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14/09/2023

Driver v. 5.01

Moreno Ortolan

Interfacing FlashRunner 2.0 with STANDARD LIN

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STANDARD LIN Limitations

This driver is an SMH Technologies STD driver (standard driver) so it can be used for free, i.e., without using any license.

However, this driver has limitations on the maximum number of commands that can be executed.
The maximum limit is set at 25 SEND commands.

Actually, this driver supports the LIN 2.1.

If you need the support of LIN 1.3, please contact the SMH support team.

Two checksum models are defined for LIN protocol: classic checksum and enhanced checksum.

The enhanced checksum includes the protected identifier in the checksum calculation, classic checksum does not.
The checksum model used in the LIN specification versions up to version 1.3 for all frames.
In LIN 2.x it is used only for the diagnostic frames.
The classic checksum considers the data bytes only.

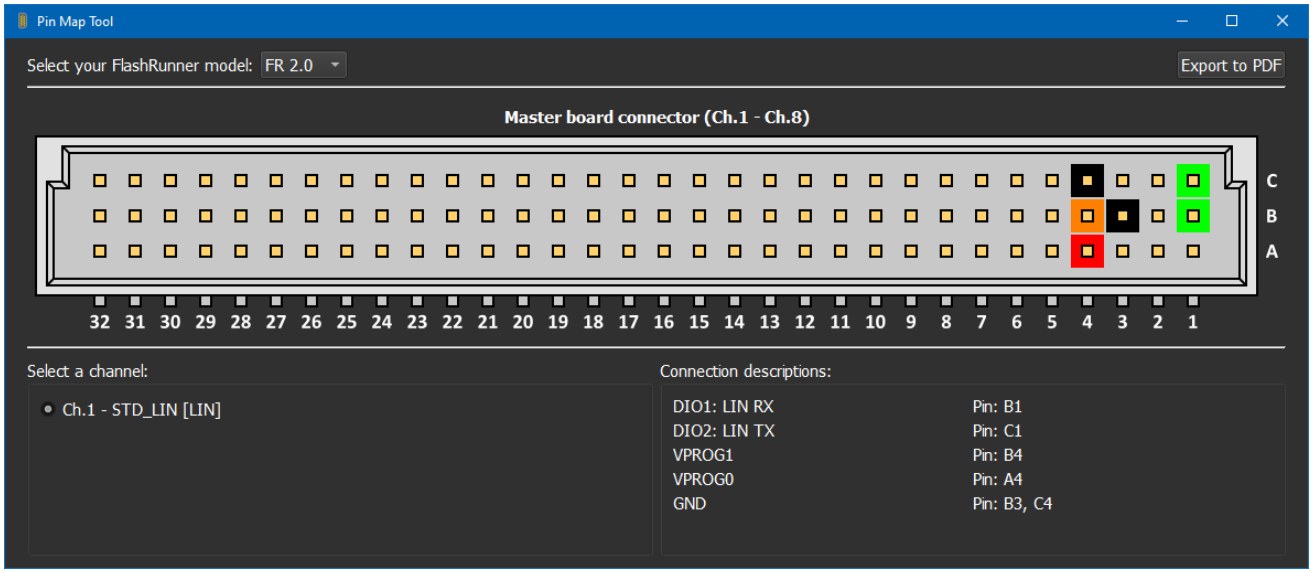
This driver supports only the LIN version 2.1 with enhanced checksum.

STANDARD LIN Protocol and PIN map

STANDARD LIN driver support only LIN protocol.

```
#TCSETPAR CMODE <LIN>
```

STANDARD LIN PIN MAP



LIN: (External Hardware VPROG1_LEVEL_SHIFTER_PC10707)

The following PIN MAP refers to the external hardware released by SMH Technologies in the first quarter of 2022.

- DIO 1 - TRANSCEIVER RX
- DIO 2 - TRANSCEIVER TX
- DIO 3 - LEVEL SHIFTER VPROG SELECTOR

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STANDARD LIN SMH LIN ADAPTER

SMH LIN Adapter Safety

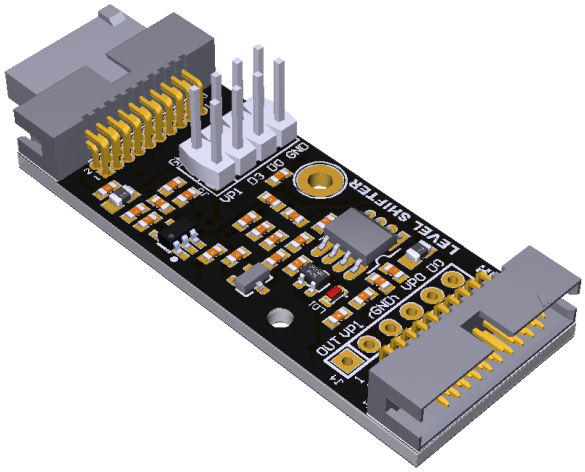
> **Note:** *Keep all the components of the FlashRunner 2.0 platform always in a well-ventilated area, to prevent product overheating, which could affect product performance and, if maintained for a long time, could damage the hardware product components.*

FlashRunner 2.0 LIN Adapter is a low-voltage device.
However, when integrated into automatic test equipment or when interfacing it with other systems, take all precautions to avoid electrical shocks due to, for example, different ground references.

To protect all the devices against electrostatic discharge (ESD), always connect yourself to the ground (e.g., via wrist straps) when handling the instrumentation.
Make all connections to the target system before applying power to the instrument.
Always store all the electronic components inside an antistatic bag when not in use.

SMH LIN Adapter for FlashRunner 2.0

The LIN Adapter for FlashRunner 2.0 and FlashRunner LAN 2.0 Next Generation is a compact high-integration device that converts the signals from the FlashRunner 2.0 output port to the levels of the LIN Bus.



Board: **PC10719**

SMH LIN Adapter for LIN

The microcontroller lines needed to program a device through LIN protocol are the following:

LIN_IO: Data RX/TX.
VSUP: Device Power Supply Voltage.
GND: Device Power Supply Ground.

When the FlashRunner 2.0 is interfaced through our adapter VP1_EXT power supply line voltage can be in the range 2.7 V – 27 V.
The pull-up resistor is directly integrated into the adapter board with no need for external components.

Typically, a value of 0.6 V of dropout is present in the power line.
For this reason, if the customer wants to provide 12 V to the board, at least 12.6 V has to be provided.

As a standard, the VP1_OUT line has a fixed output value of 12 V.
If the customer needs a different value on the power or communication line, he has to inform SMH Technologies' Team during the evaluation phase.

