



# Application Note Melexis Universal Master

## User Manual

Kevin Berlit

Nico Bollen

Carsten Klug

Heiko Leutert

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VAT BE 0435.604.729

Transportstraat 1  
3980 Tessenderlo  
Phone: +32 13 67 07 95  
Mobile: +32 491 15 74 18  
Fax: +32 13 67 07 70  
[www.melexis.com](http://www.melexis.com)

# Contents

<b>1</b>	<b>Abbreviations</b>	<b>3</b>
<b>2</b>	<b>Introduction</b>	<b>4</b>
<b>3</b>	<b>Hardware Kit</b>	<b>4</b>
3.1	Overview . . . . .	4
3.2	Top view . . . . .	5
3.3	Left side view . . . . .	6
3.4	Right side view . . . . .	7
<b>4</b>	<b>Installation steps</b>	<b>8</b>
4.1	Communication via USB . . . . .	8
4.2	Communication via Ethernet . . . . .	10
<b>5</b>	<b>Start the device</b>	<b>11</b>
<b>6</b>	<b>Shut down the device</b>	<b>12</b>
<b>7</b>	<b>Using the webinterface</b>	<b>13</b>
<b>8</b>	<b>Connect to customer modules</b>	<b>14</b>
8.1	MeLiBu interface . . . . .	14
8.2	FL/LIN/PPM interface . . . . .	14
<b>9</b>	<b>Update the software</b>	<b>16</b>
9.1	Preparing the micro-SD card . . . . .	16
9.2	Flashing the device . . . . .	16
9.3	Software changelog . . . . .	18
9.3.1	Release v1.14.2 . . . . .	18
9.3.2	Release v1.14.1 . . . . .	18
9.3.3	Release v1.14.0 . . . . .	18
9.3.4	Release v1.13.0 . . . . .	18
9.3.5	Release v1.12.1 . . . . .	18
9.3.6	Release v1.12.0 . . . . .	18
9.3.7	Release v1.11.0 . . . . .	18
9.3.8	Release v1.10.1 . . . . .	18
9.3.9	Release v1.10.0 . . . . .	19
9.3.10	Release v1.9.2 . . . . .	19
9.3.11	Release v1.9.1 . . . . .	19
9.3.12	Release v1.9.0 . . . . .	19
9.3.13	Release v1.8.1 . . . . .	19
9.3.14	Release v1.8.0 . . . . .	19
9.3.15	Release v1.7.0 . . . . .	19
9.3.16	Release v1.6.1 . . . . .	20
9.3.17	Release v1.6.0 . . . . .	20
9.3.18	Release v1.5.0 . . . . .	20
9.3.19	Release v1.4.0 . . . . .	20
9.3.20	Release v1.3.0 . . . . .	20
9.3.21	Release v1.2.1 . . . . .	20
9.3.22	Release v1.1.1 . . . . .	21
<b>10</b>	<b>Absolute maximum ratings</b>	<b>22</b>
<b>11</b>	<b>Electrical specifications</b>	<b>22</b>

<b>12 Revision history</b>	<b>23</b>
<b>13 Disclaimer</b>	<b>24</b>

# 1 Abbreviations

Table 1: Abbreviations

Term	Stands For
GUI	Graphical User Interface
FL	FastLin
IP	Internet Protocol
LED	Light-emitting diode
LIN	Local Interconnect Network
MeLiBu	Melexis Light Bus
MUM	Melexis Universal Master
NAD	Node Address
OS	Operating system
PPM	Pulse-position modulation
PWM	Pulse-width modulation
USB	Universal Serial Bus

## 2 Introduction

This document provides a description of the “Melexis Universal Master” (MUM).

