9         |
| 9     | DIO_10        | Digital IO 10 Signal        |
| 8     | DIO_11        | Digital IO 11 Signal        |
| 7     | DIO_GND_10_11 | Ground DIO_10, DIO_11       |
| 6     | GND           | Ground                      |
| 5     | GND           | Ground                      |
| 4     | CH_CMD        | Generic command line        |
| 3     | CH_CMD_GND    | Generic command line Ground |
| 2     | PWR           | Power supply (15V)          |
| 1     | PWR           | Power supply (15V)          |

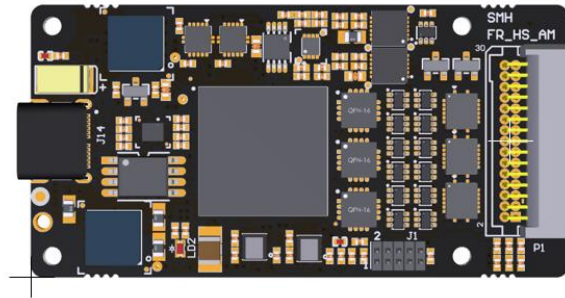


Figure 20: FlashRunner HS eMMC1/OSPI1 Active Module right-angle device connectors (top view)

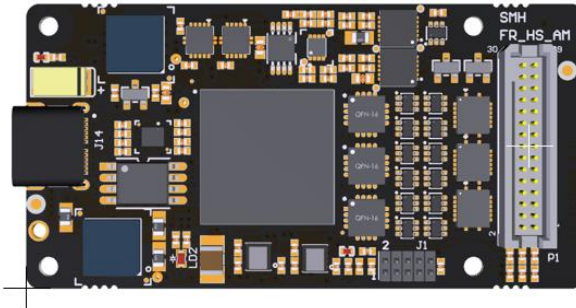


Figure 21: FlashRunner HS eMMC1/OSPI1 Active Module vertical device connectors (top view)

| Item               | X [mm] | Y [mm] |
|--------------------|--------|--------|
| Left-Bottom corner | 0.00   | 0.00   |
| Top-Right corner   | 63.00  | 32.00  |
| Connector P1       | 56.14  | 16.00  |

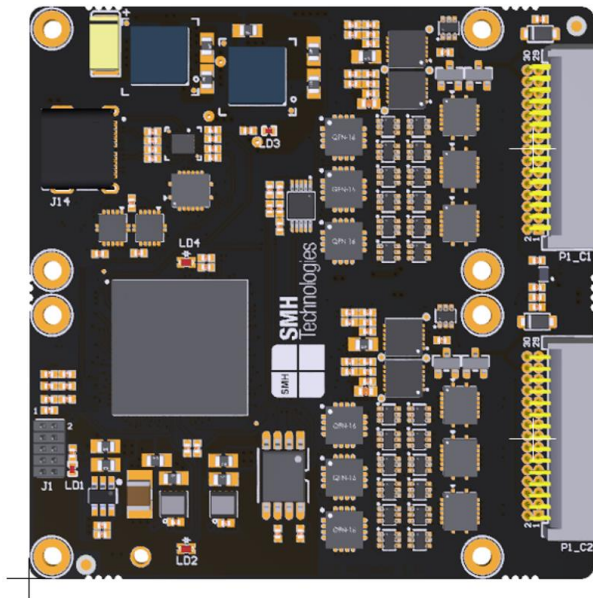


Figure 22: FlashRunner HS eMMC2/OSPI2/NAND Active Module right angle connectors (top view)

| Item               | X [mm] | Y [mm] |
|--------------------|--------|--------|
| Left-Bottom corner | 0.00   | 0.00   |
| Top-Right corner   | 63.00  | 64.00  |
| Connector P1_C1    | 56.14  | 48.00  |
| Connector P1_C2    | 56.14  | 16.00  |