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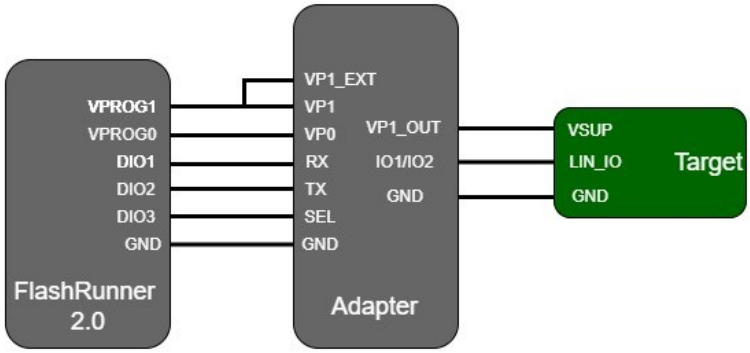
According to customers' needs and configuration, there are two possible layouts of integration:

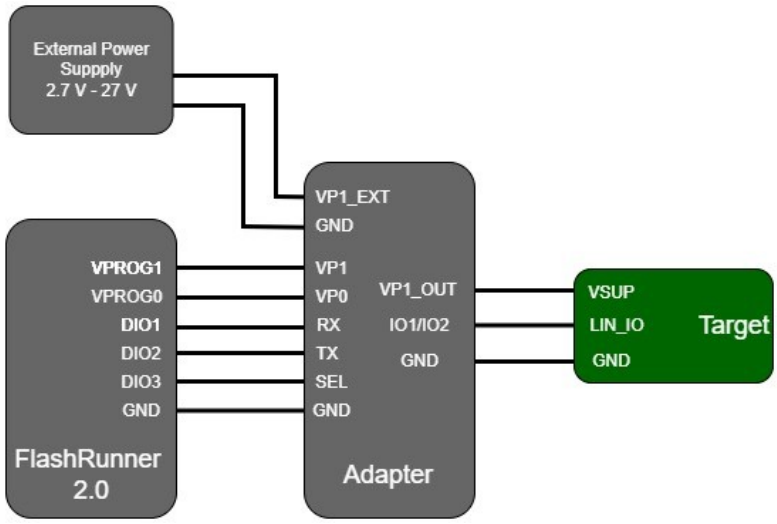
Power Supply from VPROG1:



In this configuration, if the boards are powered using FlashRunner, the limits of the VPROG1 line are applied.

A maximum of 200 mA of current absorption is supported for each channel.
The voltage range is from 13.5 V to 6 V; please take into consideration the dropout value of 0.6 V and that the default voltage output of the Adapter is 12 V.
If another value is needed, the customer has to inform SMH Technologies during the evaluation phase.

Power Supply from an External Power Supply:



In this configuration, the boards are powered by an External Power Supply.
The VP1_EXT input voltage range is from 2.7 V to 27 V; please take into consideration the dropout value of 0.6 V and that the default voltage output of the Adapter is 12 V, so at least 12.6 V has to be provided.

If another value is needed, the customer has to inform SMH Technologies during the evaluation phase.

Important Note:

If FlashRunner 2.0 is used also to power the device (case 1 above), VPROG1 provided by FlashRunner 2.0 shall be connected to both VP1_EXT and VP1 contacts on the J5 connector (see connectors' chapter for more details).
Alternatively, if VP1 is provided directly through J1/J2 then VP1_EXT and VP1 on the J5 connector shall be connected through a jumper socket. In this case, the VPROG1 voltage provided by FlashRunner 2.0 is used also to supply the target device.

If an external power supply is used (case 2 above), VP1_EXT has to be connected to the power supply and VP1 to the VPROG1 of the FlashRunner.

See next chapters for connectors details.

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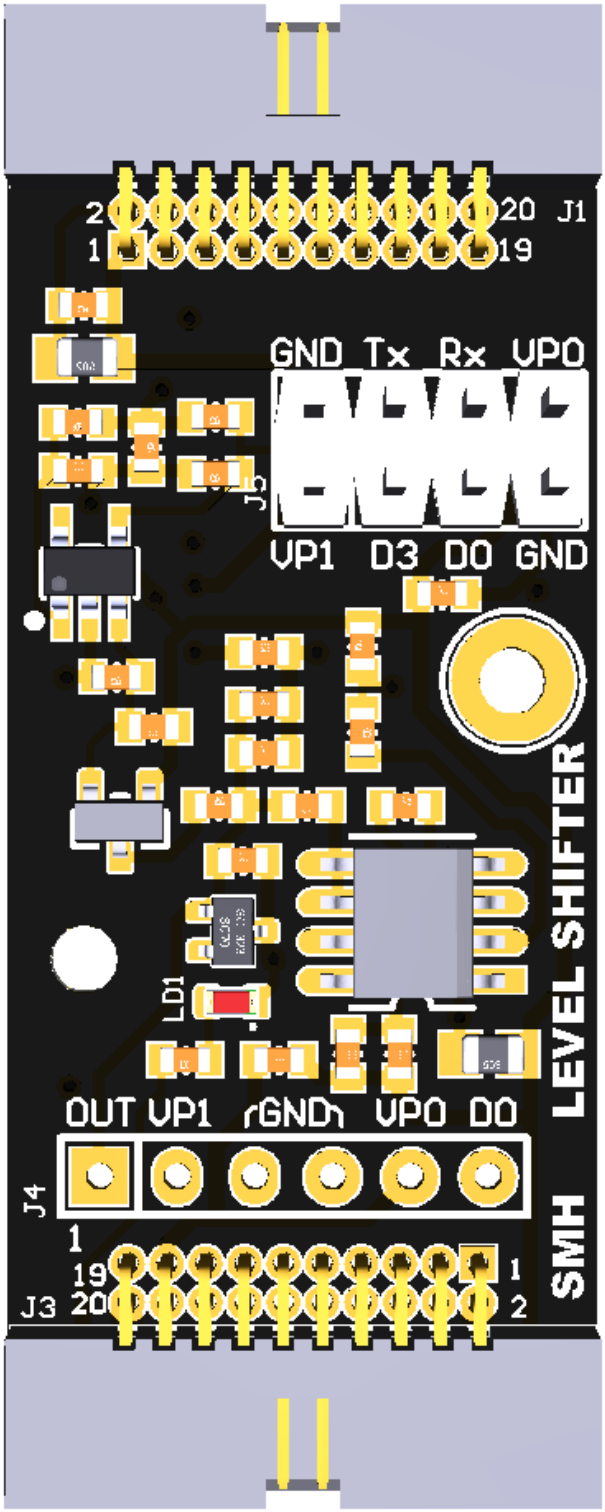
SMH LIN Adapter Front View