The “Melexis Universal Master” can be used as a master device in order control and program Melexis ICs via following interfaces:

- LIN
- PPM
- FastLIN
- MeLiBu

## 3 Hardware Kit

### 3.1 Overview



Figure 1: Hardware kit content

This hardware kit contains the following items:

- Melexis Universal Master (MUM)
- 5V power supply with interchangeable mains connector
- USB cable

## 3.2 Top view

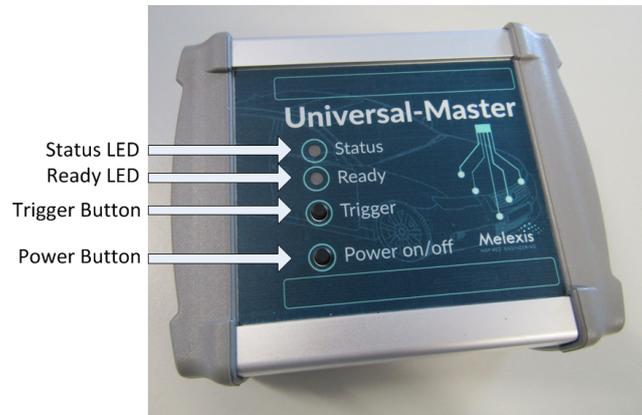


Figure 2: Top view

Status => LED currently not used

Ready => LED displays the working status of the "Melexis Universal Master"

- Red: device is busy (e.g. startup, shutdown or update)
- Green: device is ready for use
- Off: device is shut down and can be removed from the powersupply

Trigger => Button currently not used

Power => Button to start and shutdown the device

### 3.3 Left side view

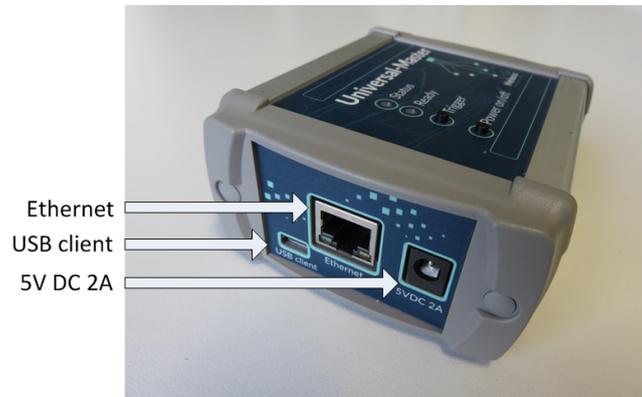


Figure 3: Left side view

Ethernet => Ethernet connector for controlling the device

USB client => USB client connector for controlling the device

5VDC 2A => Power supply connector

### 3.4 Right side view

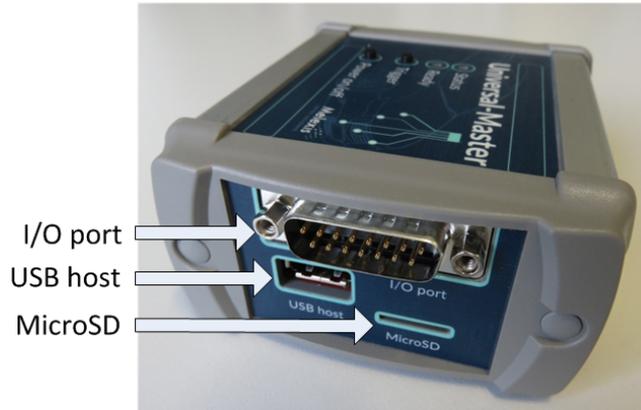


Figure 4: Right side view

I/O port => Male D-SUB15 I/O port connector (pinout see table 2)

USB host => USB host connector (currently not used)

MicroSD => MicroSD card slot used to update the “Melexis Universal Master” software see section Update the software