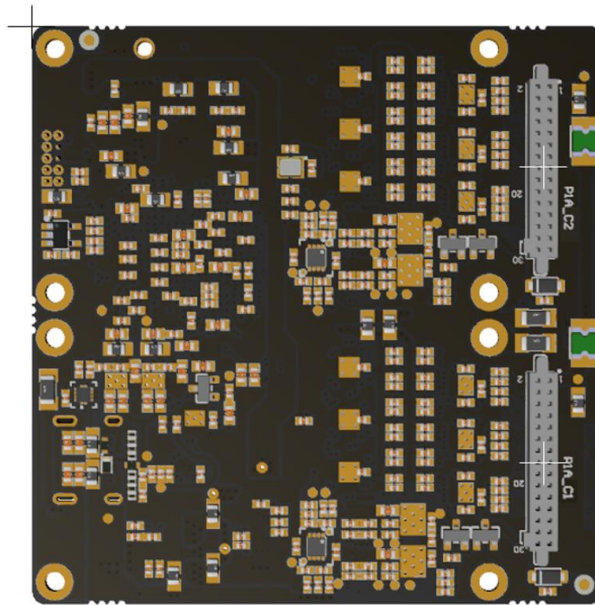


Figure 23: FlashRunner HS eMMC2/NAND Active Module vertical female connectors (bottom view)

| Item                | X [mm] | Y [mm] |
|---------------------|--------|--------|
| Top-Left corner     | 0.00   | 0.00   |
| Right-Bottom corner | 63.00  | 64.00  |
| Connector P1_C1     | 56.14  | 48.00  |
| Connector P1_C2     | 56.14  | 16.00  |

## 4.4.2 Active Module GP2/GP4 General Purpose

On FlashRunner HS GP2/GP4 General Purpose Active Module is available in vertical female (Samtec SFM-110-01-L-D) and right-angle format (Samtec TFM-110-01-L-D-RA).

Table 5: ISP/PP Connector Signals for FlashRunner HS General Purpose Active Module

| Pin # | Signal Name | Description                 |
|-------|-------------|-----------------------------|
| 20    | VPROG0      | Programmable voltage 0      |
| 19    | GND         | Ground                      |
| 18    | VPROG1      | Programmable voltage 1      |
| 17    | GND         | Ground                      |
| 16    | DIO_0       | Digital IO 0 Signal         |
| 15    | DIO_1       | Digital IO 1 Signal         |
| 14    | DIO_GND_0_1 | Ground DIO_0, DIO_1         |
| 13    | DIO_2       | Digital IO 2 Signal         |
| 12    | DIO_3       | Digital IO 3 Signal         |
| 11    | DIO_GND_2_3 | Ground DIO_2, DIO_3         |
| 10    | DIO_4       | Digital IO 4 Signal         |
| 9     | DIO_5       | Digital IO 5 Signal         |
| 8     | DIO_GND_4_5 | Ground DIO_4, DIO_5         |
| 7     | DIO_6       | Digital IO 6 Signal         |
| 6     | DIO_7       | Digital IO 7 Signal         |
| 5     | DIO_GND_6_7 | Ground DIO_6, DIO_7         |
| 4     | CH_CMD      | Generic command line        |
| 3     | CH_CMD_GND  | Generic command line Ground |
| 2     | PWR         | Power supply (15V)          |
| 1     | PWR         | Power supply (15V)          |

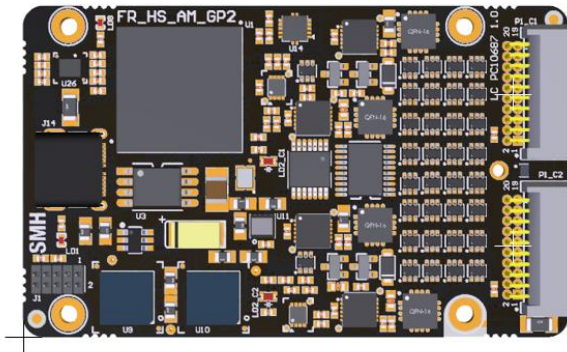


Figure 24: FlashRunner HS GP2 Active Module with right-angle device connectors (top view)

| Item               | X [mm] | Y [mm] |
|--------------------|--------|--------|
| Left-Bottom corner | 0.00   | 0.00   |
| Top-Right corner   | 66.00  | 40.00  |
| Connector P1_C1    | 59.20  | 29.39  |
| Connector P1_C2    | 59.20  | 10.86  |