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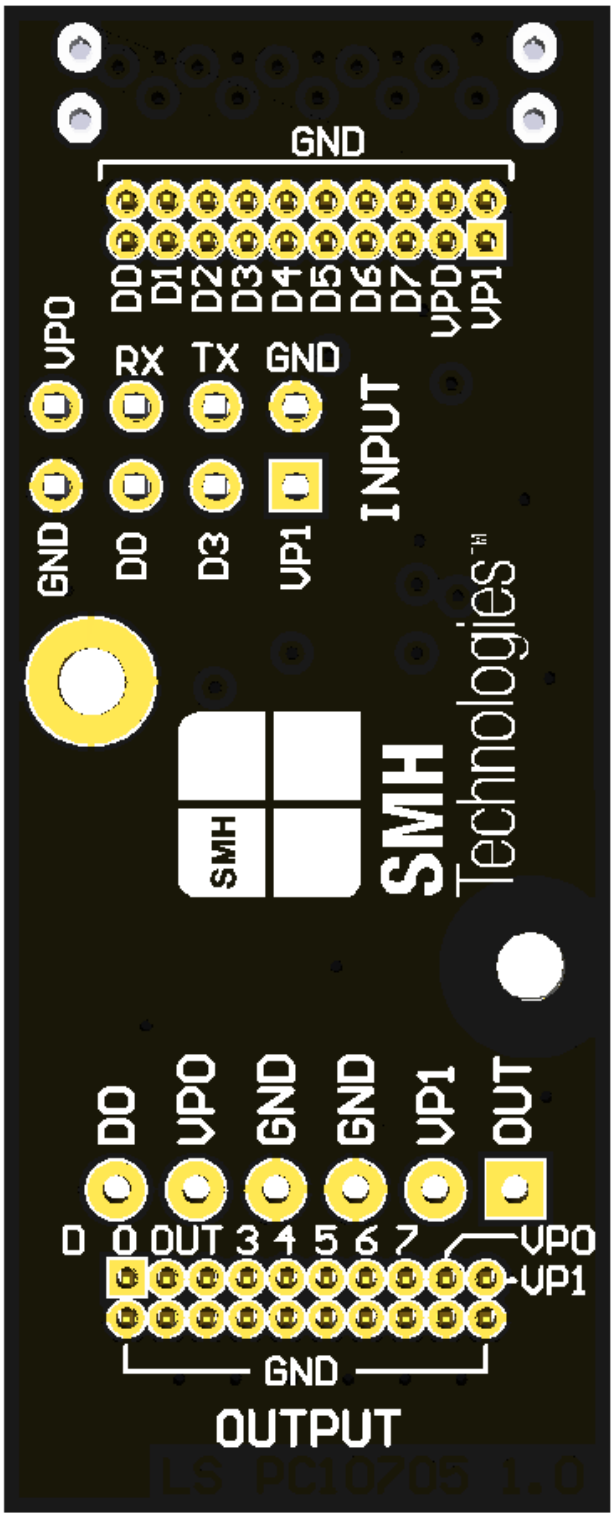
SMH LIN Adapter Back View



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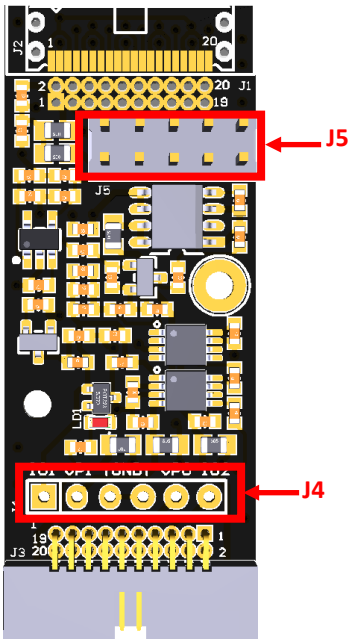
SMH LIN Adapter Available Configurations

There are three possible adapter configurations based on the connectors mounted on the board:

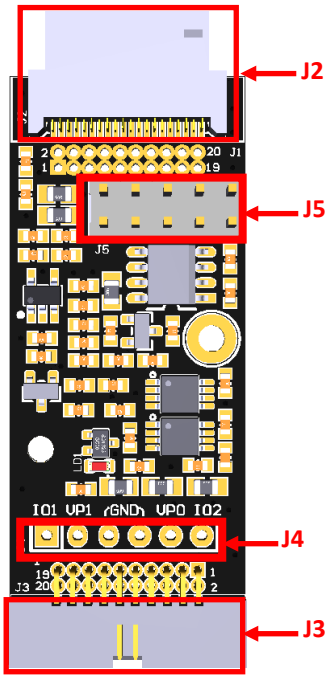
- Wire wrapping **ADP-FL-WW**: connectors J5 and J4 mounted.
- Direct plug **ADP-FL-DIRPLUG**: connectors J2, J3, J5 and J4 mounted.
- Peripherals **ADP-FL-PH**: connectors J1, J3, J5 and J4 mounted.

Based on the configuration chosen, a different version of the adapter can be selected. On chapter “Typical Integration” there are some examples.



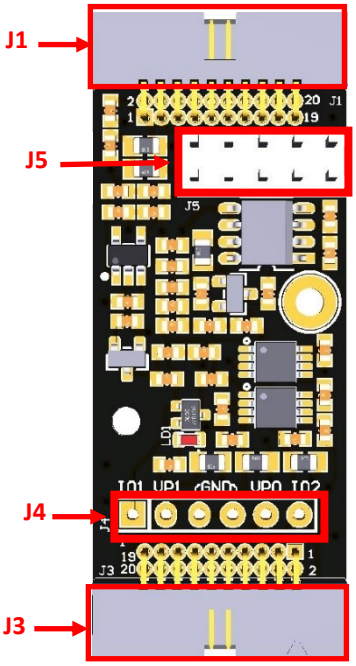
Wire wrapping

ADP-FL-WW



Direct plug

ADP-FL-DIRPLUG



Peripherals

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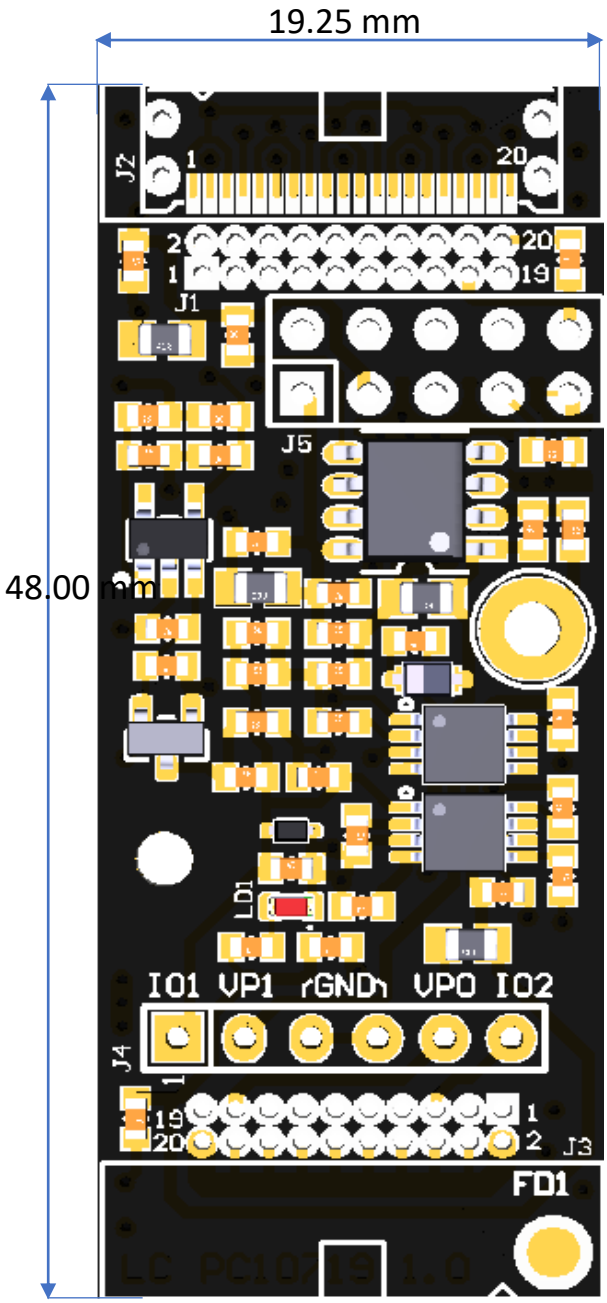
SMH LIN Adapter Board Dimension

Board dimension are expressed in millimetres [mm].