Table 2: Pinout I/O port connector

Pin	Name	Type	Description
1	COML	Input/Output	MeLiBu I/O pin
2	GND	Ground	Ground
3	I2C SCL	Output	I2C - Serial Clock Line
4	OUTPUT0	Output	Digital output (currently not used)
5	OUTPUT1	Output	Digital output (currently not used)
6	FL/LIN/PPM	Input/Output	Interface pin for LIN, PPM and Melexis FastLIN
7	GND	Ground	Ground
8	POWER OUT	Output	Output for the power supply connected to input pin 15 “POWER IN”. This output is software controlled and switched off by default.
9	COMH	Input/Output	MeLiBu I/O pin
10	GND	Ground	Ground
11	I2C SDA	Input/Output	I2C - Serial Data Line
12	INPUT0	Input	Digital input (currently not used)
13	INPUT1	Input	Digital input (currently not used)
14	GND	Ground	Ground
15	POWER IN	Input	Input for the power supply output pin 8 “POWER OUT” (max 2.5A). This pin is <b>not</b> used to power the “Melexis Universal Master”.

## 4 Installation steps

In order to allow for communication between the PC and the Melexis Universal Master it is mandatory to connect the device via USB or via Ethernet.

### 4.1 Communication via USB

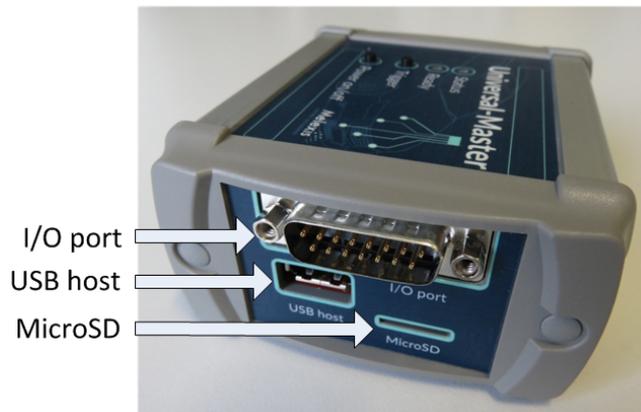


Figure 5: Location USB and the 5V input connector

1. Connect the 5V power supply to the “5VDC 2A” connector of the “Melexis Universal Master”.
2. Connect the USB Cable between the “Melexis Universal Master” and the PC.
3. Wait until the Windows OS has finished the driver installation. The CDC driver is not required and because of this it will not be installed.

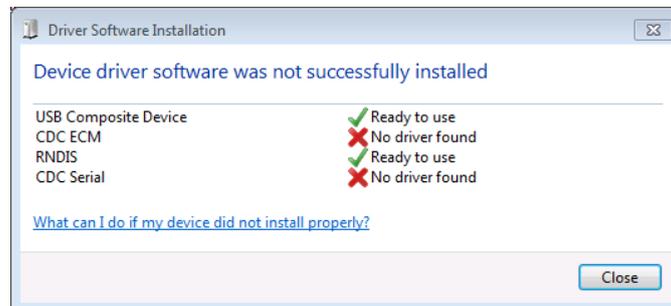


Figure 6: Driver Software Installation

The default IP address of the “Melexis Universal Master” is 192.168.7.2. This address can be checked as shown in figure 7.

