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19/03/2025

Driver v. 5.05

Moreno Ortolan

Interfacing FlashRunner 2.0 with MELEXIS Fast LIN

SMH Technologies S.r.l.

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Melexis Fast LIN Introduction

Fast LIN is a Melexis proprietary communication protocol which can be used to program a single MLX slave device connected peer-to-peer to the master. It was developed to enable the usage of higher baud rates than LIN (up to 20kBaud) which results in a decrease of the needed programming time.

It is possible to reprogram the whole Flash of the MLX16, including the LIN software using the LIN protocol or Fast LIN protocol.

Moreover, all precautions have been taken at hardware and software level to guarantee that an error during the programming does not leave the device in a dead state.

The loading of the Flash is the most complex operation but the firmware has some additional features like programming the RAM or the EEPROM / NVRAM. These operations use a subset of the Flash functions, available independently of the loader state.

A protection mechanism is implemented. Some critical functions (like reading or writing the Flash or the RAM) are disabled unless a 32- or 64- bits secret key is entered.

Melexis Fast LIN Protocol and PIN map

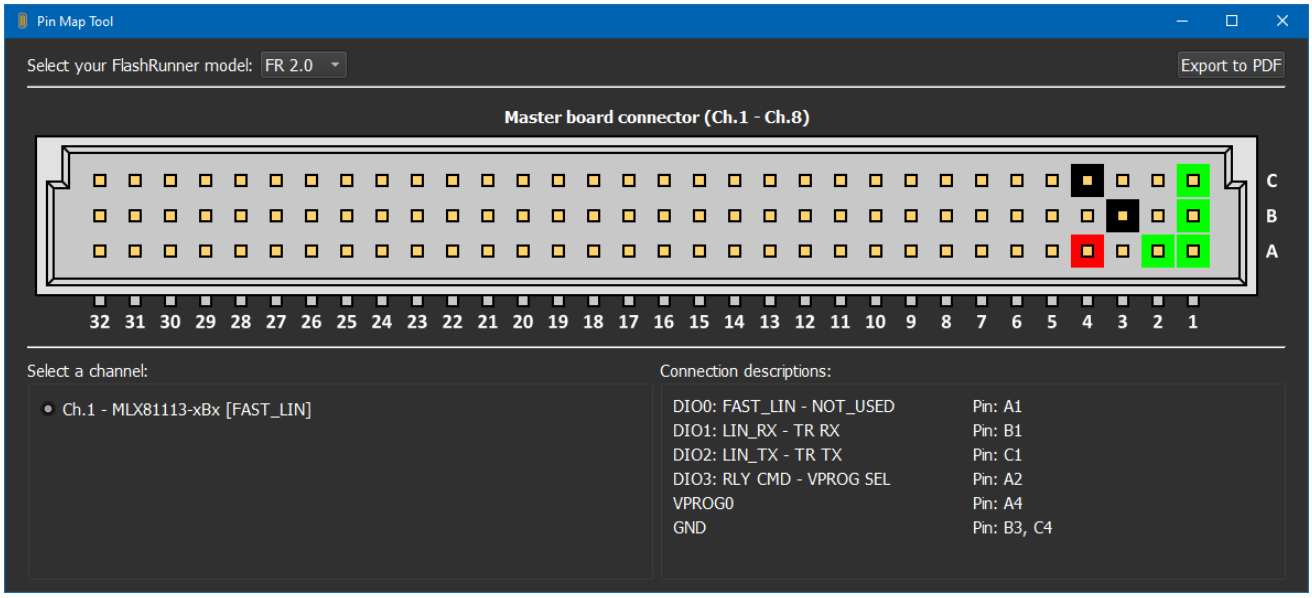
MLX81106, **MLX81109**, **MLX81310**, **MLX81107**, **MLX81150**, **MLX81315**, **MLX80110**, **MLX81108, MLX81300** and **MLX81301** devices of **Mulan 2** series support the Fast LIN protocol. (Note: **MLX81301** don't have internal Flash memory)

MLX81120, **MLX81112**, **MLX81115** and **MLX81325** devices of **Mulan 3** series support the Fast LIN protocol.

MLX81113-xBx, **MLX81114**, **MLX81118-xxB** and **MLX81123** devices of **CamCU** series support the Fast LIN protocol.

```
#TCSETPAR CMODE <FASTLIN>
```

Fast LIN PIN MAP



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Melexis Fast LIN SMH FASTLIN ADAPTER

SMH FASTLIN Adapter Safety

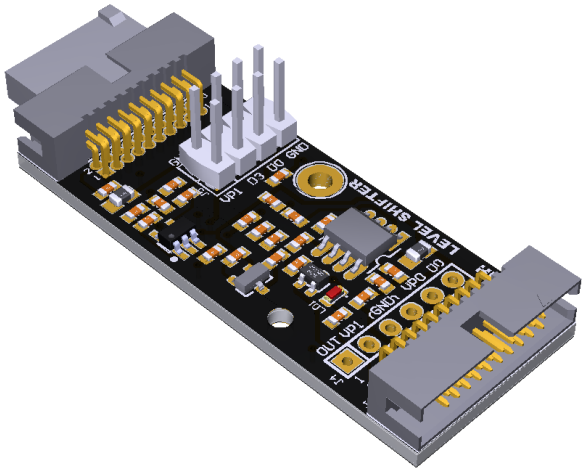
> **Note:** *Keep all the components of the FlashRunner 2.0 platform always in a well-ventilated area, to prevent product overheating, which could affect product performance and, if maintained for a long time, could damage the hardware product components.*

FlashRunner 2.0 FASTLIN 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 FASTLIN Adapter for FlashRunner 2.0

The Fast 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 FASTLIN Adapter for Fast LIN

The microcontroller lines needed to program a device through FASTLIN 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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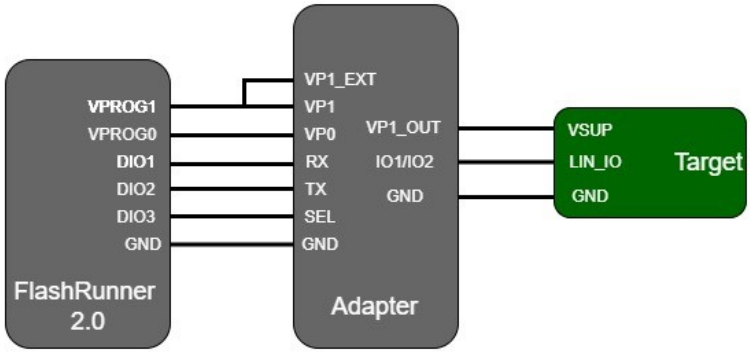
According to customers' needs and configuration, there are two possible layouts of integration:

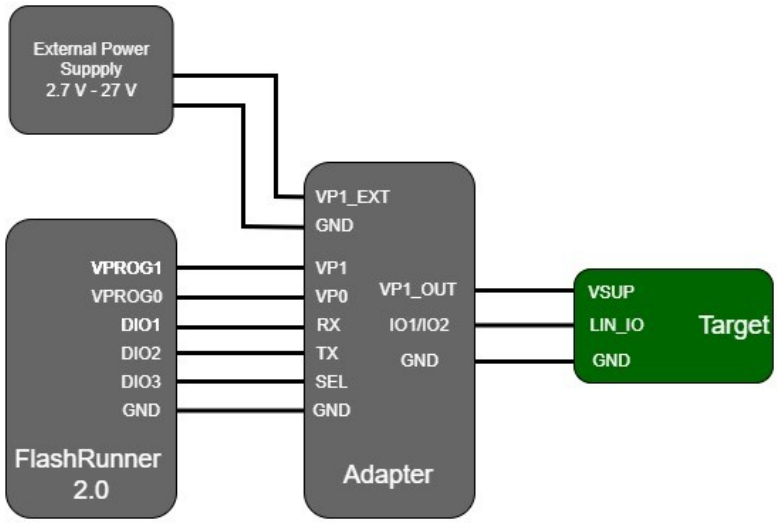
Power Supply from VPROG1:



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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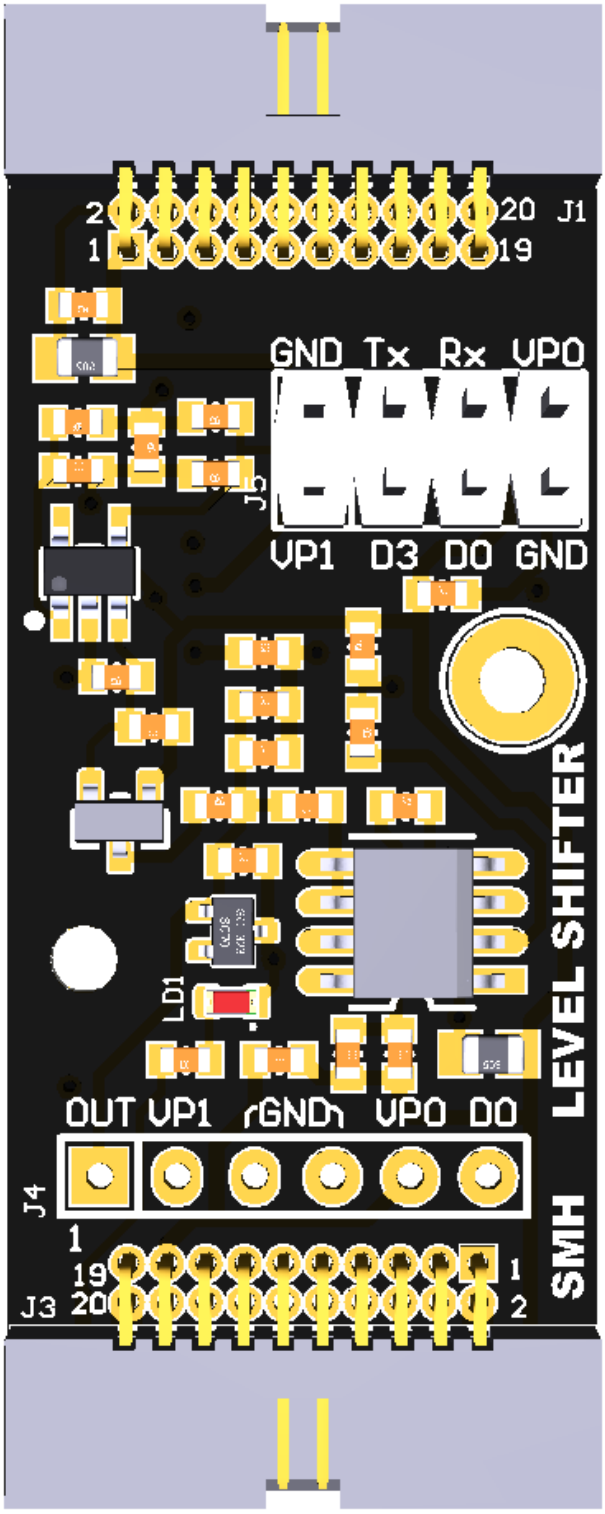
SMH FASTLIN Adapter Front View