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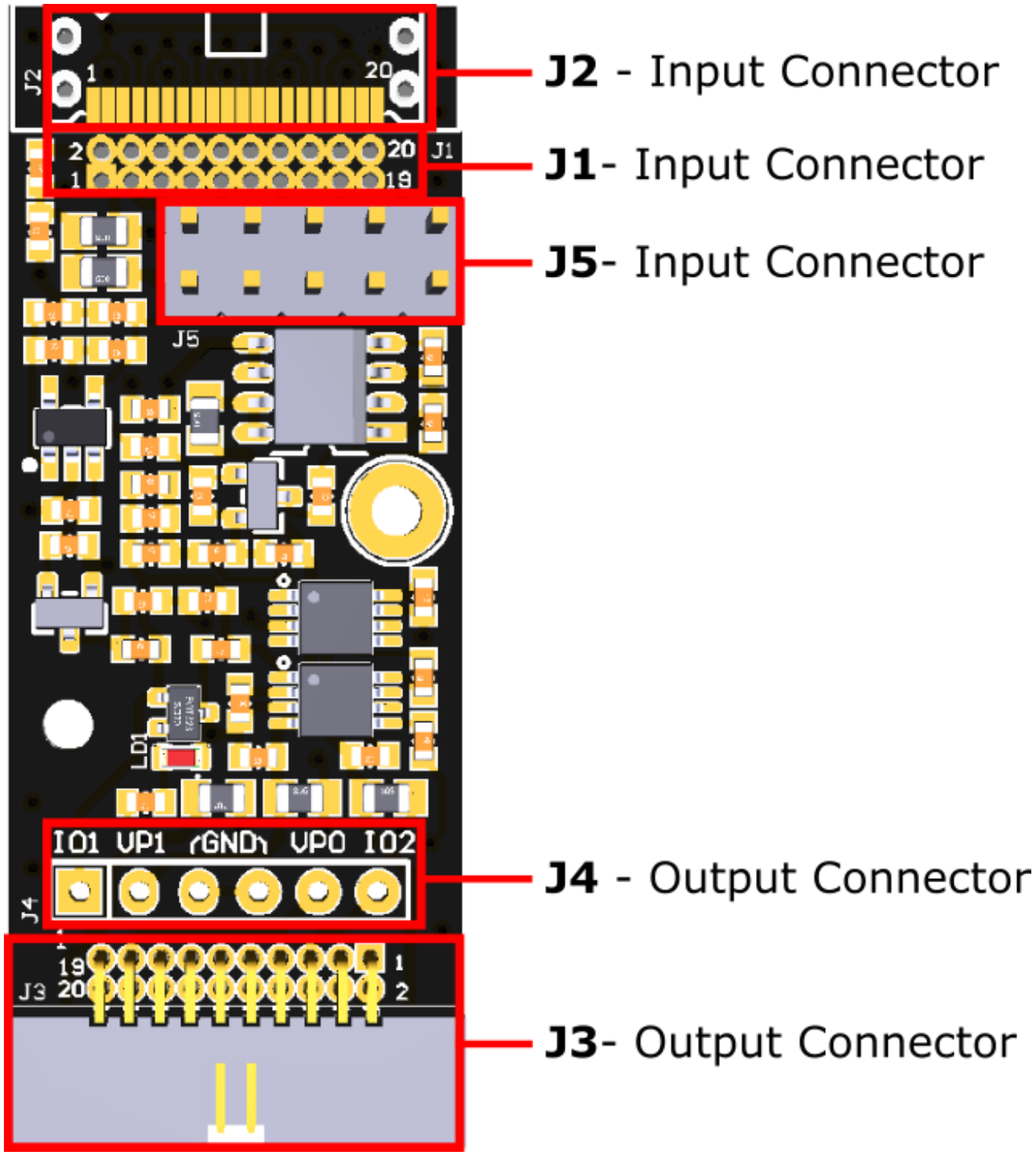
SMH LIN Adapter Connections



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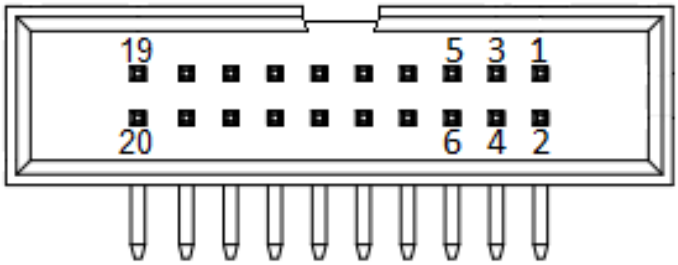
SMH LIN Adapter Input connector J1



Pin #	Signal Name	Input/Output or Power	Description
1	**VPROG1**	**P**	**Programmable Voltage 1 – VP1**
2	**VPROG1_GND**	**-**	**Ground – GND**
3	**VPROG0**	**P**	**Programmable Voltage 0 – VP0**
4	**VPROG0_GND**	**-**	**Ground – GND**
5	DIO7	I/O	Digital Input-Output 7
6	DIO7_GND	-	Ground – GND
7	DIO6	I/O	Digital Input-Output 6
8	DIO6_GND	-	Ground – GND
9	DIO5	I/O	Digital Input-Output 5
10	DIO5_GND	-	Ground – GND
11	DIO4	I/O	Digital Input-Output 4
12	DIO4_GND	-	Ground – GND
13	**DIO3**	**I**	**Digital Input – SEL**
14	**DIO3_GND**	**-**	**Ground – GND**
15	**DIO2**	**I**	**Digital Input – TX data signal**
16	**DIO2_GND**	**-**	**Ground – GND**
17	**DIO1**	**O**	**Digital Output – RX data signal**
18	**DIO1_GND**	**-**	**Ground – GND**
19	DIO0	I/O	Digital Input-Output 0
20	DIO0_GND	-	Ground – GND

The input connector **J1** is a right-angle 20-position 2-row male connector 1.27mm pitch (e.g., CNC Tech 3221-20-0200-00).
Only the signals in bold are mandatory for a proper connection between FlashRunner and the adapter board input connector.