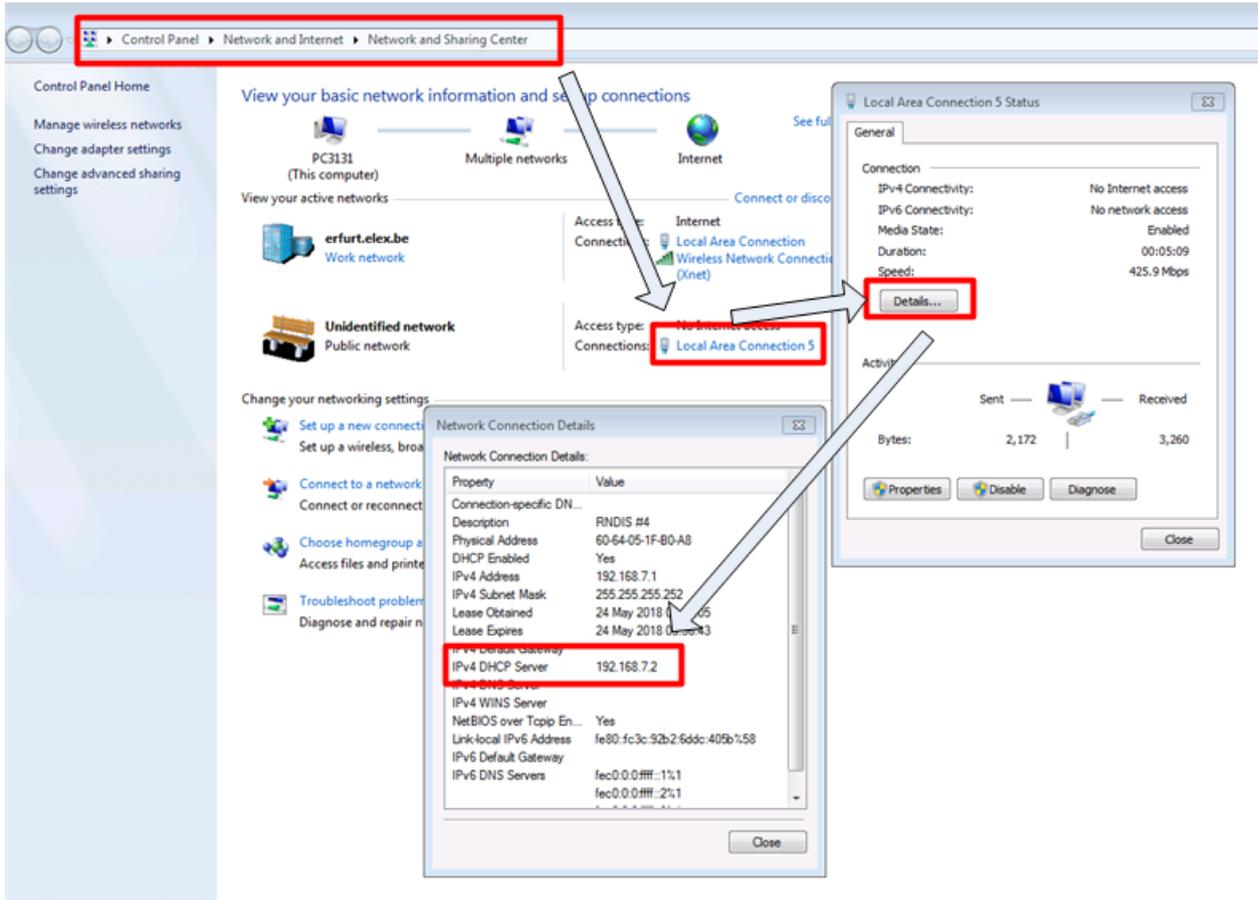


Figure 7: Windows IP settings

## 4.2 Communication via Ethernet

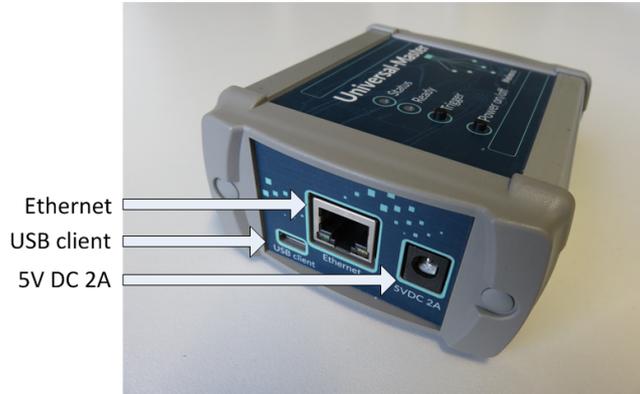


Figure 8: Location Ethernet and the 5V input connector

1. Connect the 5V power supply to the “5VDC 2A” connector of the “Melexis Universal Master”.
2. Connect a UTP cable between the “Melexis Universal Master” and the switch/router which your computer is connected to.