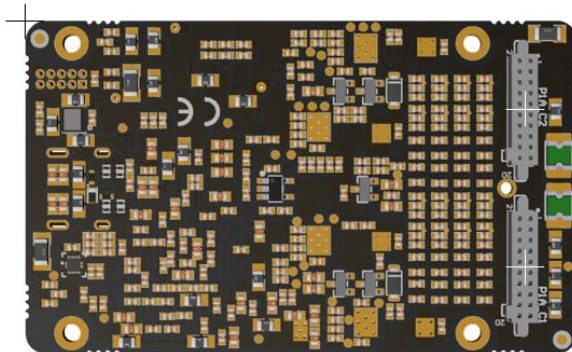


Figure 25: FlashRunner HS GP2 Active Module with vertical device connectors (bottom view)

| Item                | X [mm] | Y [mm] |
|---------------------|--------|--------|
| Top-Left corner     | 0.00   | 0.00   |
| Bottom-Right corner | 66.00  | 40.00  |
| Connector P1_C1     | 59.20  | 29.39  |
| Connector P1_C2     | 59.20  | 10.86  |

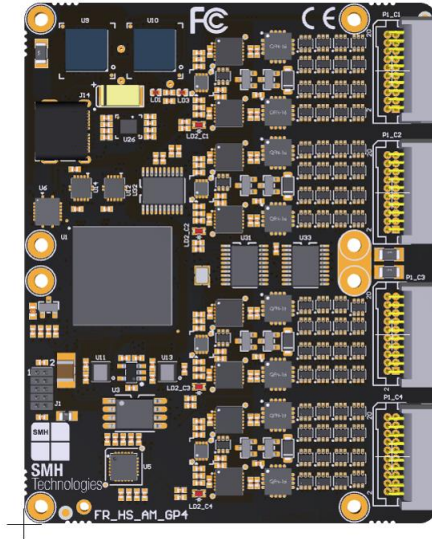


Figure 26: FlashRunner HS GP4 Active Module with right-angle device connectors (top view)

| Item               | X [mm] | Y [mm] |
|--------------------|--------|--------|
| Left-Bottom corner | 0.00   | 0.00   |
| Top-Right corner   | 63.00  | 80.00  |
| Connector P1_C1    | 56.20  | 69.39  |
| Connector P1_C2    | 56.20  | 50.86  |
| Connector P1_C3    | 56.20  | 29.14  |
| Connector P1_C4    | 56.20  | 10.61  |

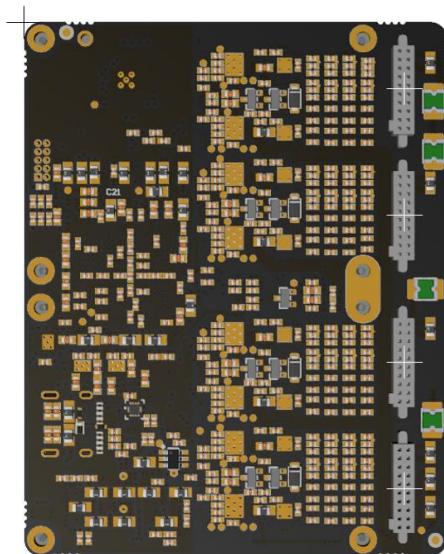


Figure 27: FlashRunner HS GP4 Active Module with vertical device connectors (bottom view)

| Item                | X [mm] | Y [mm] |
|---------------------|--------|--------|
| Top-Left corner     | 0.00   | 0.00   |
| Bottom-Right corner | 63.00  | 80.00  |
| Connector P1_C1     | 56.20  | 69.39  |
| Connector P1_C2     | 56.20  | 50.86  |
| Connector P1_C3     | 56.20  | 29.14  |
| Connector P1_C4     | 56.20  | 10.61  |

### 4.4.3 Active Module CAN4

On FlashRunner HS CAN4 Active Module is available in vertical female (Samtec SFM-110-01-L-D) and right-angle format (Samtec TFM-110-01-L-D-RA).

Table 6: ISP/PP Connector Signals for FlashRunner HS General Purpose Active Module

| Pin # | Signal Name | Description                    |
|-------|-------------|--------------------------------|
| 20    | -           | Not Connected                  |
| 19    | -           | Not Connected                  |
| 18    | -           | Not Connected                  |
| 17    | -           | Not Connected                  |
| 16    | CANH        | CAN High Input/Output signal   |
| 15    | CANL        | CAN Low Input/Output signal    |
| 14    | GND_ISO     | Ground Reference for CANH/CANL |
| 13    | -           | Not Connected                  |
| 12    | -           | Not Connected                  |
| 11    | -           | Not Connected                  |
| 10    | -           | Not Connected                  |
| 9     | -           | Not Connected                  |
| 8     | -           | Not Connected                  |
| 7     | -           | Not Connected                  |
| 6     | -           | Not Connected                  |
| 5     | -           | Not Connected                  |
| 4     | CH_CMD      | Generic command line           |
| 3     | CH_CMD_GND  | Generic command line Ground    |
| 2     | PWR         | Power supply (15V)             |
| 1     | PWR         | Power supply (15V)             |

CANH/CANL signals with their reference ground GND\_ISO are isolated from the Active Module power supply.