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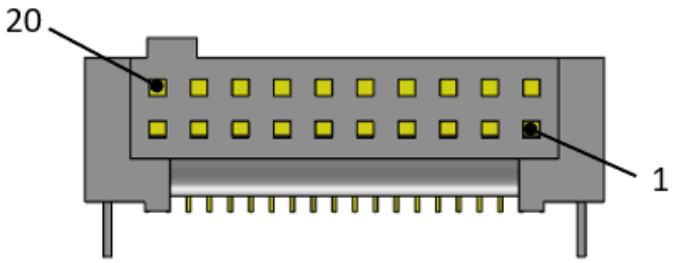
SMH LIN Adapter Input connector J2



Pin #	Signal Name	Input/Output or Power	Description
1	**VPROG1_GND**	**-**	**Ground – GND**
2	**VPROG1**	**P**	**Programmable Voltage 1 – VP1**
3	**VPROG0_GND**	**-**	**Ground – GND**
4	**VPROG0**	**P**	**Programmable Voltage 0 – VP0**
5	DIO7_GND	-	Ground – GND
6	DIO7	I/O	Digital Input-Output 7
7	DIO6_GND	-	Ground – GND
8	DIO6	I/O	Digital Input-Output 6
9	DIO5_GND	-	Ground – GND
10	DIO5	I/O	Digital Input-Output 5
11	DIO4_GND	-	Ground – GND
12	DIO4	I/O	Digital Input-Output 4
13	**DIO3_GND**	**-**	**Ground – GND**
14	**DIO3**	**I**	**Digital Input – SEL**
15	**DIO2_GND**	**-**	**Ground – GND**
16	**DIO2**	**I**	**Digital Input – TX data signal**
17	**DIO1_GND**	**-**	**Ground – GND**
18	**DIO1**	**O**	**Digital Output – RX data signal**
19	DIO0_GND	-	Ground – GND
20	DIO0	I/O	Digital Input-Output 0

The input connector **J2** is a right-angle 20-position 2-row female connector 1.27mm pitch (e.g. Samtec SFM-110-02-L-DH; mating connector Samtec TFM-110-01-L-D-RA).

Only the signals in bold are mandatory for a proper connection between FlashRunner and the adapter board input connector.

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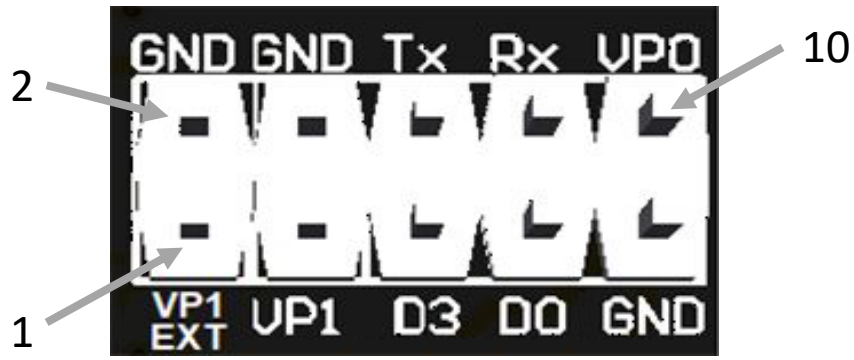
SMH LIN Adapter Input connector J5



Pin #	Signal Name	Input/Output or Power	Description
1	VP1_EXT	P	Power Line
2	GND	-	Ground – GND
3	VP1	P	Programmable Voltage 1 – VPROG1
4	GND	-	Ground – GND
5	D3	I	Digital Input – SEL *[1]
6	Tx	I	Digital Input – TX data signal
7	D0	I/O	Not used, reserved for future use
8	Rx	O	Digital Output – RX data signal
9	GND	-	Ground – GND
10	VP0	I/O	Programmable Voltage 0 – VPROG0

The input connector **J5** is a vertical 10-position 2-row male connector with a 2.54 mm pitch (e.g., Harwin M20-9980545).

If FlashRunner 2.0 is used also to power the device, VPROG1 provided by FlashRunner 2.0 shall be connected to both VP1_EXT and VP1 contacts on the J5 connector.

Alternatively, if VP1 is provided directly through J1/J2 then VP1_EXT and VP1 on the J5 connector shall be connected through a jumper socket. In this case, the VPROG1 voltage provided by FlashRunner 2.0 is used also to supply the target device.

If an external power supply is used, VP1_EXT has to be connected to the power supply and VP1 to the VPROG1 of the FlashRunner 2.0.

This connector is always mounted.

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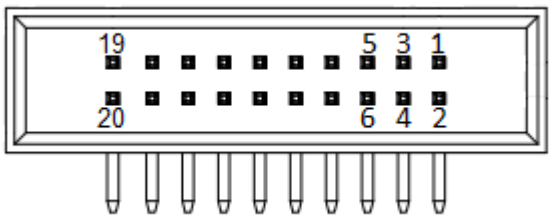
SMH LIN Adapter Output connector J3



Pin #	Signal Name	Input/Output or Power	Description
1	DIO0	I/O	Digital Input-Output 0
2	DIO0_GND	-	Ground – GND
3	**IO1**	**I/O**	**Digital Input-Output 1**
4	**DIO1_GND**	**-**	**Ground – GND**
5	**IO2**	**I/O**	**Digital Input-Output 2**
6	**DIO2_GND**	**-**	**Ground – GND**
7	DIO3	I/O	Digital Input-Output 3
8	DIO3_GND	-	Ground – GND
9	DIO4	I/O	Digital Input-Output 4
10	DIO4_GND	-	Ground – GND
11	DIO5	I/O	Digital Input-Output 5
12	DIO5_GND	-	Ground – GND
13	DIO6	I/O	Digital Input-Output 6
14	DIO6_GND	-	Ground – GND
15	DIO7	I/O	Digital Input-Output 7
16	DIO7_GND	-	Ground – GND
17	**VPROG0**	**P**	**Programmable Voltage 0 – VP0**
18	**VPROG0_GND**	**-**	**Ground – GND**
19	**VPROG1**	**P**	**Programmable Voltage 1 – VP1**
20	**VPROG1_GND**	**-**	**Ground – GND**

The output connector **J3** is a right-angle 20-position 2-row male connector 1.27mm pitch (e.g., CNC Tech 3221-20-0200-00).

Only the signals in bold are mandatory for a proper connection between FlashRunner and the adapter board input connector. IO1 and IO2 are the same signal, you just need to connect one of them.

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SMH LIN Adapter Output connector J4

Pin #	Signal Name	Input/Output or Power	Description
1	IO1	I/O	Data Input/Output
2	VP1	P	VSUP – VP1_OUT
3	GND	-	Ground – GND
4	GND	-	Ground – GND
5	VP0	P	Programmable Voltage 0 – VPROG0
6	IO2	I/O	Data Input/Output

The output connector **J4** is a vertical 6-position 1-row male connector 2.54 mm pitch (e.g., WE 61300611121).

Only the signals highlighted in the picture are mandatory for a proper connection of the adapter board output connector to the target device board.

IO1 and IO2 are the same signal, you just need to connect one of them.

This connector is always mounted.