The Melexis Universal Master is preconfigured for dynamic IP assignment via DHCP, check your DHCP server for the assigned IP address. The device can also be accessed via its **hostname**, per default the hostname will be set to “mum-XXXXXXX” wherein “XXXXXXX” is the serial number as written on the bottom of the device. This hostname can be changed via the device’s webinterface.

**ATTENTION:** After updating the MUM via SD-CARD the hostname is reset to the default value. Please connect the MUM via USB and update the hostname according to the description in section Using the webinterface.

## 5 Start the device

The “Melexis Universal Master” will start automatically after connecting the power supply and the USB cable.

In case the “Melexis Universal Master” was shutdown via the Power button (location see Figure 2) or via software and the power supply and the USB cable are already connected, it can be started by pushing the Power button.

If the boot process is finished the Ready LED (location see Figure 2) will switch from red to green.

## 6 Shut down the device

The “Melexis Universal Master” is a Linux based device and needs to be handled like a PC. This means it will boot automatically but it requires a manual shutdown of the “Melexis Universal Master” before the power supply is disconnected.

Shutdown sequence:

1. In case the 5V power supply **and** the USB cable are connected, please unplug the USB cable. This avoids an unwanted restart of the device after shutdown.
2. Press the “Power on/off” button and the color of the “Ready LED” will change to red.
3. Wait until the “Ready LED” is switched off. These will takes around 5s.
4. Remove the 5V power supply.

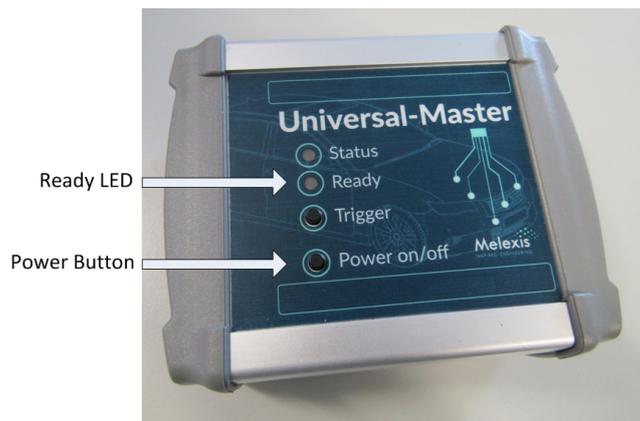


Figure 9: Location of the “Ready LED” and the “Power on/off” button

**It is mandatory to shut down the “Melexis Universal Master” before the power supply will be disconnected. Otherwise the Linux OS can be damaged!**

In case the Linux OS of the “Melexis Universal Master” was damaged because of an incorrect shutdown handling, the device can be recovered. Please follow the instructions mentioned in chapter Update the software.

## 7 Using the webinterface

The “Melexis Universal Master” has a build in webinterface which allows users to get some device details and update configurations.

To access the webinterface one should:

- Open his preferred webbrower
- Surf to:
  - if connected via USB: `http://192.168.7.2/`
  - if connected via Ethernet: `http://<mum_ip_address>/` OR `http://<mum_hostname>/`