Generic command line (CH\_CMD) and power supply (PWR, CH\_CMD\_GND) are not isolated from the Active Module power supply.

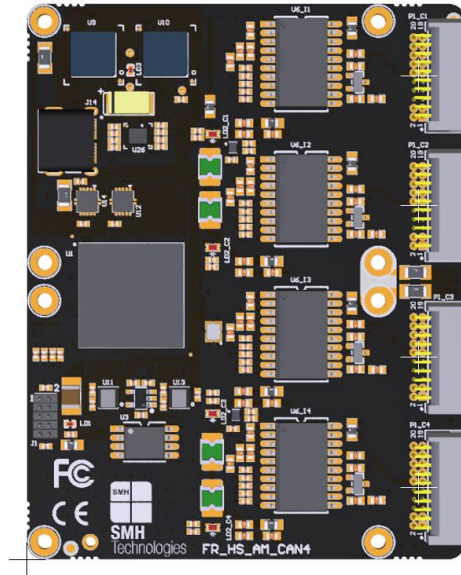


Figure 28: FlashRunner HS CAN4 Active Module with right-angle device connectors (top view)

| Item               | X [mm] | Y [mm] |
|--------------------|--------|--------|
| Left-Bottom corner | 0.00   | 0.00   |
| Top-Right corner   | 63.00  | 80.00  |
| Connector P1_C1    | 56.20  | 69.39  |
| Connector P1_C2    | 56.20  | 50.86  |
| Connector P1_C3    | 56.20  | 29.14  |
| Connector P1_C4    | 56.20  | 10.61  |

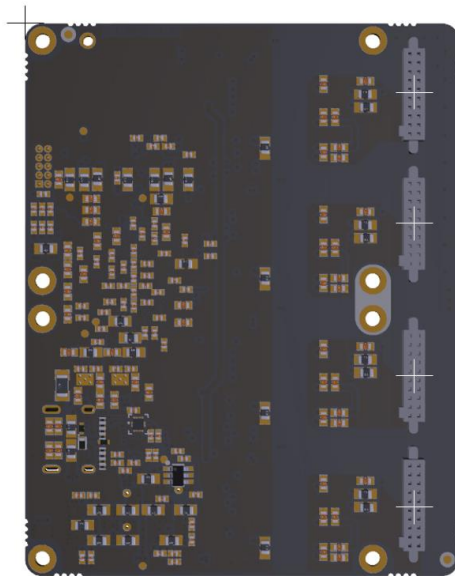


Figure 29: FlashRunner HS CAN4 Active Module with vertical device connectors (bottom view)

| Item                | X [mm] | Y [mm] |
|---------------------|--------|--------|
| Top-Left corner     | 0.00   | 0.00   |
| Bottom-Right corner | 63.00  | 80.00  |
| Connector P1_C1     | 56.20  | 69.39  |
| Connector P1_C2     | 56.20  | 50.86  |
| Connector P1_C3     | 56.20  | 29.14  |
| Connector P1_C4     | 56.20  | 10.61  |

# 5 Technical Specifications

## 5.1 Absolute Maximum Ratings

Table 7: Absolute Maximum Ratings

| Parameter  | Value          |
|--|----------------|
| <b>“POWER” Connector</b>   |                |
| Supply voltage on line POWER (reference GND)   | +15V           |
| <b>CONTROL Connector</b>   |                |
| Maximum input voltage on lines START, SEL[4..0], SG[1..0]                                    | -2V to +20V    |
| Maximum current on lines BUSY, PASS, FAIL  | ±10mA          |
| <b>“ISP GROUP” Connectors – eMMC Active Module – OSPI Active Module – NAND Active Module</b> |                |
| Maximum input voltage on lines DIO[11..0]  | -0,5V to +4,6V |
| Maximum current on lines DIO   | ±12mA          |
| Maximum current on line VPROG0   | 300 mA         |
| Maximum current on line VPROG1   | 300 mA         |
| <b>“ISP GROUP” Connectors – General Purpose Active Module</b>                                |                |
| Maximum input voltage on lines DIO[7..0]   | -0,5V to +6,5V |
| Maximum current on lines DIO   | ±32mA          |
| Maximum current on line VPROG0   | 300 mA         |
| Maximum current on line VPROG1   | 300 mA         |
| <b>CMD command line</b>  |                |
| Coil Supply Voltage  | 15V            |
| “CMD_ON” signal Voltage  | 3.3V           |
| Maximum current on lines CMD_ON  | ±24mA          |