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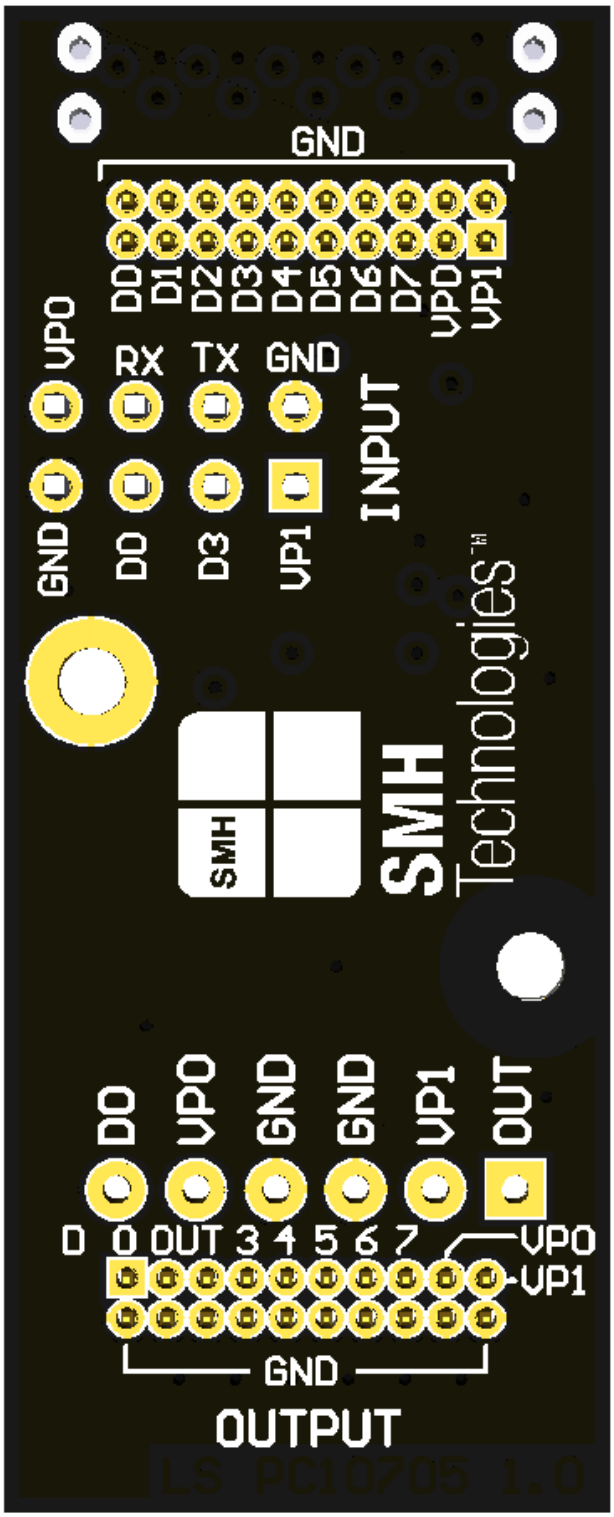
SMH FASTLIN Adapter Back View



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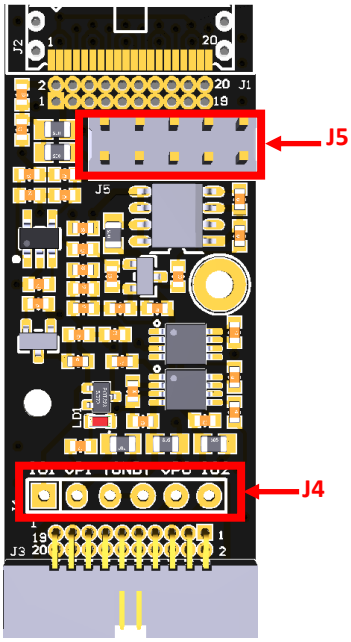
SMH FASTLIN Adapter Available Configurations

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

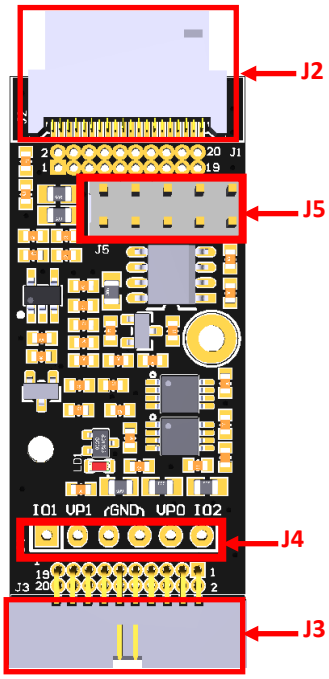
- Wire wrapping **ADP-FL-WW**: connectors J5 and J4 mounted.
- Direct plug **ADP-FL-DIRPLUG**: connectors J2, J3, J5 and J4 mounted.
- Peripherals **ADP-FL-PH**: connectors J1, J3, J5 and J4 mounted.

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



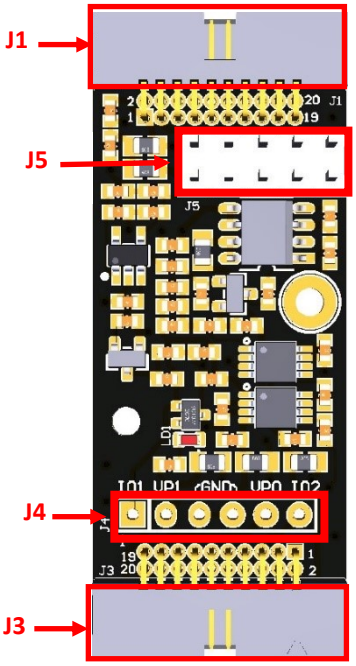
Wire wrapping

ADP-FL-WW



Direct plug

ADP-FL-DIRPLUG



Peripherals

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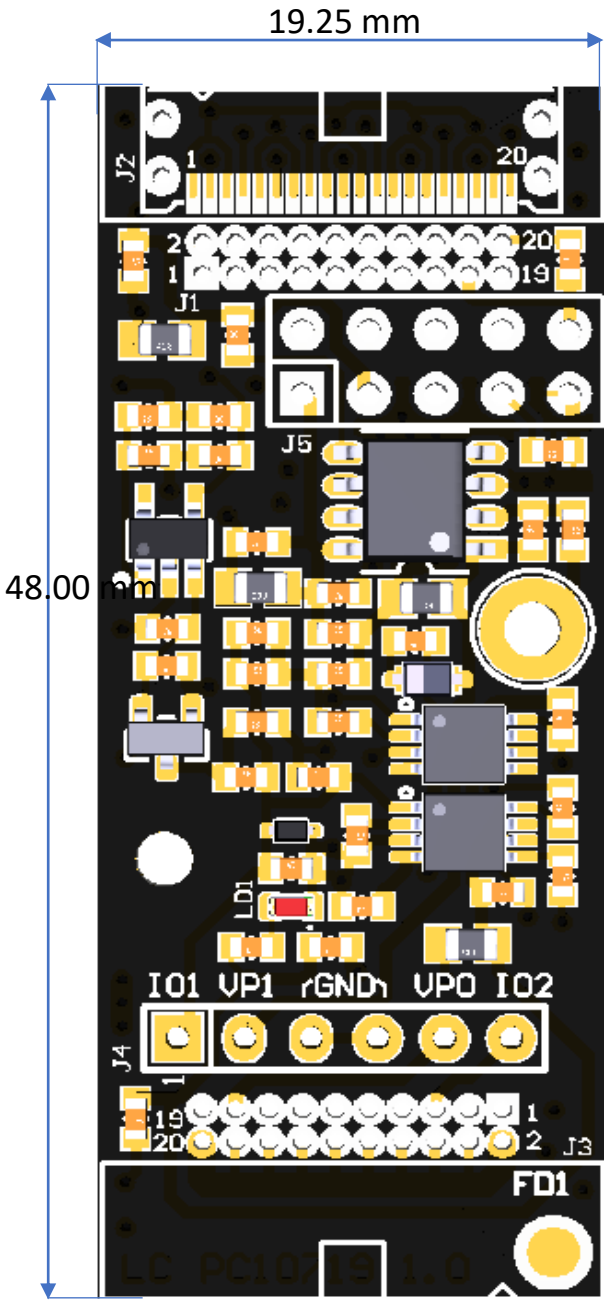
SMH FASTLIN Adapter Board Dimension

Board dimension is expressed in millimetres [mm].



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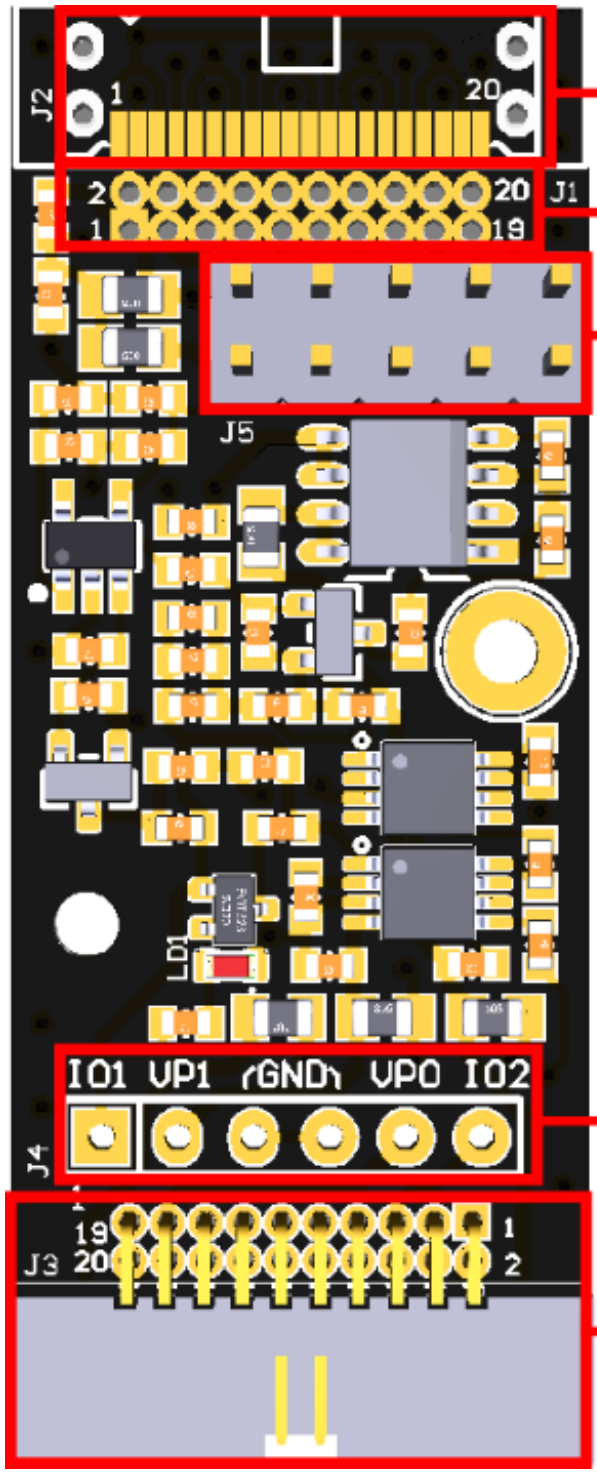
SMH FASTLIN Adapter Connections



J2 - Input Connector

J1- Input Connector

J5- Input Connector

J4 - Output Connector

J3- Output Connector

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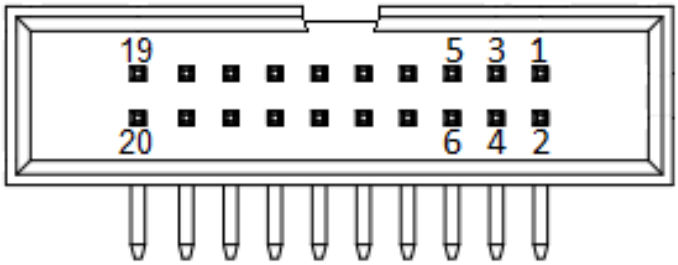
SMH FASTLIN Adapter Input connector J1