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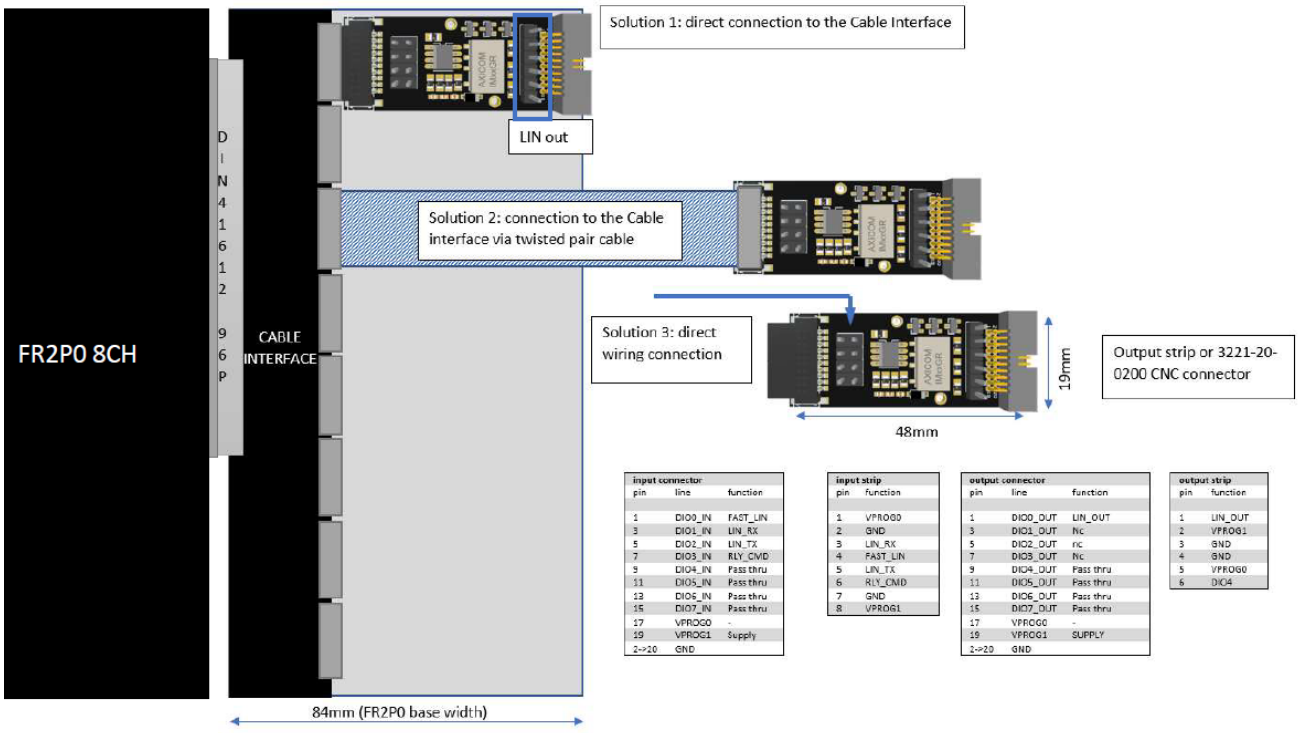
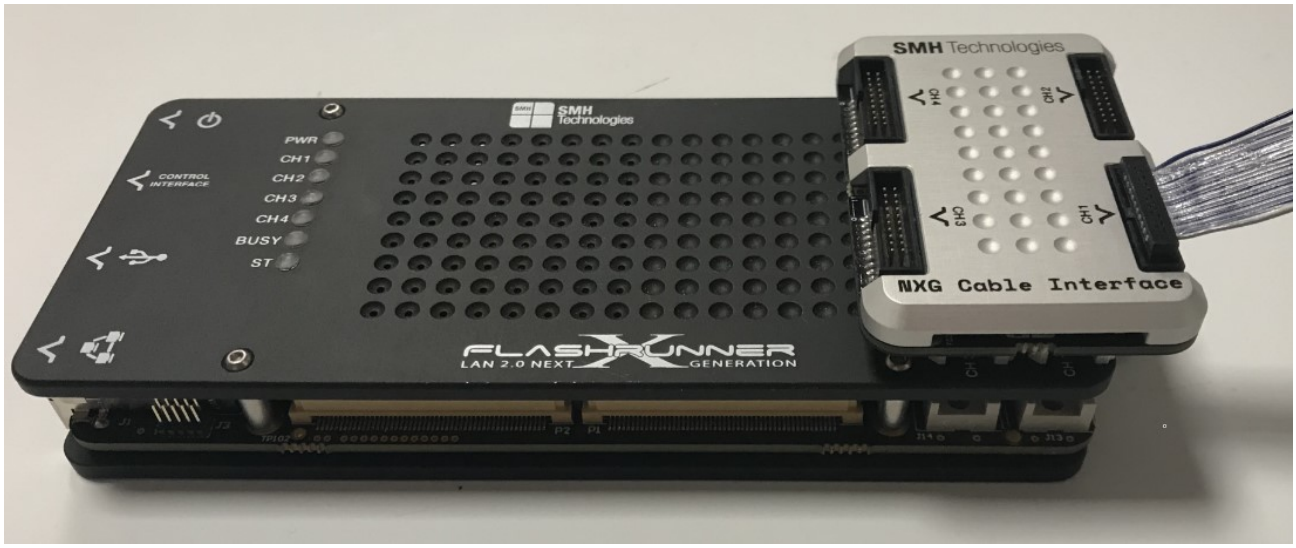
SMH LIN Adapter Interconnection Example



Cable interface with 20 pin CNC connector is available also for the the FR2P0 NXG:



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SMH LIN Adapter Typical Integration

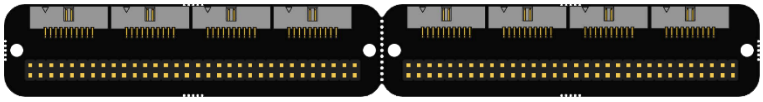
The External Hardware designed by SMH Technologies allows matching the needs of the user in terms of integration, selecting carefully the Input/Output connectors.

The solutions presented in this chapter are available for both FlashRunner 2.0 (8 and 16 channels) and FlashRunner NXG, except for the ones with the J2 connector because a special Cable Interface is necessary.
Those solutions are only available for FlashRunner 2.0.

To have the best integration possible, the module can be integrated also with other SMH tools:

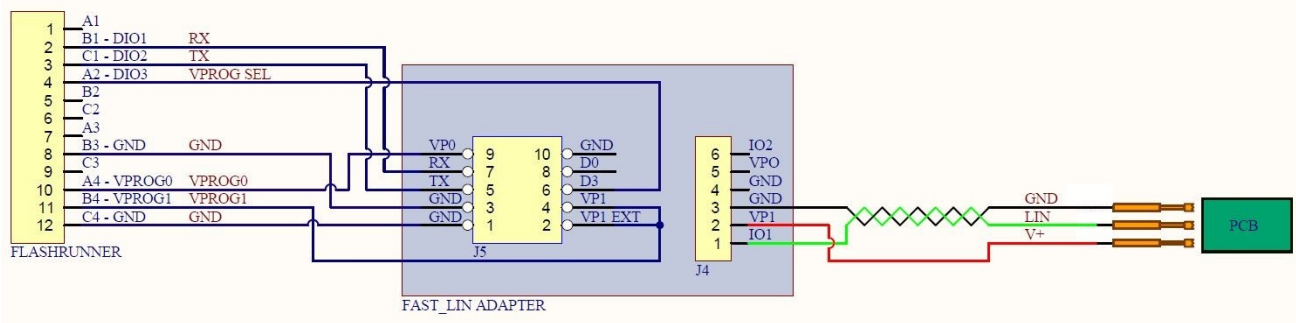
FRCABLE: special cables of length up to 1 m, to be plugged into **J1** or **J3** connectors as Input or Output, and the pinstrip Header or the Cable Interface

Pinstrip Header: connects the output of the External Hardware to the pinstrip using the **FRCABLE**.
Then wiring on the pinstrip the final connection to the target can be managed.