## 5.2 DC Characteristics and Functional Operating Range

Table 8: DC Characteristics and Functional Operating Range

| Parameter   | Condition   | Value                   |       |                         |
|---|---|-------------------------|-------|-------------------------|
|   |   | Min                     | Typ   | Max                     |
| CONTROL Connector   |   |                         |       |                         |
| V <sub>IL</sub> (input low voltage) on lines START_PRJ, PRJ_SEL[4..0]   |   | 0V                      | -     | 0.8V                    |
| V <sub>IH</sub> (input high voltage) on lines START_PRJ, PRJ_SEL[4..0]  |   | 2.4V                    | -     | 15V                     |
| V <sub>OL</sub> (output low voltage) on lines BUSY, PASS/FAIL_CH, FAIL_CH, VAILD_CH   | I <sub>OL</sub> = 4mA   | -                       | -     | 0.8V                    |
| V <sub>OH</sub> (output high voltage) on lines BUSY, PASS/FAIL_CH, FAIL_CH, VAILD_CH  |   | 4.5V                    | -     | 5V                      |
| “ISP” Connectors - eMMC Active Module - OSPI Active Module – NAND Active Module   |   |                         |       |                         |
| V <sub>IL</sub> (input low voltage) on DIO lines  |   | -                       | -     | 0.35 V <sub>PROG0</sub> |
| V <sub>IH</sub> (input high voltage) on DIO lines   | Configured as digital lines   | 0.65 V <sub>PROG0</sub> | -     |                         |
| V <sub>OL</sub> (output low voltage) on DIO lines   | Configured as digital lines, V <sub>PROG0</sub> = 1.8V, I <sub>OL</sub> = 8mA   | -                       | -     | 0.65V                   |
| V <sub>OH</sub> (output high voltage) on DIO lines  | Configured as digital lines, V <sub>PROG0</sub> = 1.8V, I <sub>OH</sub> = -8mA  | 1.15V                   | -     | -                       |
| V <sub>OL</sub> (output low voltage) on DIO lines   | Configured as digital lines, V <sub>PROG0</sub> = 3.3V, I <sub>OL</sub> = 12mA  | -                       | -     | 1.15V                   |
| V <sub>OH</sub> (output high voltage) on DIO lines  | Configured as digital lines, V <sub>PROG0</sub> = 3.3V, I <sub>OH</sub> = -12mA | 2.15V                   | -     | -                       |
| I <sub>OH</sub> current (source) on DIO lines   | Configured as input with active pull-ups  | -                       | 3.8mA | -                       |
| V <sub>PROG0</sub> output voltage   |   | 1.2V                    | -     | 3.6V                    |
| V <sub>PROG0</sub> current (source)   |   | -                       | -     | 300mA*                  |
| V <sub>PROG1</sub> output voltage   |   | 1.2V                    | -     | 5.5V                    |
| V <sub>PROG1</sub> current (source)   |   | -                       | -     | 300mA*                  |
| *maximum overall power provided through V <sub>PROG0</sub> and V <sub>PROG1</sub> for all the Active Modules of the FlashRunner HS configuration is limited to 60W. |   |                         |       |                         |
| “ISP” Connectors - General Purpose Active Module  |   |                         |       |                         |
| V <sub>IL</sub> (input low voltage) on DIO lines  |   | -                       | -     | 0.3V <sub>PROG0</sub>   |
| V <sub>IH</sub> (input high voltage) on DIO lines   | Configured as digital lines   | 0.7V <sub>PROG0</sub>   | -     |                         |
| V <sub>OL</sub> (output low voltage) on DIO lines   | Configured as digital lines, V <sub>PROG0</sub> = 3.3V, I <sub>OL</sub> = 24mA  | -                       | -     | 0.55V                   |
| V <sub>OH</sub> (output high voltage) on DIO lines  | Configured as digital lines, V <sub>PROG0</sub> = 3.3V, I <sub>OH</sub> = -24mA | 2.56V                   | -     | -                       |
| V <sub>OL</sub> (output low voltage) on DIO lines   | Configured as digital lines,  | -                       | -     | 0.55V                   |