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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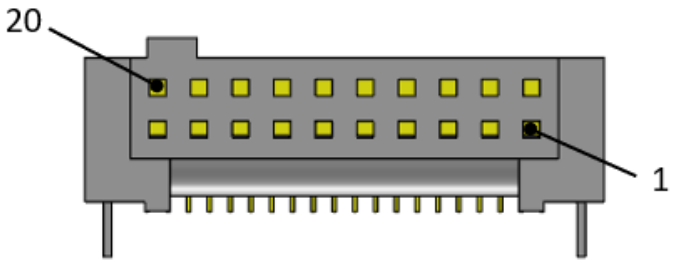
SMH FASTLIN Adapter Input connector J2



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 FASTLIN 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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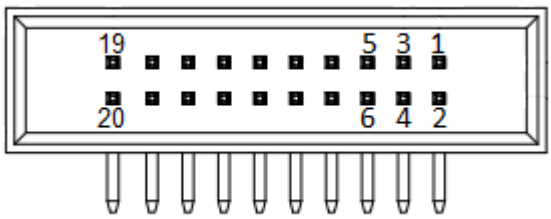
SMH FASTLIN Adapter Output connector J3



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 FASTLIN 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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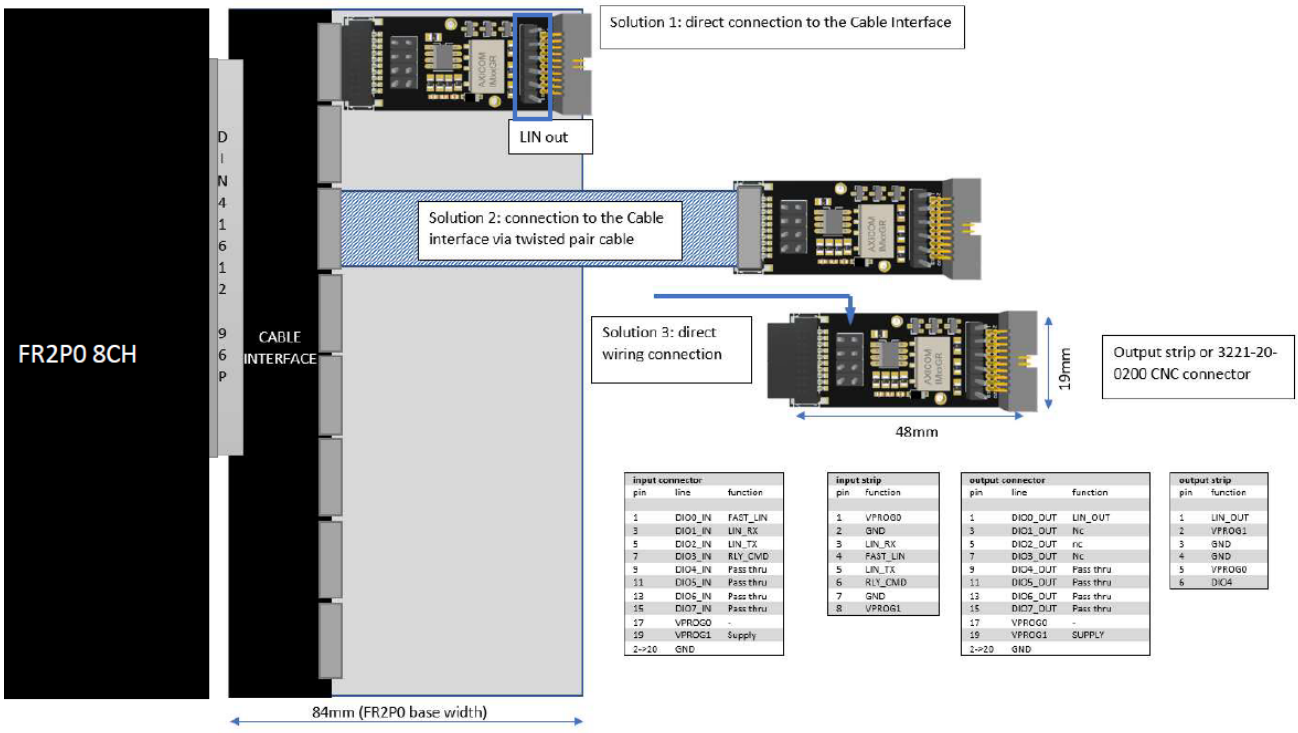
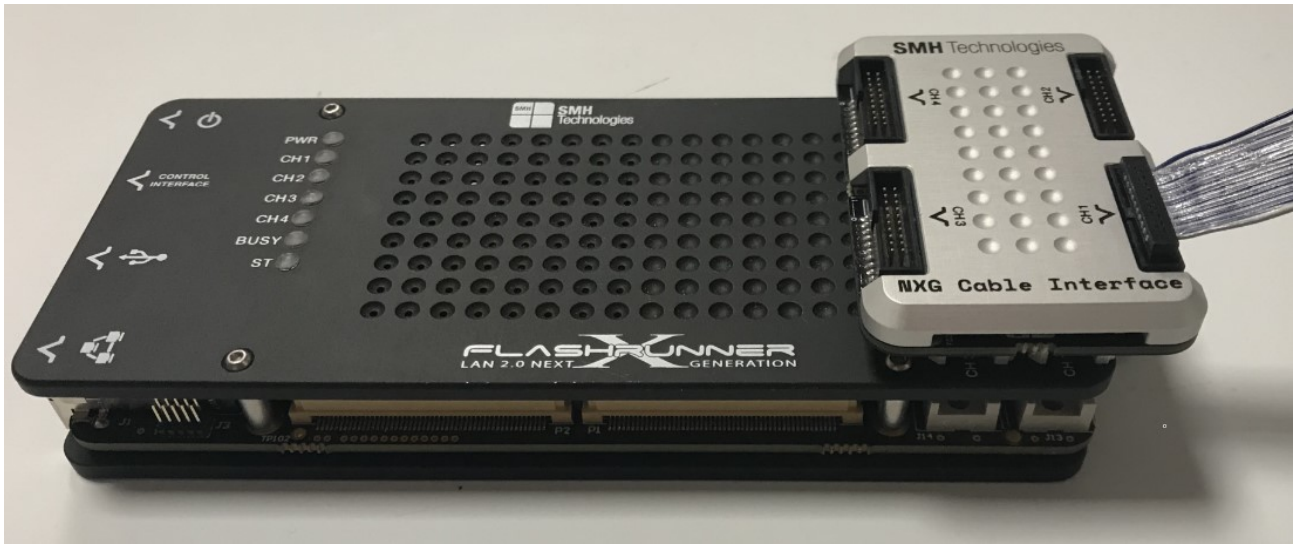
SMH FASTLIN Adapter Interconnection Example



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



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SMH FASTLIN Adapter Typical Integration

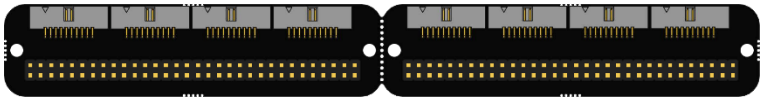
The External Hardware designed by SMH Technologies allows matching the needs of the user in terms of integration, selecting carefully the Input/Output connectors.

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:

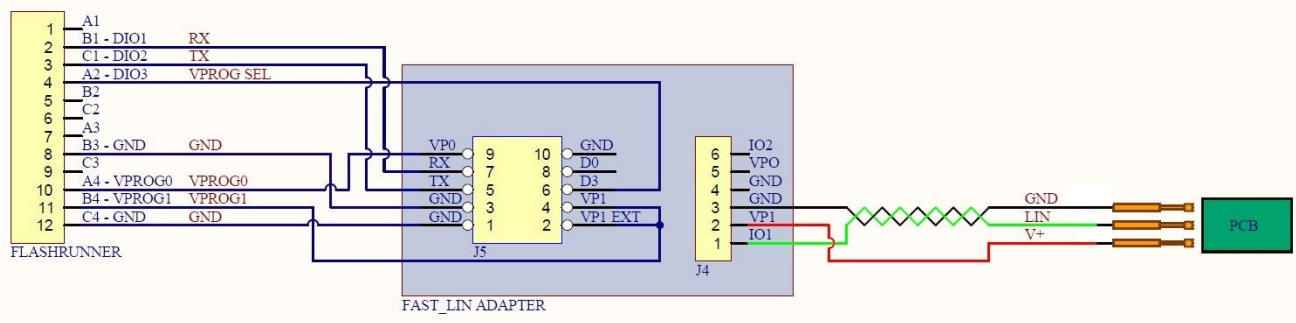
FRCABLE: special cables of length up to 1 m, to be plugged into **J1** or **J3** connectors as Input or Output, and the pinstrip Header or the Cable Interface

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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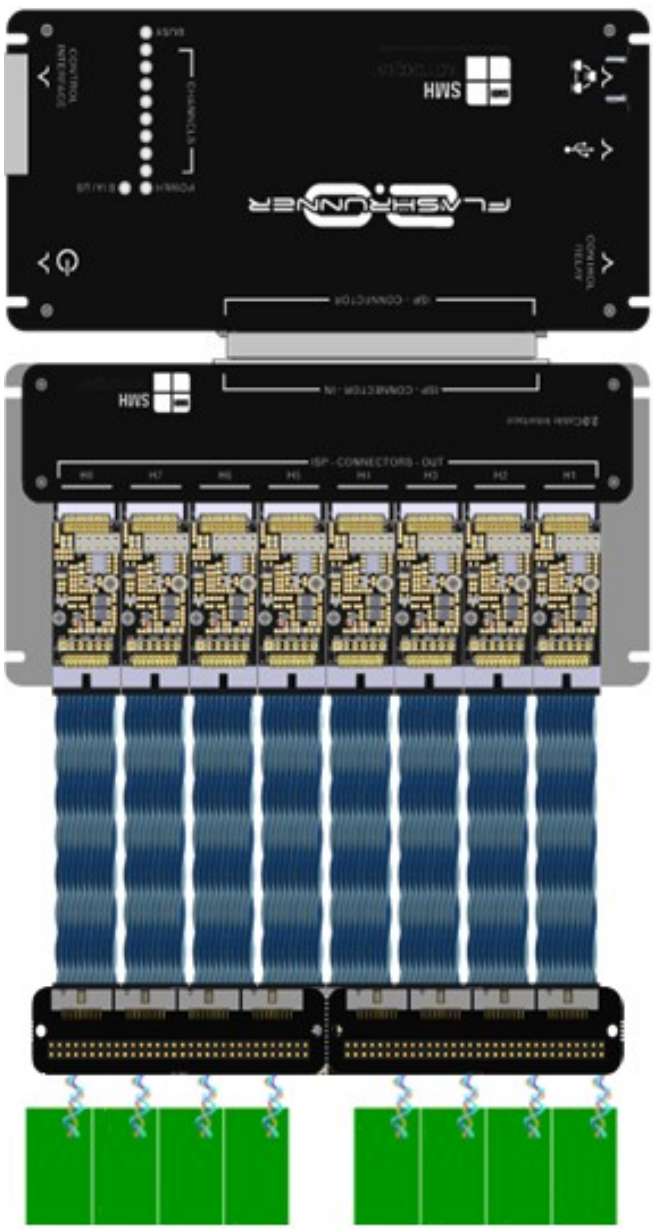
SMH FASTLIN Adapter Direct Plug

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.