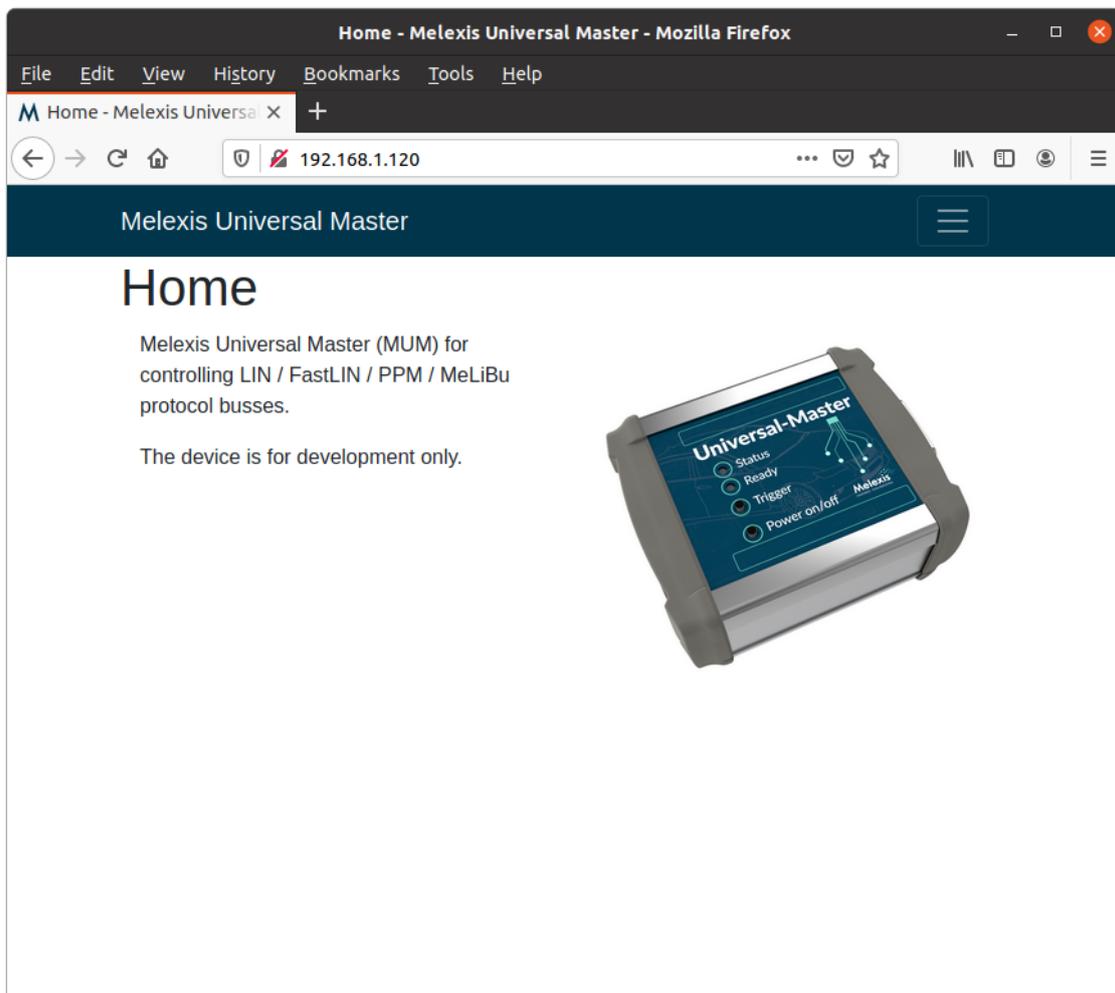


Figure 10: Webinterface: Homepage

## 8 Connect to customer modules

The “Melexis Universal Master” has a male D-SUB15 connector, which provides all required interface pins in order to connect the “Melexis Universal Master” to a customer module. The pinout of the connector is printed on the bottom side of the device and the detailed description is available in table 2.



Figure 11: Pin configuration of the D-SUB15 connector

### 8.1 MeLiBu interface

In order to use the MeLiBu interface, following pins need to be connected between the “Melexis Universal Master” and the customer module:

- Pin 1 (COML)
- Pin 2 (GND) or any other GND pin of the connector
- Pin 9 (COMH)

The customer module with the MeLiBu slaves will not be powered from the “Melexis Universal Master”. This means it needs to be connected to its own power supply.

The first MeLiBu slave on a customer module needs to be configured as first slave in the MeLiBu chain. This will be done by connecting the AA\_IN pin to the VIO pin. This is also valid in case only one MeLiBu slave is connected to the “Melexis Universal Master”.