| Parameter   | Condition  | Value |       |        |
|---|--|-------|-------|--------|
|   |  | Min   | Typ   | Max    |
|   | V <sub>PROG0</sub> = 5V, I <sub>OL</sub> = 32mA                                  |       |       |        |
| V <sub>OH</sub> (output high voltage) on DIO lines  | Configured as digital lines,<br>V <sub>PROG0</sub> = 5V, I <sub>OH</sub> = -32mA | 3.9V  | -     | -      |
| I <sub>OH</sub> current (source) on DIO lines   | Configured as input with<br>active pull-ups                                      | -     | 3.8mA | -      |
| V <sub>PROG0</sub> output voltage   |  | 1.65V | -     | 5.5V   |
| V <sub>PROG0</sub> current (source)   |  | -     | -     | 300mA* |
| V <sub>PROG1</sub> output voltage   |  | 5.5V  | -     | 13.5V  |
| V <sub>PROG1</sub> current (source)   |  | -     | -     | 300mA* |
| *Maximum overall power provided through V <sub>PROG0</sub> and V <sub>PROG1</sub> for all the Active Modules of the FlashRunner HS configuration is limited to 60W. |  |       |       |        |
| <b>"POWER" Connector</b>  |  |       |       |        |
| Supply voltage  |  | 14,5V | -     | 15,5V  |
| Supply current  |  | -     | -     | 8A     |
| Power consumption   |  | -     | -     | 120W   |



**Note:** Keep FlashRunner HS Control Unit and Active Modules always in a well-ventilated area in order to prevent product overheating, which could affect product performance and, if maintained for long time, it could damage product hardware components.

## 5.3 AC Characteristics

Table 9: AC Characteristics HS General Purpose Active Module

| Parameter   | Condition             |                        | Value |       |        |
|---|-----------------------|------------------------|-------|-------|--------|
|   |                       |                        | Min   | Typ   | Max    |
| $t_{RISE}$ on DIO lines when configured as digital output push-pull | $V_{PROG0} = 1.8V$    | Load: $2K\Omega//15pF$ | 2.1ns | -     | 15.5ns |
|   | $V_{PROG0} = 3.3V$    |                        | 0.7ns | -     | 5.8ns  |
|   | $V_{PROG0} = 5V$      |                        | 0.7ns | 25ns  | 4.4ns  |
| $t_{FALL}$ on DIO lines when configured as digital output push-pull | $V_{PROG0} = 1.8V$    | Load: $2K\Omega//15pF$ | 2ns   | -     | 12.6ns |
|   | $V_{PROG0} = 3.3V$    |                        | 0.8ns | -     | 5ns    |
|   | $V_{PROG0} = 5V$      |                        | 0.7ns | -     | 4ns    |
| $t_{RISE}$ on line VPROG0   | $V_{PROG0} = 0-1.8V$  | Load: $15\Omega//10mF$ | -     | 10ms  | -      |
|   | $V_{PROG0} = 0-3.3V$  | Load: $22\Omega//10mF$ | -     | 15ms  | -      |
|   | $V_{PROG0} = 0-5.5V$  | Load: $22\Omega//10mF$ | -     | 20ms  | -      |
| $t_{FALL}$ on line VPROG0   | $V_{PROG0} = 1.8-0V$  | Load: $10mF$           | -     | 300ms | -      |
|   | $V_{PROG0} = 3.3-0V$  |                        | -     | 350ms | -      |
|   | $V_{PROG0} = 5.5-0V$  |                        | -     | 350ms | -      |
| $t_{RISE}$ on line VPROG1   | $V_{PROG1} = 0-3V$    | Load: $10\Omega//1mF$  | -     | 1.3ms | -      |
|   | $V_{PROG1} = 0-5V$    | Load: $47\Omega//1mF$  | -     | 1.8ms | -      |
|   | $V_{PROG1} = 0-13.5V$ | Load: $94\Omega//1mF$  | -     | 13ms  | -      |
| $t_{FALL}$ on line VPROG1   | $V_{PROG1} = 3-0V$    | Load: $1mF$            | -     | 18ms  | -      |
|   | $V_{PROG1} = 5-0V$    |                        | -     | 30ms  | -      |
|   | $V_{PROG1} = 13.5-0V$ |                        | -     | 45ms  | -      |