FlashRunner 2.0

Cable Interface for Direct Plug

FR2P0INTF08_ADP

Adapter

ADP-FL-DIRPLUG

FR Cable

PinStrip Header

Target

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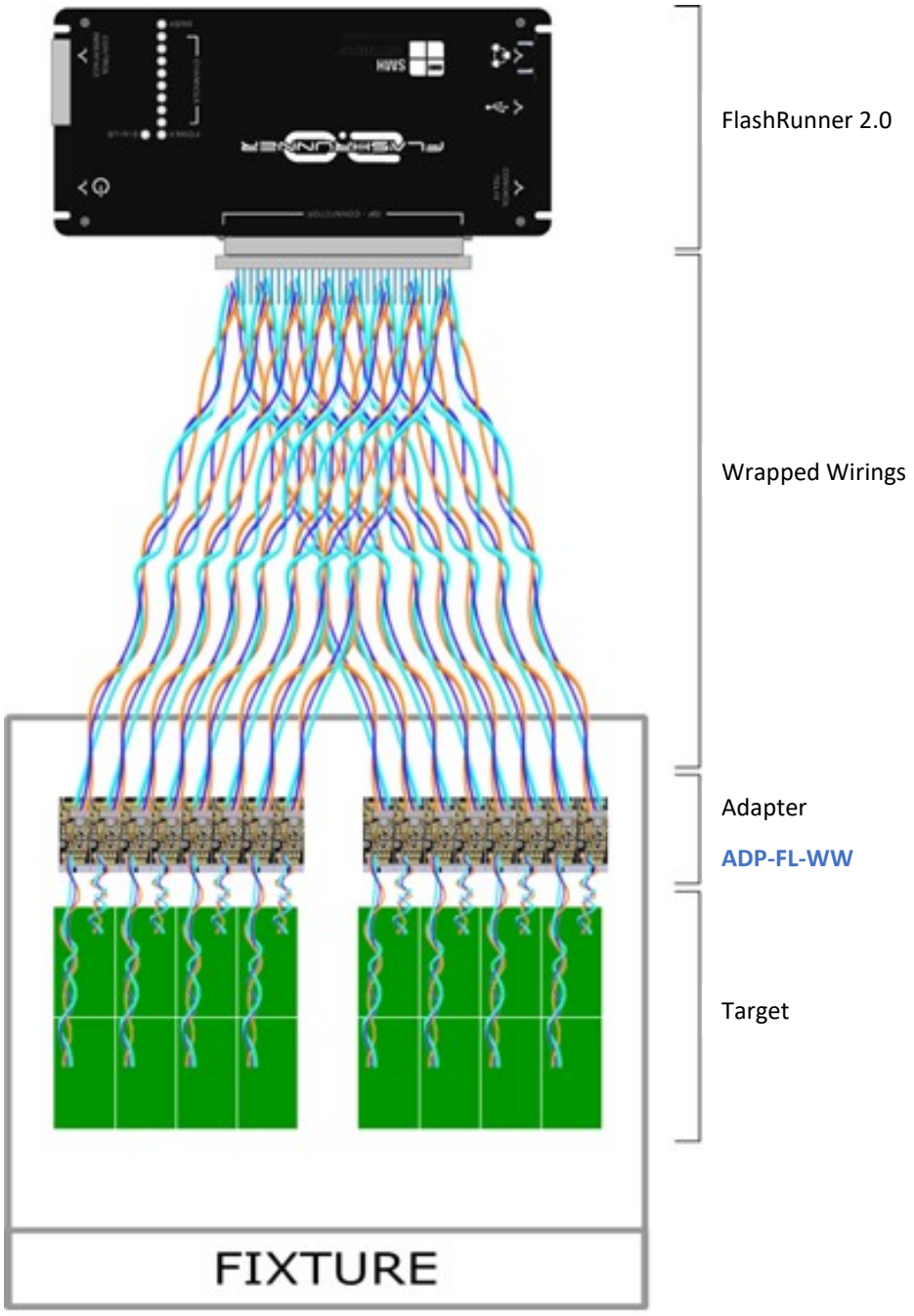
SMH FASTLIN Adapter Wire Wrapping

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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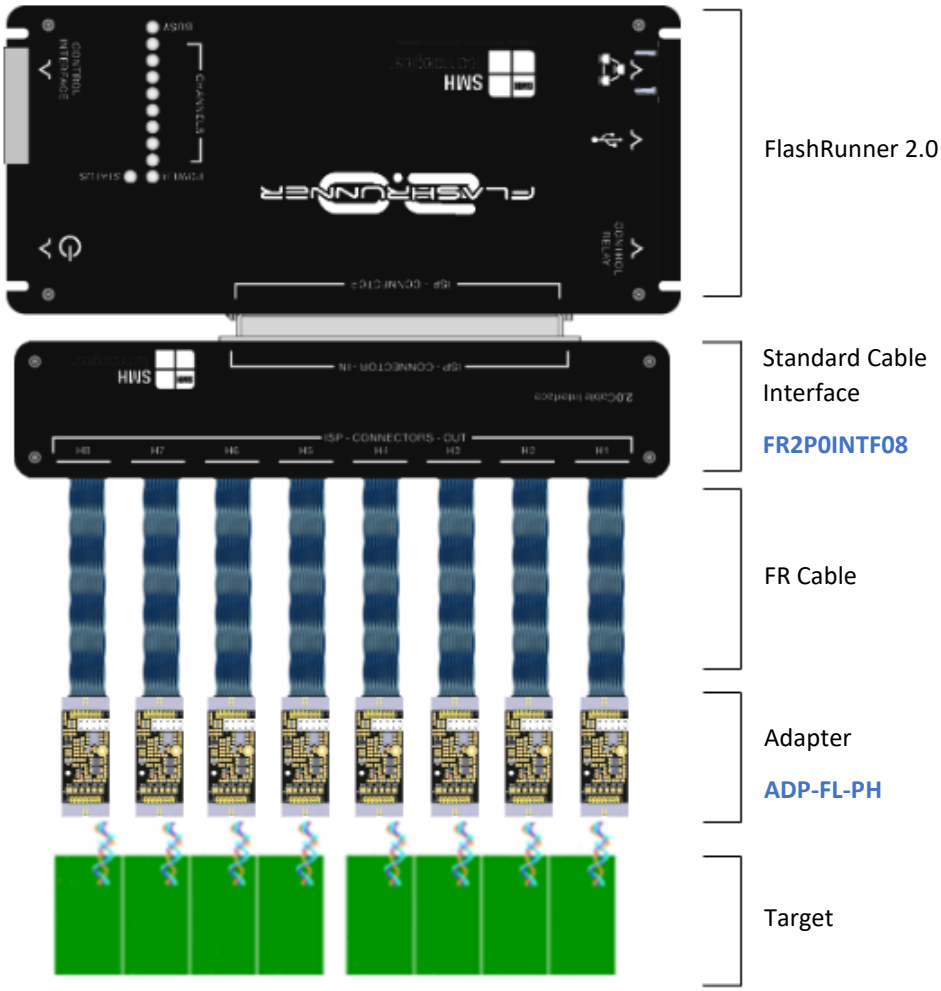
SMH FASTLIN Adapter Peripherals

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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Melexis Fast LIN Mulan 2 Programming Procedure

The LIN/Fast LIN bootloader is located in the Flash.
Even during upload of a new application, the bootloader must always remain.

Thus, the Flash programming is divided into 4 steps which have to be executed in the right order.

The loader state is indicating the current step in the programming procedure of the Flash.
It is a number from 0 to 3 which is stored inside the Flash at address 0xBF66 (16-bit size).

The loader state represents the following scenarios:

0. **State 0**: The normal application is running. The whole Flash area can be used in this state.

1. **State 1**: The built-in bootloader is running which is located in the lower half of the Flash. In this state, the built-in bootloader programs the loader B (a functional copy of the built-in bootloader) into the upper half of the Flash.

2. **State 2**: The loader B is running. In this state, the loader B programs the built-in bootloader of the new application into the lower half of the Flash.

3. **State 3**: The built-in bootloader of the new application is running. In this state, the built-in bootloader programs the new application in the upper half of the Flash.

The loader state descriptions:

0 => Entire Flash area None Normal application execution [0x4000 - 0xC000].

1 => Lower half of Flash Upper half of Flash Application execution is disabled; Built-in loader of the [0x4000 - 0x8000] [0x8000 - 0xC000] application programs the upper half of the Flash with loader B.

2 => Upper half of Flash Lower half of Flash Loader B programs lower half of the Flash with new [0x8000 - 0xC000] [0x4000 - 0x8000] application including new built-in loader.

3 => Lower half of Flash Upper half of Flash Built-in loader of new application programs the upper half of [0x4000 - 0x8000] [0x8000 - 0xC000] the Flash with new application (loader B will be overwritten).

At first, when the loader state is 0, FlashRunner 2.0 directly writes the new loader state value 1 to the address 0xBF66.

In the next step, when the loader state is 1, the loader B will be programmed into the chip.
The loader B HEX file already contains the new loader state value 2 at address 0xBF66.
Thus, the loader state will automatically be updated when the loader B code will be programmed in the device.

In the next step, when the loader state is 2, the built-in loader of the new application will be programmed into the chip.
The HEX file of the new application already contains the new loader state value 3 at address 0xBF66.
Thus, the loader state will automatically be updated when the code of the new application will be programmed in the device).

Finally, when the loader state is 3, the user code of the new application will be programmed into the chip. After its completion, the programming tool directly writes the new loader state value 0 to the address 0xBF66.

0. => 1 Direct write of the word 0x0001 to the address 0xBF66.
1. => 2 New state is included in loader B HEX file -> will be written during loader B upload.
2. => 3 New state is included in new application HEX file -> will be written during new application upload.
3. => 0 Direct write of the word 0x0000 to the address 0xBF66.

All these programming steps are performed automatically by the driver.
Depending on the state the device is in, the driver will choose which steps it will have to perform.
For each step the device must be turned off and on again, so the power supply must be supplied directly by the FlashRunner.

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Melexis Fast LIN Mulan 3 NVRAM Memory

NVRAM page	Address	Content
NVRAM1 page 1	0x1000-0x107F	Customer Area
NVRAM1 page 2	0x1080-0x10FF	MLX reserved
NVRAM2 page 1	0x1080-0x10FF	Customer Area
NVRAM2 page 2	0x1180-0x11FF	MLX reserved

Melexis Fast LIN Mulan 2 NVRAM Memory

NVRAM page	Address	Content
NVRAM1 page1	0x1000-0x107F	Customer Area
NVRAM1 page2	0x1080-0x10FB	Customer Area
NVRAM1 page2	0x10FC-0x10FF	MLX reserved
NVRAM2 page1	0x1180-0x11FF	Customer Area
NVRAM2 page2	0x1180-0x11FF	MLX reserved

Melexis Fast LIN Driver Parameters

The additional parameters are used to configure some specific options inside MLXFASTLIN driver.