Cable Interface: a special cable interface (**FR2P0INTF08_ADP**) to connect the External Hardware directly to it using the **J2** connector.
The standard Cable Interface, instead, can be used with **FRCABLE** on the **J1** connector.
It can be mixed with the Relay Barrier and the Demultiplexer.
Please note that a specifically designed Cable Interface is necessary to use the **J2** connector and it is available only for FlashRunner 2.0.

In the next chapters, the most common integrations are explained.
The ones presented are not the only solutions.
If necessary it is possible to ask for different integration and SMH Technologies' Technical Team will evaluate it.



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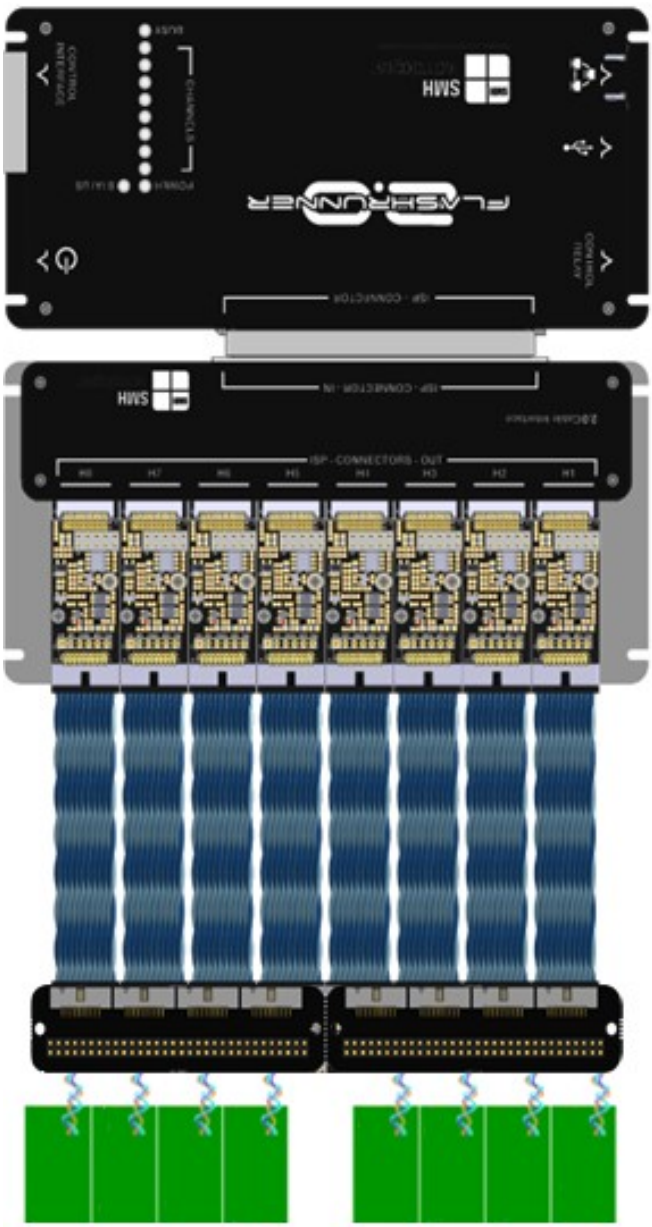
SMH LIN Adapter Direct Plug

With the integration in the picture below, the user directly connects the External Hardware to the Cable Interface (special Cable Interface, available only for FlashRunner 2.0), which is directly connected to the FlashRunner, using the J2 connector.

Then, on the output of the External Hardware, the FRCABLE is connected to the J3 connector.
At the end there is the pinstrip header from which the user can perform the final wiring to the target.



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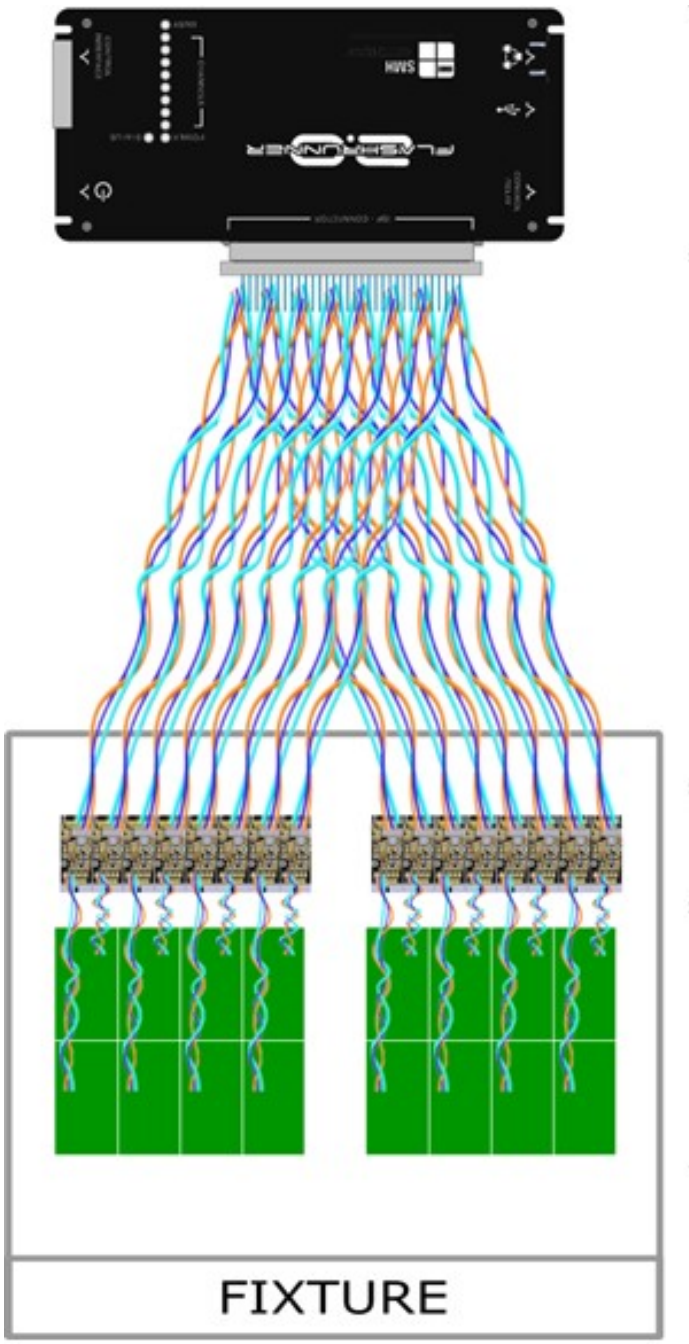
SMH LIN Adapter Wire Wrapping

With the integration in the picture below, the user connects the External Hardware to the FlashRunner wrapping the wires directly to the ISP Connector.