Table 10: AC Characteristics HS eMMC – OSPI – NAND Active Module

| Parameter  | Condition                   |                         | Value |       |       |
|--|-----------------------------|-------------------------|-------|-------|-------|
|  |                             |                         | Min   | Typ   | Max   |
| t <sub>RISE</sub> on DIO lines when configured as digital output push-pull | V <sub>PROG0</sub> = 1.2V   | Load: 2K $\Omega$ /15pF | -     | 2.5ns | -     |
|  | V <sub>PROG0</sub> = 1.8V   |                         | 0.1ns | -     | 3ns   |
|  | V <sub>PROG0</sub> = 3.3V   |                         | 0.1ns | -     | 2.4ns |
| t <sub>FALL</sub> on DIO lines when configured as digital output push-pull | V <sub>PROG0</sub> = 1.2V   | Load: 2K $\Omega$ /15pF | -     | 2.5ns | -     |
|  | V <sub>PROG0</sub> = 1.8V   |                         | 0.1ns | -     | 3ns   |
|  | V <sub>PROG0</sub> = 3.3V   |                         | 0.1ns | -     | 2.4ns |
| t <sub>RISE</sub> on line VPROG0   | V <sub>PROG0</sub> = 0-1.8V | Load: 15 $\Omega$ /10mF | -     | 10ms  | -     |
|  | V <sub>PROG0</sub> = 0-3.3V | Load: 22 $\Omega$ /10mF | -     | 15ms  | -     |
| t <sub>FALL</sub> on line VPROG0   | V <sub>PROG0</sub> = 1.8-0V | Load: 10mF              | -     | 300ms | -     |
|  | V <sub>PROG0</sub> = 3.3-0V |                         | -     | 350ms | -     |
| t <sub>RISE</sub> on line VPROG1   | V <sub>PROG1</sub> = 0-3.3V | Load: 10 $\Omega$ /1mF  | -     | 1.3ms | -     |
|  | V <sub>PROG1</sub> = 0-5.5V | Load: 47 $\Omega$ /1mF  | -     | 1.8ms | -     |
| t <sub>FALL</sub> on line VPROG1   | V <sub>PROG1</sub> = 3.3-0V | Load: 1mF               | -     | 18ms  | -     |
|  | V <sub>PROG1</sub> = 5.5-0V |                         | -     | 30ms  | -     |

## 5.4 Physical and Environmental Specifications

Table 11: Physical and Environmental Specifications

| Parameter  | Value  |
|--|--|
| Dimensions, HS Control Unit  | 170 x 83 x 19 mm   |
| Dimensions, HS Active Module Single eMMC                           | 63 x 32 x 12 mm  |
| Dimensions, HS Active Module Dual eMMC/NAND                        | 63 x 64 x 12 mm  |
| Dimensions, HS Active Module Dual General Purpose                  | 66 x 40 x 12 mm  |
| Dimensions, HS Active Module Quad General Purpose                  | 63 x 80 x 12 mm  |
| Dimensions, HS Active Module Quad CAN                              | 63 x 80 x 12 mm  |
| "ISP" connectors type – HS Active Module Single/Dual eMMC/NAND     | 30 positions, 2 row, pitch = 1.27mm, male, vertical or right-angle |
| "ISP" connectors type – HS Active Module Dual/Quad General Purpose | 20 positions, 2 row, pitch = 1.27mm, male, vertical or right-angle |
| "ISP" connectors type – HS Active Module Quad CAN                  | 20 positions, 2 row, pitch = 1.27mm, male, vertical or right-angle |
| CONTROL connector type   | 20 positions, 2 row, box header, pitch = 1.27mm, male              |
| "USB" connector type   | USB-B micro receptable   |
| "LAN" connector type   | RJ-45 connector  |
| "POWER" connector type   | DC Power Jack  |
| Operating temperature  | 0-50°C   |
| Operating humidity   | 90% max (without condensation)                                     |
| Storage temperature  | 0-70°C   |
| Storage humidity   | 90% max (without condensation)                                     |
| EMC (EMI/EMS)  | CE, FCC  |
| SD CARD size   | Up to 256 GB, by default mounts 64GB                               |