#TCSETPAR EXTERNAL HARDWARE

Syntax: **#TCSETPAR** EXTERNAL_HARDWARE <Use External Hardware>

<Use External Hardware> Accepted parameters are Yes or No

Description: Enable it to configure FlashRunner to use the Transceiver described in Fast LIN Transceiver Schematic
If you disable it, FlashRunner cannot be able to use the transceiver and will only use DIO0 line

Please do not set this parameter to "NO" if you are unsure of what you are doing, you could damage the DIO0 of the FlashRunner

In case customer chooses to set parameter to "NO" SMH assumes no responsibility

Note: Default value is YES

#TCSETPAR EXTERNAL HARDWARE REVISION

Syntax: **#TCSETPAR** EXTERNAL_HARDWARE_REVISION <Revision>

From driver version **5.01**

<Revision> Accepted parameters are:

- **PC10719**
- **PC10707**
- **PC10694**

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Accepted parameters for retro compatibility are:
- **VPROG1_LEVEL_SHIFTER_PC10707**
- **LIN/FAST_LIN_adapter_PC10694**

From driver version **4.16** to **5.00**
<Revision> Accepted parameters are:
- **VPROG1_LEVEL_SHIFTER_PC10707**
- **LIN/FAST_LIN_adapter_PC10694**

Description: Use this command to select the new SMH External Hardware revision named VPROG1_LEVEL_SHIFTER_PC10707 (or higher than PC10707) or the older revision named LIN/FAST_LIN_adapter_PC10694
VPROG1_LEVEL_SHIFTER_PC10707 is the new external hardware version released by SMH Technologies in the first quarter of 2022

From driver version **5.01** you can insert directly the PC number (i.e., **PC10719**, **PC10707** or **PC10694**)

Note: Default value is PC10719
Available from driver version **4.16**, updated on driver version **5.01**

#TCSETPAR LIN ENTRY

Syntax: `#TCSETPAR LIN_ENTRY <Use LIN Entry>`

<Use LIN Entry> Accepted parameters are Yes or No

Description: Enable it to configure the `#TPCMD CONNECT` command to send the LIN frames to enter into programming mode

The frames sent by FlashRunner through LIN protocol are described into LIN entry image
If you disable this parameter, all LIN frames are skipped into Connect command and only frames via Fast LIN protocol are sent to target device

Obviously, to get the command to work in this configuration, the device must be set in the Fast LIN configuration before sending the commands in Fast LIN protocol

In case customer chooses to set parameter to "NO" SMH assumes no responsibility

Note: Default value is YES

#TCSETPAR NAD1 and NAD2

Syntax:
`#TCSETPAR NAD1 <HEX Value>`
`#TCSETPAR NAD2 <HEX Value>`

<HEX Value> Accepted parameter is between **0x00** and **0x7F**

Description: NAD1 and NAD2 they must be between value **0x00** and value **0x7F**
NAD2 is optional

It is recommended to not set NAD2 in Mulan2 devices and leave NAD1 at 0x7F.

Typically, the NAD (Node Address for Diagnostic), is set to 0x7F when the device has just left the production factory

The value 0x7F is the one defined as default by Melexis
If the target device doesn't have the same NAD as the one set in the project, it will not recognize the commands through LIN protocol
So, I recommend setting the NAD1 to 0x7F if the device is virgin

After the first programming of your firmware in FLASH, the NAD may change due to the firmware programmed in the flash memory

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If the device responds but with a different NAD than the one set with NAD1, if NAD2 has not been set by project, then the driver will retry connect through the NAD it received in response
Instead, if the NAD2 is set by project, then the driver will try the new connect with it

If the device does not respond to NAD1 and NAD2 is not set by project, then the driver will try again with the value of NAD1

If the #TCSETPAR LIN_ENTRY parameter is set to NO, this parameter it's not used

Note: Default value is **0x7F**
Available from driver version **2.01**

#TCSETPAR RAM KEY

Syntax:

```
#TCSETPAR RAM_KEY_0 <HEX Value>
#TCSETPAR RAM_KEY_1 <HEX Value>
#TCSETPAR RAM_KEY_2 <HEX Value>
#TCSETPAR RAM_KEY_3 <HEX Value>
#TCSETPAR RAM_KEY_4 <HEX Value>
#TCSETPAR RAM_KEY_5 <HEX Value>
#TCSETPAR RAM_KEY_6 <HEX Value>
#TCSETPAR RAM_KEY_7 <HEX Value>
```

<HEX Value> Accepted parameter is between value **0x00** and **0xFF**

Description: It is possible for a customer to define a 64bit protection key in his firmware in order to prevent a FLASH read operation after the application firmware was programmed [*Flash Readout Protection*]

In case this option is used by developer of the Melexis firmware, the FLASH read operation delivers only valid content when the correct key was sent before via the "Set key" message you are referring to.

The value of the key will be defined by the developer of the Melexis firmware and can be different for each firmware. This means there is no constant key which can be used

This key has no impact for FLASH erase or write operation

For Mulan 3 devices, The Flash is read protected when the upper 32-bits are not equal to the lower 32-bits of the 64-bit Flash protection key as stored in the Flash memory at address **0xBF46**.

Note: Default value is **0x40**

#TCSETPAR CONNECT RETRY

Syntax:

```
#TCSETPAR CONNECT_RETRY <Retries>
```

<Retries> Accepted parameter is between **1** and **100**

Description: Parameter to retry the #TPCMD CONNECT command several times
Each connect will perform a Wake-Up Pulse of the duration set by the parameter #TCSETPAR WAKEUP_PULSE and a double entry programming mode attempt, first with a NAD1 frame and then with a NAD2 frame if device not respond at NAD1

Note: Default value is **1**
Available from driver version **2.02**

#TCSETPAR WAKEUP PULSE

Syntax:

```
#TCSETPAR WAKEUP_PULSE <Time [ms]>
```

<Time [ms]> Accepted parameter is between **1** and **32768**

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Description: Wake Up Pulse duration in ms before LIN Entry Programming Mode frame during **#TPCMD CONNECT** command
If the **#TCSETPAR** LIN_ENTRY parameter is set to NO, this parameter it's not used

Note: Default value is **100**
Available from driver version **2.03**

#TCSETPAR BOOTLOADER B

Syntax: **#TCSETPAR** BOOTLOADER_B <Filename.frb>

<Filename.frb> Filename.frb must be a name with no spaces, no non-ASCII characters and up to 40 characters (including the frb extension)

Description: This parameter is used only for **Mulan2** family devices.
This FRB file must be used when a Mulan2 device has the Loader State at **1**.
In this case it will be necessary to program the Bootloader B.

Note: Available from driver version **4.00**

#TCSETPAR CUSTUMER FIRMWARE

Syntax: **#TCSETPAR** CUSTUMER_FIRMWARE <Filename.frb>

<Filename.frb> Filename.frb must be a name with no spaces, no non-ASCII characters and up to 40 characters (including the frb extension)

Description: This parameter is used only for **Mulan2** family devices.
This FRB file must be used when a Mulan2 device has the Loader State at **2** and **3**.
In this case it will be necessary to program the Customer Firmware.

Note: Available from driver version **4.00**

#TCSETPAR FASTLIN FRAME GAP

Syntax: **#TCSETPAR** FASTLIN_FRAME_GAP <Time [us]>

<Time [us]> Accepted parameter is between **1** and **32768**

Description: A small delay can be added after some specific FASTLIN frames to handle specific boards that have different timings than standard boards.

Please leave this parameter at zero (unselected) if you do not have causal problems on some board in commands other than **#TPCMD CONNECT**.
If you notice that by some a board of a panel has failures, for example in Blankcheck or in Program commands, it is advisable to add a small delay (a few us, for example 10).

Note: Default value is **0**
Available from driver version **4.10**

#TCSETPAR LIN FREQUENCY

Syntax: **#TCSETPAR** LIN_FREQUENCY <Frequency [bps]>

<Frequency [bps]> Accepted parameter is between **1** and **19200**

Description: With this parameter you can change the LIN frequency used into Connect command during LIN phase
If the **#TCSETPAR** LIN_ENTRY parameter is set to NO, this parameter it's not used

Note: Default value is **19200**
Available from driver version **4.21**

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Melexis Fast LIN Driver Commands

#TPCMD CONNECT

#TPCMD CONNECT
Connect function. Power on and entry.
The connection procedure is divided into two parts.

In the first part of the Connect command the protocol used to communicate with the device is **LIN**.
Remember that the **LIN** protocol normally operates at around 10-12V and FlashRunner 2.0 can accept a maximum input of 5.5V in the digital lines.

For this reason, it is necessary to use external hardware that prevents the 12V of the **LIN** line from entering directly into a DIO of the FlashRunner 2.0.

The second phase of the Connect command is performed in the **FASTLIN** protocol which uses a voltage range of approximately 5V and this protocol will then be used throughout the entire programming phase of the device.

Connect example for CamCU device:

```
---#TPCMD CONNECT
Melexis MLX81113-xBx CamCU series.
Execute wake up pulse of 100ms.
Selected LIN Baudrate is 19200 bps.
Selected NAD1 is 0x7F [wildcard].
Send LIN Entry Programming Mode frame.
 * Device respond with NAD 0x01.
 * Device PCI: 0x06, SID: 0xF2.
 * Melexis SW Platform Major: 0x01.
 * Melexis SW Platform Minor: 0x23.
 * Melexis SW Platform Build: 0x00.
 * Melexis SW Platform Revision: 0x00.
 * Device Loader state: 0x05 - 3rd generation loader.
Send switch to FASTLIN frame.
 * Requested FASTLIN Baudrate is 150000 bps.
 * Generated FASTLIN Baudrate is 150000 bps.
Write Melexis RAM keys.
* Write Melexis RAM keys completed.
Time for Connect: 0.384 s.
>|
```

#TPCMD MASSERASE

#TPCMD MASSERASE <F>
Masserase for FLASH memory of target device.
This command is available only for **Mulan3** and **CamCU** devices.
For **CamCU** devices a Page Erase of entire Flash memory is performed.
This command is not available for **Mulan2** devices. (Melexis Bootloader don't support this command).

#TPCMD ERASE

#TPCMD ERASE <F>
#TPCMD ERASE <F> <start address> <size>
Page erase of all/selected part for FLASH memory of target device.
This command is available only for **CamCU**.
This command is not available for **Mulan2** and **Mulan3** devices. (Melexis Bootloader don't support this command).
Enter start address and size in Hexadecimal format.

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#TPCMD BLANKCHECK

```
#TPCMD BLANKCHECK <F>
#TPCMD BLANKCHECK <F> <start address> <size>
```
Blankcheck BIST of all/selected part for FLASH memory of target device.
This command is available only for **Mulan3** and **CamCU** devices.
This command is not available for **MLX81123** and **MLX81118-xxB CamCU** device. (This command is not available because the content of the Flash is undefined if it has been erased before. This results in different CRCs reported by the device via the LIN bootloader).
This command is not available for **Mulan2** devices. (Melexis Bootloader don't support this command).
Enter start address and size in Hexadecimal format.

```
#TPCMD BLANKCHECK <N>
#TPCMD BLANKCHECK <N> <start address> <size>
```
Blankcheck of all/selected part for NVRAM memory of target device.
This command is available for **Mulan2**, **Mulan3** and **CamCU** devices.
Enter start address and size in Hexadecimal format.

#TPCMD PROGRAM

```
#TPCMD PROGRAM <F>
#TPCMD PROGRAM <F> <start address> <size>
```
Program of all/selected part for FLASH memory of target device.
This command is available for **Mulan2**, **Mulan3** and **CamCU** devices.
This command is not available for **MLX81301 Mulan2** device. (This device has no internal FLASH memory).
Enter start address and size in Hexadecimal format.

```
#TPCMD PROGRAM <N>
#TPCMD PROGRAM <N> <start address> <size>
```
Program of all/selected part for NVRAM memory of target device.
This command is available for **Mulan2**, **Mulan3** and **CamCU** devices.
Enter start address and size in Hexadecimal format.

#TPCMD VERIFY

```
#TPCMD VERIFY <F> <R>
#TPCMD VERIFY <F> <R> <start address> <size>
```
Verify Readout of all/selected part for FLASH memory of target device.
This command is available for **Mulan2**, **Mulan3** and **CamCU** devices.
This command is not available for **MLX81123** and **MLX81118-xxB CamCU** device. (Melexis Bootloader don't support this command).
This command is not available for **MLX81301 Mulan2** device. (This device has no internal FLASH memory).
Enter start address and size in Hexadecimal format.

```
#TPCMD VERIFY <N> <R>
#TPCMD VERIFY <N> <R> <start address> <size>
```
Verify Readout of all/selected part for NVRAM memory of target device.
This command is available for **Mulan2**, **Mulan3** and **CamCU** devices.
Enter start address and size in Hexadecimal format.

```
#TPCMD VERIFY <F> <S>
#TPCMD VERIFY <F> <S> <start address> <size>
```
Verify BIST of all/selected part for FLASH memory of target device.
This command is available for **Mulan2**, **Mulan3** and **CamCU** devices.
This command is not available for **MLX81301 Mulan2** device. (This device has no internal FLASH memory).
Enter start address and size in Hexadecimal format.