Then, on the output of the External Hardware, the customer can perform the final wiring from connector J4 to the target. Typically, with this solution, the adapters are placed on the fixture.

This way the integration is not bounded to a specific project because by changing the fixture, the customer can flash other targets.



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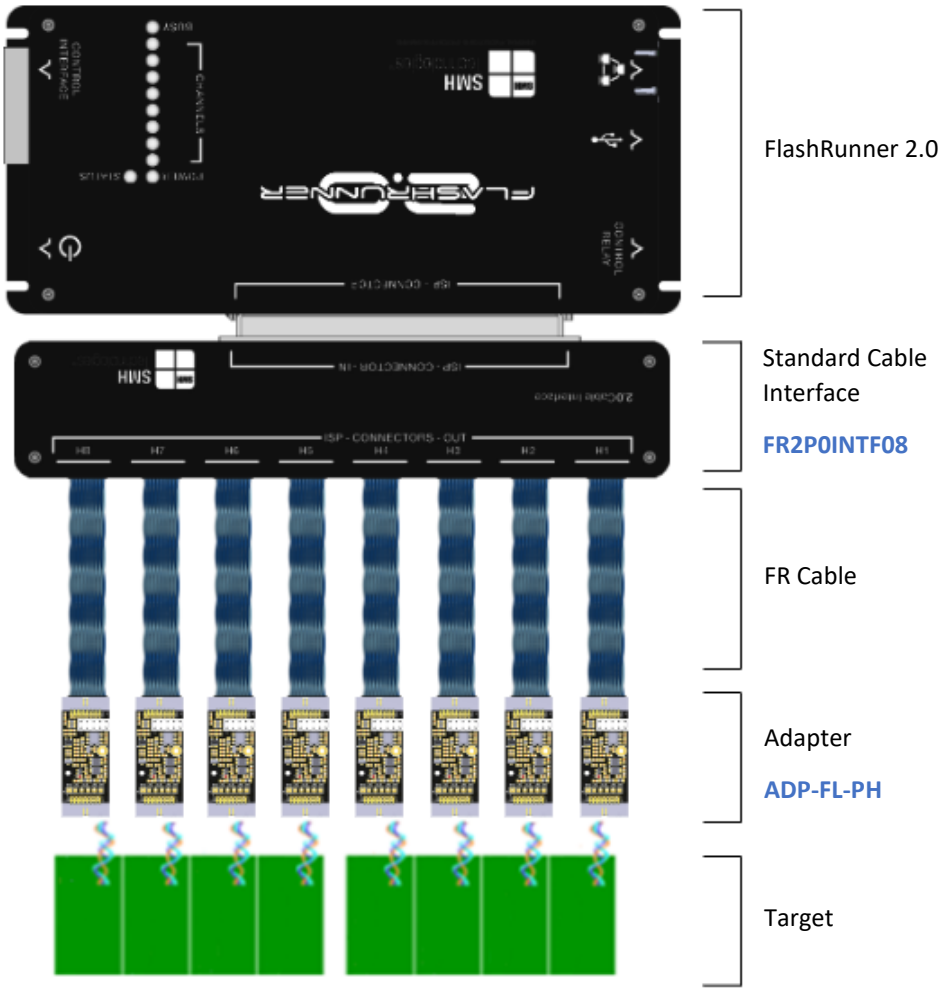
SMH LIN Adapter Peripherals

With the integration in the picture below, the user connects the External Hardware to the Cable Interface using the FRCABLE on connector J1.

Then, on the output of the External Hardware, the customer can perform the final wiring from connector J4 to the target.



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STANDARD LIN Driver Commands

Here you can find the complete list of all available commands for STANDARD LIN driver.

#TPCMD CONNECT

#TPCMD CONNECT

Connect function. Power on and entry.
Enable the FPGA and set the request LIN frequency.
Remember that the LIN protocol normally works around 10-12V and FlashRunner 2.0 can accept a maximum input of 5.5V into digital lines. For this reason, it is necessary to use an external hardware that prevents the 12V of the LIN line go directly into a DIO of the FlashRunner 2.0.

This command is not counted to reach the maximum number of commands allowed.

On Real Time Log Window:

```
---#TPCMD CONNECT
Requested Baudrate is 10400 bps.
Generated Baudrate is 10400 bps.
The maximum number of operations is 25.
Time for Connect: 0.204 s.
```

#TPCMD WAKEUP_PULSE

#TPCMD WAKEUP_PULSE <Time [ms]>

Execute a wake-up pulse waiting the inserted time.

This command is not counted to reach the maximum number of commands allowed.

On Real Time Log Window:

```
---#TPCMD WAKEUP_PULSE 100
Execute wake up pulse of 100ms.
Time for Wake Up Pulse: 0.100 s.
```

#TPCMD SEND

#TPCMD SEND <Byte 1> <Byte 2> <Byte 3> ...

Send inserted bytes in a single transfer LIN sequence.

Before sending the bytes inserted in the command, the **SOF** (Start of Frame - break field) and **SYC** (Synchronize field - sync field) are automatically sent.
The **checksum** is automatically calculated and sent to the device.

This command is counted to reach the maximum number of commands allowed.

On Real Time Log Window:

```
---#TPCMD SEND 0x3C 0x7F 0x06 0xB2 0x33 0x13 0x00 0xFE 0xCA
LIN TX: SOF SYNC 0x3C 0x7F 0x06 0xB2 0x33 0x13 0x00 0xFE 0xCA [CHECKSUM: 0xB7]
Time for Send data: 0.001 s.
```

On Terminal Window:

```
01|TX: 0x3C 0x7F 0x06 0xB2 0x33 0x13 0x00 0xFE 0xCA 0xB7
```


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#TPCMD READ

#TPCMD READ <Number of bytes> <PID> <Optional: response space us>
Read the inserted number of bytes in a single transfer LIN sequence.

Before read the bytes, the command sends the **SOF** (Start of Frame - break field), the **SYC** (Synchronize field - sync field) and the **PID** (Protected Identifier Field).

The parameter <**Optional: response space us**> can be used to add a small delay [us] to separate the PID to the bytes sent by the device. If not inserted no delay is performed.

This command is not counted to reach the maximum number of commands allowed.

On Real Time Log Window:

```
---#TPCMD READ 9 0x7D
LIN RX: SOF SYNC 0x7D 0x07 0x06 0xF2 0x01 0x00 0x05 0x02 0x04 [CHECKSUM: 0xF3]
Time for Read data: 0.008 s.
```

On Terminal Window:

```
01|RX: 0x7D 0x07 0x06 0xF2 0x01 0x00 0x05 0x02 0x04 0xF3
```

#TPCMD DISCONNECT

#TPCMD DISCONNECT
Disconnect function. Power off and exit.

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STANDARD LIN Driver Changelog

Info about driver version 4.00 - 14/06/2022
First official version for STD_LIN driver.

Info about driver version 5.00 - 01/08/2022
Added FPGA for new FlashRunner 2.0 models.
Updated maximum SEND command limit to 25.

Info about driver version 5.01 - 14/09/2023
Internal driver upgrade.

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