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#TPCMD READ

```
#TPCMD READ <F> <R>
#TPCMD READ <F> <R> <start address> <size>
```

Read of all/selected part for FLASH memory of target device.
This command is available for **Mulan2**, **Mulan3** and **CamCU** devices.
This command is not available for **MLX81123** and **MLX81118-xxB CamCU** device. (Melexis Bootloader don't support this command).
This command is not available for **MLX81301 Mulan2** device. (This device has no internal FLASH memory).
Enter start address and size in Hexadecimal format.
The result of the read command will be visible into the Terminal.

```
#TPCMD READ <N> <R>
#TPCMD READ <N> <R> <start address> <size>
```

Read of all/selected part for NVRAM memory of target device.
This command is available for **Mulan2**, **Mulan3** and **CamCU** devices.
Enter start address and size in Hexadecimal format.
The result of the read command will be visible into the Terminal.

#TPCMD DUMP

```
#TPCMD DUMP <F> <R>
#TPCMD DUMP <F> <R> <start address> <size>
```

Dump of all/selected part for FLASH memory of target device.
This command is available for **Mulan2**, **Mulan3** and **CamCU** devices.
This command is not available for **MLX81123** and **MLX81118-xxB CamCU** device. (Melexis Bootloader don't support this command).
This command is not available for **MLX81301 Mulan2** device. (This device has no internal FLASH memory).
Enter start address and size in Hexadecimal format.
The result of the dump command will be stored in the FlashRunner 2.0 internal memory.

```
#TPCMD DUMP <N> <R>
#TPCMD DUMP <N> <R> <start address> <size>
```

Dump of all/selected part for NVRAM memory of target device.
This command is available for **Mulan2**, **Mulan3** and **CamCU** devices.
Enter start address and size in Hexadecimal format.
The result of the dump command will be stored in the FlashRunner 2.0 internal memory.

#TPCMD GET_CRC

```
#TPCMD GET_CRC <F>
#TPCMD GET_CRC <F> <start address> <size>
```

Get CRC BIST of all/selected part for FLASH memory of target device.
This command is available for **Mulan2**, **Mulan3** and **CamCU** devices.
This command is not available for **MLX81301 Mulan2** device. (This device has no internal FLASH memory).
Enter start address and size in Hexadecimal format.

#TPCMD DISCONNECT

```
#TPCMD DISCONNECT
```

Disconnect function. Restart the device, power off and exit.

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Melexis Fast LIN Driver Examples

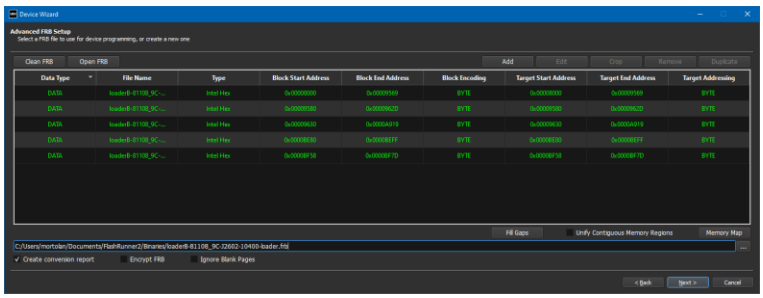
Here you can see a complete examples of Melexis Fast LIN projects.

Melexis Fast LIN MLX81109 MULAN 2 example

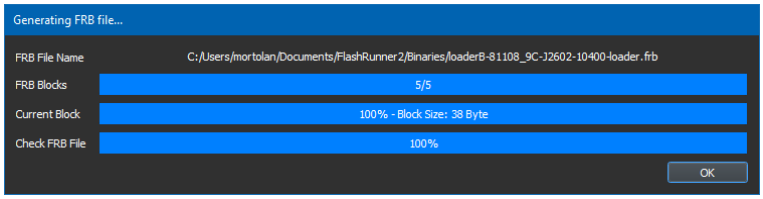
Here you can find an example for MLX81109 Mulan 2 device.

Melexis Fast LIN MLX81109 MULAN 2 example FRB creation

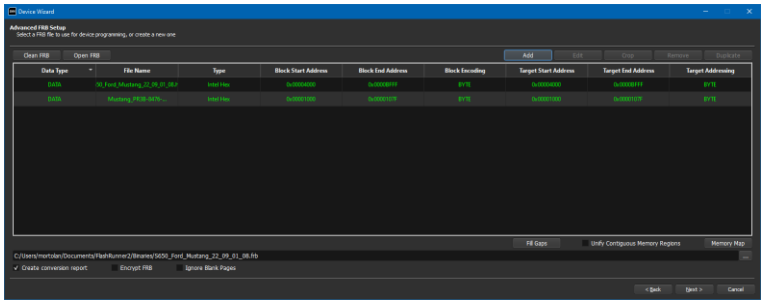
On Advanced FRB setup select **New frb -> Add > Import from source file HEX** and choose from your local path the '**LOADER_B.hex'** source file (Loader B file).



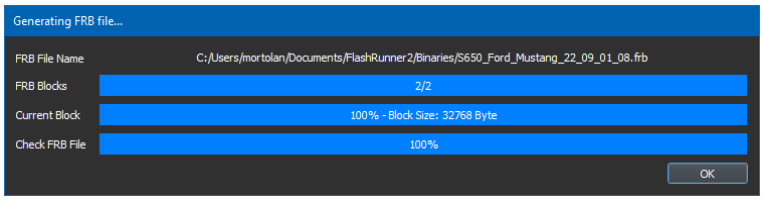
Create the **LOADER_B.frb**:



Now select **Add > Import from source file HEX** and choose from your local path the '**FLASH_and_NVRAM.hex"** source file.



Create the **FLASH_and_NVRAM.frb**:



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Melexis Fast LIN MLX81109 MULAN 2 example Commands

Additional parameters:

```
#TCSETPAR BOOTLOADER_B: LOADER_B.frb
#TCSETPAR CUSTUMER_FIRMWARE: FLASH_and_NVRAM.frb
#TCSETPAR EXTERNAL_HARDWARE: YES
#TCSETPAR EXTERNAL_HARDWARE_REVISION: PC10694
#TCSETPAR LIN_ENTRY: YES
#TCSETPAR LIN_FREQUENCY: 10400
#TCSETPAR NAD1: 0x7F
#TCSETPAR PROTCLK: 75000
#TCSETPAR WAKEUP_PULSE: 100
```

75000 bps is the maximum frequency supported by Melexis Mulan2 bootloader

```
#TCSETPAR BOOTLOADER_B LOADER_B.frb <- Remember to send this FRB to FR 2.0
#TCSETPAR CUSTUMER_FIRMWARE FLASH_and_NVRAM.frb <- Remember to send this FRB to FR 2.0
#TCSETPAR EXTERNAL_HARDWARE YES
#TCSETPAR EXTERNAL_HARDWARE_REVISION PC10694
#TCSETPAR LIN_ENTRY YES
#TCSETPAR LIN_FREQUENCY 10400
#TCSETPAR NAD1 0x7F
#TCSETPAR PROTCLK 75000
#TCSETPAR PWDOWN 100
#TCSETPAR PWUP 100
#TCSETPAR VPROG0 5000
#TCSETPAR VPROG1 10000
#TCSETPAR WAKEUP_PULSE 100
#TCSETPAR CMODE FAST_LIN
#TPSETSRC FLASH_and_NVRAM.frb
#TPSTART
#TPCMD CONNECT
#TPCMD PROGRAM F
#TPCMD VERIFY F S
#TPCMD PROGRAM N
#TPCMD VERIFY N R
#TPCMD DISCONNECT
#TPEND
```

Melexis Fast LIN MLX81109 MULAN 2 example Real Time Log

```
---#TPCMD CONNECT
Melexis MLX81109 Mulan2 series.
Execute wake up pulse of 100ms.
Selected LIN Baudrate is 10400 bps.
Selected NAD1 is 0x7F [wildcard].
Send LIN Entry Programming Mode frame.
 * Device respond with NAD 0x66.
 * Device PCI: 0x06, SID: 0xF2.
 * Melexis SW Platform Major: 0x04.
 * Melexis SW Platform Minor: 0x03.
 * Melexis SW Platform Build: 0x00.
 * Melexis SW Platform Revision: 0x01.
 * Device Loader state: 0x00 - 1st generation loader.
Send key frames.
 * Completed send key frames.
Send switch to FASTLIN frame.
 * Requested FASTLIN Baudrate is 75000 bps.
 * Generated FASTLIN Baudrate is 75000 bps.
Read device RAM table.
 * Read device RAM table completed.
Device Loader State: 0.
Time for Connect: 0.443 s.
>|
---#TPCMD PROGRAM F
> Device Loader State is: 0.
Change Device Loader State to 1.
> Device Loader State is: 1.
Change Device Loader State to 2.
Load Melexis Bootloader.
```


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```
FRB CRC32 = 0x27C85626
FRB Headers collected.
Program Melexis Bootloader.
FRB CRC32 = 0x86287841
> Device Loader State is: 2.
Program the Lower Half of FLASH.
FRB Headers collected.
Change Device Loader State to 3.
> Device Loader State is: 3.
Program the Upper Half of FLASH.
> Device Loader State is: 0.
Time for Program F: 15.038 s.
>|
---#TPCMD VERIFY F S
Requested CRC: 0x86EC - Device CRC: 0x86EC.
Time for Verify Bist F: 0.225 s.
>|
---#TPCMD PROGRAM N
Time for Program N: 0.065 s.
>|
---#TPCMD VERIFY N R
Time for Verify Readout N: 0.039 s.
>|
---#TPCMD DISCONNECT
Restart the Melexis device.
>|
```

Melexis Fast LIN MLX81109 MULAN 2 example Programming Times

Operation	Timings FlashRunner 2.0
Time for Connect	0.443 s
Time for Program Flash	15,038 s
Time for Verify BIST Flash	0,225 s
Time for Program NVRAM	0,065 s
Time for Verify Readout NVRAM	0.039 s
Cycle Time	**00:15.860 s**

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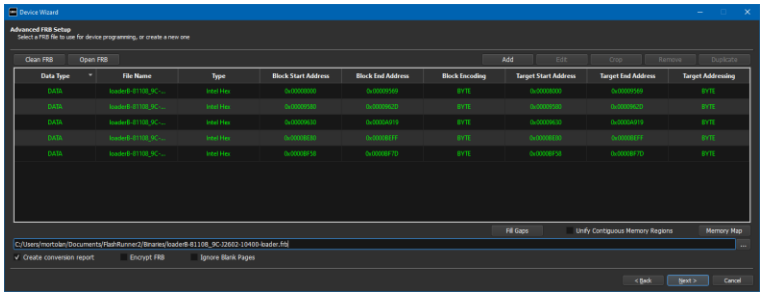
Melexis Fast LIN MLX81109 MULAN 2 example from driver version 5.03

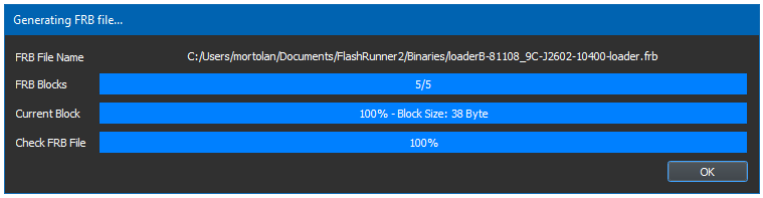
Here you can find an example for MLX81109 Mulan 2 device.

Melexis Fast LIN MLX81109 MULAN 2 example FRB creation

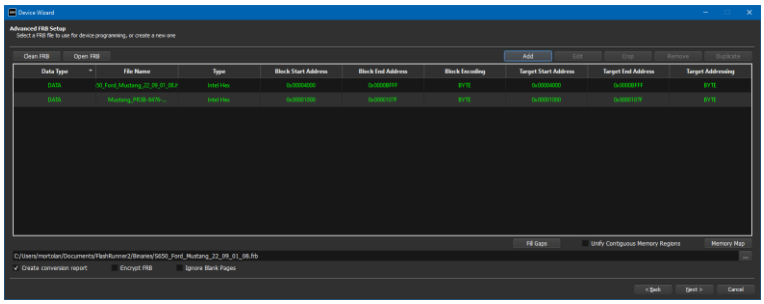
On Advanced FRB setup select **New frb -> Add > Import from source file HEX** and choose from your local path the '**LOADER_B.hex'** source file (Loader B file).



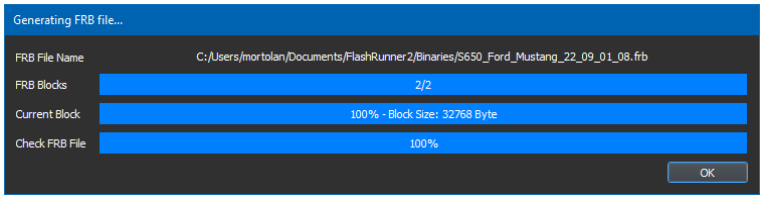
Create the **LOADER_B.frb**:



Now select **Add > Import from source file HEX** and choose from your local path the '**FLASH_and_NVRAM.hex"** source file.



Create the **FLASH_and_NVRAM.frb**:



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Melexis Fast LIN MLX81109 MULAN 2 example Commands

Additional parameters:

```
#TCSETPAR BOOTLOADER_B: LOADER_B.frb
#TCSETPAR CUSTUMER_FIRMWARE: FLASH_and_NVRAM.frb
#TCSETPAR EXTERNAL_HARDWARE: YES
#TCSETPAR EXTERNAL_HARDWARE_REVISION: PC10694
#TCSETPAR LIN_ENTRY: YES
#TCSETPAR LIN_FREQUENCY: 10400
#TCSETPAR NAD1: 0x7F
#TCSETPAR PROTCLK: 75000
#TCSETPAR WAKEUP_PULSE: 100
```

75000 bps is the maximum frequency supported by Melexis Mulan2 bootloader

```
#TCSETPAR BOOTLOADER_B LOADER_B.frb <- Remember to send this FRB to FR 2.0
#TCSETPAR CUSTUMER_FIRMWARE FLASH_and_NVRAM.frb <- Remember to send this FRB to FR 2.0
#TCSETPAR EXTERNAL_HARDWARE YES
#TCSETPAR EXTERNAL_HARDWARE_REVISION PC10694
#TCSETPAR LIN_ENTRY YES
#TCSETPAR LIN_FREQUENCY 10400
#TCSETPAR NAD1 0x7F
#TCSETPAR PROTCLK 75000
#TCSETPAR PWDOWN 100
#TCSETPAR PWUP 100
#TCSETPAR VPROG0 5000
#TCSETPAR VPROG1 10000
#TCSETPAR WAKEUP_PULSE 100
#TCSETPAR CMODE FAST_LIN
#TPSETSRC FLASH_and_NVRAM.frb
#TPSTART
#TPCMD CONNECT
#TPCMD PROGRAM F
#TPCMD VERIFY F S
#TPCMD PROGRAM N
#TPCMD VERIFY N R
#TPCMD DISCONNECT
#TPEND
```

Melexis Fast LIN MLX81109 MULAN 2 example Real Time Log

```
---#TPCMD CONNECT
Melexis MLX81108 Mulan2 series.
Execute wake up pulse of 100ms.
Selected LIN Baudrate is 19200 bps.
Selected NAD1 is 0x7F [wildcard].
Send LIN Entry Programming Mode frame.
 * Device respond with NAD 0x1B.
 * Device PCI: 0x06, SID: 0xF2.
 * Melexis SW Platform Major: 0x04.
 * Melexis SW Platform Minor: 0x02.
 * Melexis SW Platform Build: 0x00.
 * Melexis SW Platform Revision: 0x00.
 * Device Loader state: 0x00 - 1st generation loader.
Send key frames.
 * Completed send key frames.
Send switch to FASTLIN frame.
 * Requested FASTLIN Baudrate is 75000 bps.
 * Generated FASTLIN Baudrate is 75000 bps.
Read device RAM table.
 * Read device RAM table completed.
Device Loader State: 0.
Time for Connect: 0.415 s.
>|
---#TPCMD PROGRAM F
> Device Loader State is: 0.
Change Device Loader State to 1.
Operation completed after 0.426 s.
> Device Loader State is: 1.
Change Device Loader State to 2.
```


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```
Load Melexis Bootloader.
FRB CRC32 = 0x3EA757F5
FRB Headers collected.
Program Melexis Bootloader.
 * 01664/16384 KiB - 10%
 * 03200/16384 KiB - 20%
 * 04736/16384 KiB - 30%
 * 06272/16384 KiB - 40%
 * 07808/16384 KiB - 50%
 * 09344/16384 KiB - 60%
 * 16384/16384 KiB - 100%
Operation completed after 3.575 s.
FRB CRC32 = 0xCDB26A3F
> Device Loader State is: 2.
Program the Lower Half of FLASH.
FRB Headers collected.
 * 01664/16384 KiB - 10%
 * 03200/16384 KiB - 20%
 * 04736/16384 KiB - 30%
 * 06272/16384 KiB - 40%
 * 07808/16384 KiB - 50%
 * 09344/16384 KiB - 60%
 * 10880/16384 KiB - 70%
 * 12416/16384 KiB - 80%
 * 13952/16384 KiB - 90%
 * 16384/16384 KiB - 100%
Operation completed after 5.432 s.
> Device Loader State is: 3.
Program the Upper Half of FLASH.
 * 01664/16384 KiB - 10%
 * 03200/16384 KiB - 20%
 * 04736/16384 KiB - 30%
 * 06272/16384 KiB - 40%
 * 07808/16384 KiB - 50%
 * 09344/16384 KiB - 60%
 * 10880/16384 KiB - 70%
 * 12416/16384 KiB - 80%
 * 13952/16384 KiB - 90%
 * 16384/16384 KiB - 100%
Operation completed after 4.903 s.
> Device Loader State is: 0.
Time for Program F: 14.748 s.
>|---#TPCMD VERIFY F R
Time for Verify Readout F: 7.960 s.
>|
---#TPCMD VERIFY F S
Requested CRC: 0x86EC - Device CRC: 0x86EC.
Time for Verify Bist F: 0.225 s.
>|
---#TPCMD DISCONNECT
Restart the Melexis device.
>|
```

Melexis Fast LIN MLX81109 MULAN 2 example Programming Times

Operation	Timings FlashRunner 2.0
Time for Connect	0.415 s
Time for Program Flash	14,748 s
Time for Verify Readout Flash	7.960 s
Time for Verify BIST Flash	0,225 s
Cycle Time	**00:23.408 s**

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Melexis Fast LIN MLX81325 MULAN 3 example

Here you can find an example for MLX81325 Mulan 3 device.

Melexis Fast LIN MLX81325 MULAN 3 example Commands

Additional parameters:

```
#TCSETPAR EXTERNAL_HARDWARE: YES
#TCSETPAR EXTERNAL_HARDWARE_REVISION: PC10707
#TCSETPAR LIN_ENTRY: YES
#TCSETPAR LIN_FREQUENCY: 19200
#TCSETPAR NAD1: 0x7F
#TCSETPAR PROTCLK: 75000
#TCSETPAR WAKEUP_PULSE: 100
```

75000 bps is the maximum frequency supported by Melexis Mulan2 bootloader

```
#TCSETPAR EXTERNAL_HARDWARE YES
#TCSETPAR EXTERNAL_HARDWARE_REVISION PC10707
#TCSETPAR LIN_ENTRY YES
#TCSETPAR LIN_FREQUENCY 19200
#TCSETPAR NAD1 0x7F
#TCSETPAR PROTCLK 75000
#TCSETPAR PWDOWN 100
#TCSETPAR PWUP 100
#TCSETPAR VPROG0 5000
#TCSETPAR VPROG1 10000
#TCSETPAR WAKEUP PULSE 100
#TCSETPAR CMODE FAST_LIN
#TPSETSRC FLASH.frb
#TPSTART
#TPCMD CONNECT
#TPCMD MASSERASE F
#TPCMD BLANKCHECK F
#TPCMD PROGRAM F
#TPCMD VERIFY F S
#TPCMD DISCONNECT
#TPEND
```

Melexis Fast LIN MLX81325 MULAN 3 example Real Time Log

```
---#TPCMD CONNECT
Melexis MLX81325 Mulan3 series.
Execute wake up pulse of 100ms.
Selected LIN Baudrate is 19200 bps.
Selected NAD1 is 0x7F [wildcard].
Send LIN Entry Programming Mode frame.
 * Device respond with NAD 0x07.
 * Device PCI: 0x06, SID: 0xF2.
 * Melexis SW Platform Major: 0x01.
 * Melexis SW Platform Minor: 0x00.
 * Melexis SW Platform Build: 0x02.
 * Melexis SW Platform Revision: 0x05.
 * Device Loader state: 0x04 - 2nd generation loader.
Send key frames.
 * Completed send key frames.
Send switch to FASTLIN frame.
 * Requested Baudrate is 75000 bps.
 * Generated Baudrate is 75000 bps.
Read device RAM table.
 * Read device RAM table completed.
Write Melexis RAM keys.
 * Write Melexis RAM keys completed.
Time for Connect: 0.410 s.
>|
---#TPCMD MASSERASE F
Time for Masserase F: 0.044 s.
>|
```


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```
---#TPCMD BLANKCHECK F
Requested CRC: 0xE1F0 - Device CRC: 0xE1F0.
Time for Blankcheck F: 0.180 s.
>|
---#TPCMD PROGRAM F
The firmware enables the Flash readout protection.
Time for Program F: 8.096 s.
>|
---#TPCMD VERIFY F S
Requested CRC: 0x9D02 - Device CRC: 0x9D02.
Time for Verify Bist F: 0.180 s.
>|
---#TPCMD DISCONNECT
Restart the Melexis device.
>|
```

Melexis Fast LIN MLX81325 MULAN 3 example Programming Times

Operation	Timings FlashRunner 2.0
Time for Connect	0.410 s
Time for Masserase Flash	0,044 s
Time for Blankcheck BIST Flash	0,180 s
Time for Program Flash	8,096 s
Time for Verify BIST Flash	0.180 s
Cycle Time	**00:08.969 s**

Melexis Fast LIN MLX81325 MULAN 3 example Flash Readout Protection

If The firmware enables the Flash Readout Protection:

"The Flash is read protected when the upper 32-bits are not equal to the lower 32-bits of the 64-bit Flash protection key as stored in the Flash memory at address **0xBF46**"

So, it is not possible to read back the contents of the Flash Memory and only the verify BIST can be performed.

To execute the Verify Readout (`#TPCMD VERIFY F R`) or a read/dump command (`#TPCMD READ F` / `#TPCMD DUMP F`) you must send the correct ram keys into connect procedure.

To do that you must set these eight `#TCSETPAR` commands:

```
#TCSETPAR RAM_KEY_0 <RAM key Value 0>
#TCSETPAR RAM_KEY_1 <RAM key Value 1>
#TCSETPAR RAM_KEY_2 <RAM key Value 2>
#TCSETPAR RAM_KEY_3 <RAM key Value 3>
#TCSETPAR RAM_KEY_4 <RAM key Value 4>
#TCSETPAR RAM_KEY_5 <RAM key Value 5>
#TCSETPAR RAM_KEY_6 <RAM key Value 6>
#TCSETPAR RAM_KEY_7 <RAM key Value 7>
```


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Melexis Fast LIN MLX81113 CAMCU example

Here you can find an example for MLX81113-xBx CAMCU device.

Melexis Fast LIN MLX81113 CAMCU example Commands

Additional parameters:

```
#TCSETPAR NAD1: 0x7F
#TCSETPAR EXTERNAL_HARDWARE: YES
#TCSETPAR EXTERNAL_HARDWARE_REVISION: PC10719
#TCSETPAR LIN_ENTRY: YES
#TCSETPAR LIN_FREQUENCY: 19200
#TCSETPAR NAD1: 0x7F
#TCSETPAR PROTCLK: 150000
#TCSETPAR WAKEUP_PULSE: 100
```

150000 bps is the maximum frequency supported by Melexis CamCU bootloader

```
#TCSETPAR EXTERNAL_HARDWARE YES
#TCSETPAR EXTERNAL_HARDWARE_REVISION PC10719
#TCSETPAR LIN_ENTRY YES
#TCSETPAR LIN_FREQUENCY 19200
#TCSETPAR NAD1 0x7F
#TCSETPAR PROTCLK 150000
#TCSETPAR PWDOWN 100
#TCSETPAR PWUP 100
#TCSETPAR VPROG0 5000
#TCSETPAR VPROG1 10000
#TCSETPAR WAKEUP_PULSE 100
#TCSETPAR CMODE FAST_LIN
#TPSETSRC FLASH_and_NVRAM.frb
#TPSTART
#TPCMD CONNECT
#TPCMD MASSERASE F
#TPCMD BLANKCHECK F
#TPCMD PROGRAM F
#TPCMD VERIFY F S
#TPCMD PROGRAM N
#TPCMD VERIFY N R
#TPCMD DISCONNECT
#TPEND
```

Melexis Fast LIN MLX81113 CAMCU example Real Time Log

```
---#TPCMD CONNECT
Melexis MLX81113-xBx CamCU series.
Execute wake up pulse of 100ms.
Selected LIN Baudrate is 19200 bps.
Selected NAD1 is 0x7F [wildcard].
Send LIN Entry Programming Mode frame.
 * Device respond with NAD 0x01.
 * Device PCI: 0x06, SID: 0xF2.
 * Melexis SW Platform Major: 0x01.
 * Melexis SW Platform Minor: 0x23.
 * Melexis SW Platform Build: 0x00.
 * Melexis SW Platform Revision: 0x00.
 * Device Loader state: 0x05 - 3rd generation loader.
Send switch to FASTLIN frame.
 * Requested FASTLIN Baudrate is 150000 bps.
 * Generated FASTLIN Baudrate is 150000 bps.
Write Melexis RAM keys.
* Write Melexis RAM keys completed.
Time for Connect: 0.384 s.
>|
---#TPCMD MASSERASE F
Erase page address [0x5800-0x5FFF].
Erase page address [0x6000-0x67FF].
Erase page address [0x6800-0x6FFF].
```


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```
Erase page address [0x7000-0x77FF].
Erase page address [0x7800-0x7FFF].
Erase page address [0x8000-0x87FF].
Erase page address [0x8800-0x8FFF].
Erase page address [0x9000-0x97FF].
Erase page address [0x9800-0x9FFF].
Erase page address [0xA000-0xA7FF].
Erase page address [0xA800-0xAFFF].
Erase page address [0xB000-0xB7FF].
Erase page address [0xB800-0xBFFF].
Erase page address [0xC000-0xC7FF].
Erase page address [0xC800-0xCFFF].
Erase page address [0xD000-0xD7FF].
Time for Masserase F: 0.512 s.
>|
---#TPCMD BLANKCHECK F
Requested CRC: 0x30B8 - Device CRC: 0x30B8.
Time for Blankcheck F: 0.073 s.
>|
---#TPCMD PROGRAM F
Time for Program F: 3.497 s.
>|
---#TPCMD VERIFY F S
Requested CRC: 0x6DF0 - Device CRC: 0x6DF0.
Time for Verify Bist F: 0.073 s.
>|
---#TPCMD PROGRAM N
Time for Program N: 0.024 s.
>|
---#TPCMD VERIFY N R
Time for Verify Readout N: 0.004 s.
>|
---#TPCMD DISCONNECT
Restart the Melexis device.
>|
```

Melexis Fast LIN MLX81113 CAMCU example Programming Times

Operation	Timings FlashRunner 2.0
Time for Connect	0.384 s
Time for Masserase Flash	0,512 s
Time for Blankcheck BIST Flash	0,073 s
Time for Program Flash	3.497 s
Time for Verify BIST Flash	0.073 s
Time for Program NVRAM	0.024 s
Time for Verify BIST NVRAM	0.004 s
Cycle Time	**00:04.617 s**

Operation	FlashRunner 2.0 Ch. 1	FlashRunner 2.0 Ch. 2	FlashRunner 2.0 Ch. 3
Time for Connect	0.384 s	0.386 s	0.385 s
Time for Masserase Flash	0,512 s	0.512 s	0.513 s
Time for Blankcheck BIST Flash	0,073 s	0.074 s	0.073 s
Time for Program Flash	3.497 s	3.501 s	3.500 s
Time for Verify BIST Flash	0.073 s	0.074 s	0.075 s
Time for Program NVRAM	0.024 s	0.024 s	0.024 s
Time for Verify BIST NVRAM	0.004 s	0.003 s	0.003 s
Cycle Time	**00:04.633 s**		

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Melexis Fast LIN Driver Changelog

Info about driver version 1.00
Supported standard operations for Melexis MLX81115.

Info about driver version 2.00 - 14/10/2020
Completely supported Melexis MLX81115.

Info about driver version 2.01 - 30/10/2020
Upgraded entry with two NAD **#TCSETPAR** NAD1 <Hex> and **TCSETPAR** NAD2 <Hex>.
Added autodetect NAD procedure into Connect procedure.

Info about driver version 2.02 - 11/11/2020
Multiple Connect with **#TCSETPAR** CONNECT_RETRY <Retries>.

Info about driver version 2.03 - 12/08/2021
Added custom **#TCSETPAR** WAKEUP_PULSE <ms> parameter.

Info about driver version 4.00 - 29/12/2021
Supported Mulan2 and Mulan3 Melexis families.
Added custom **#TCSETPAR** MELEXIS_BOOTLOADER_B <filename.frb> parameter.
Added custom **#TCSETPAR** CUSTOMER_FIRMWARE <filename.frb> parameter.

Info about driver version 4.01 - 01/02/2021
Upgraded connect procedure.

Info about driver version 4.02 - 11/02/2021
Upgraded connect procedure for Melexis Mulan 2 Device.

Info about driver version 4.03 - 22/02/2021
Fixed small details for Melexis Mulan 2 Device.

Info about driver version 4.04 - 01/04/2021
Improved stability for Mulan 2 Device in full parallel.

Info about driver version 4.05 - 30/05/2021
Improved stability and performances with new FASTLIN FPGA.

Info about driver version 4.06 - 30/06/2021
Improved stability and performances with new FASTLIN FPGA.

Info about driver version 4.07 - 12/08/2021
Internal upgrade of the algorithm, no change to the operations it performs.

Info about driver version 4.08 - 25/08/2021
Changed driver name from libmlxflin.so to libmlxfastlin.so.
Internal upgrade of the algorithm, no change to the operations it performs.

Info about driver version 4.09 - 27/08/2021
Improved stability and performances for Melexis Mulan2 and Mulan3 devices.

Info about driver version 4.10 - 31/08/2021
Improved stability and performance through a new parameter **#TCSETPAR** FASTLIN_FRAME_GAP <us> that can be modified by the user.

Info about driver version 4.11 - 25/10/2021
Added new device MLX81113-xBx CamCU series.
Improved stability and performance.

Info about driver version 4.12 - 18/11/2021
Updated connect procedure for the MLX81113-xBx CamCU series when the device responds with an unexpected state in the Fast LIN switch frame.

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Info about driver version 4.13 - 17/01/2022
Improved stability of programming NVRAM for Mulan3 series.

Info about driver version 4.14 - 04/04/2022
Improved programming procedure for Mulan 2 devices with Melexis old SW platform and fixed Baudrate.

Info about driver version 4.15 - 18/04/2022
Added New Fast LIN FPGA to manage the new SMH External Hardware.
Added **#TCSETPAR** EXTERNAL_HARDWARE_REVISION <VPROG1_LEVEL_SHIFTER_PC10707> or <LIN/FAST_LIN_adapter_PC10694> to manage the new SMH External Hardware.

Info about driver version 4.16 - 15/05/2022
Supported MLX81300, MLX81310 and MLX81315 devices of Mulan 2 series.
Supported MLX81325 device of Mulan 3 series.
Added new FASTLIN FPGA to upgraded performances with new SMH External Hardware.
Upgraded program procedure for CamCU series following the new updated Melexis Reference Manual.
Increased delay time of 4 ms after Blankcheck/Verify [BIST] request for Melexis Mulan 3 series.

Info about driver version 4.17 - 19/05/2022
Updated NVRAM Program and Verify for Mulan 2 and Mulan 3 series by skipping reserved NVRAM addresses.
Removed an incorrect print on the log during the Connect phase that could appear in special device conditions.
Improved the delay for the program of the Mulan 2 series devices when you are forced to use a frequency of 25000 bps (old Melexis Software Platform).
Added algorithm trimming commands that allow customer to modify any delay in the execution flow. These commands are for confidential use and should only be used if SMH Technologies claims to use them.

Info about driver version 4.18 - 26/05/2022
Fixed program timings for Melexis Mulan 2 first loader step [0-1] at 25000 bps.

Info about driver version 4.19 - 14/06/2022
Added verify BIST performed through LIN protocol for Mulan2 devices when Melexis SW Platform version is old and verify BIST through FASTLIN protocol is not supported.

Info about driver version 4.20 - 16/06/2022
Print current FPGA version loaded into TPSTART command.
Upgraded internal code to align all drivers.

Info about driver version 4.21 - 30/06/2022
Added **#TCSETPAR** LIN_FREQUENCY <bps>.
Now you can set the LIN frequency for Connect command.

Info about driver version 5.00 - 01/08/2022
Added FPGA for new FlashRunner 2.0 models.

Info about driver version 5.01 – 31/08/2023
Updated **#TCSETPAR** EXTERNAL_HARDWARE_REVISION <Revision> command.
Supported MLX81301 device.

Info about driver version 5.02 – 15/12/2023
Supported MLX81123 CamCU device.
Updated help table to show available commands for all Melexis families.
Added description for Melexis Generation Loader into Connect procedure.
Added print into TPSTART command to show the selected SMH Fast LIN hardware revision.

Info about driver version 5.03 – 11/11/2024
Supported old Melexis loader peculiarities.
Added log print during Mulan2 program operation.

Info about driver version 5.04 – 02/12/2024
Supported MLX81118-xxB CamCU device.

Info about driver version 5.05 – 19/03/2025
Updated Connect procedure and Program procedure for Mulan2 devices with old bootloader.

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