### 8.2 FL/LIN/PPM interface

In order to use the LIN interface, following pins need to be connected between the “Melexis Universal Master” and the customer module:

- Pin 2 (GND) or any other GND pin of the connector
- Pin 6 (FL/LIN/PPM)

Additionally an external 12V supply voltage for the LIN master transceiver of the “Melexis Universal Master” needs to be provided:

- Pin 15 (POWER\_IN) (connect an external 12V power supply)

In case the PPM interface will be used for programming the connected Melexis IC, two use cases need to be considered:

1. The Melexis IC has an empty/invalid FLASH memory or an firmware build **with** option “APP\_MODULES += mls\_device\_id”: => no additional steps are required
2. The Melexis IC has a firmware inside, build **without** option “APP\_MODULES += mls\_device\_id”:  
=> in order to be able to program the device via PPM, the supply voltage of the IC needs to be controlled via the “Melexis Universal Master”. For this reason pin 8 “POWER\_OUT” needs to be connected to the supply voltage input pin of the customer module and it provides now directly the power supply for that customer module. (current consumption of the module must be <2.5A)
  - Pin 7 (GND) or any other GND pin of the connector
  - Pin 8 (POWER\_OUT) (12V supply voltage for the customer module)

## 9 Update the software

The “Melexis Universal Master” software can be updated via a micro-SD card slot of the device. The necessary steps for preparing the SD-card and flashing the “Melexis Universal Master” are described in this chapter.

These instructions should also be followed in case the Universal Master is not anymore working as expected.

### 9.1 Preparing the micro-SD card

For the “Melexis Universal Master” software update a 4GB micro-SD card is required.

1. Download the latest “Melexis Universal Master” software image from the Melexis Softdist-Server: [https://softdist.melexis.com/custassetsJRightFrame?assetname=MUM\\_Image](https://softdist.melexis.com/custassetsJRightFrame?assetname=MUM_Image)
2. Unzip the downloaded image to a local folder on your PC.
3. Writing the image to the micro-SD card using the tool Win32DiskImager or similar. This tool can be downloaded from following location: <https://sourceforge.net/projects/win32diskimager/files/latest/download?source=navbar>. The program settings can be found in Figure 12.

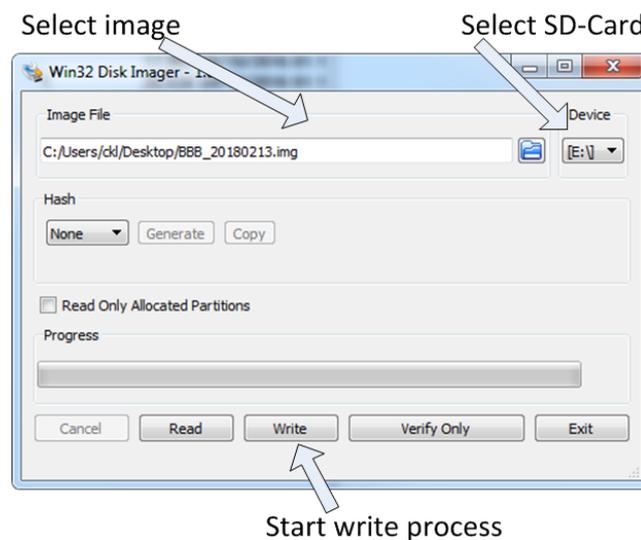


Figure 12: GUI of Win32DiskImager

### 9.2 Flashing the device

1. Shutdown the “Melexis Universal Master”.
2. Disconnect all connected cables including the powers supply and USB
3. Insert the micro-SD card into the SD-card slot (see Figure 13).
4. Connect the power supply to the “Melexis Universal Master”.
5. The Universal Master will start to update its software using the micro-SD card content. During this process the “Ready LED” (Figure 14) is red. This will take around 5min and it’s not allowed to remove the power supply during this process.
6. The software update is finished as soon as the “Ready LED” is switched OFF.
7. Remove the power supply.
8. Remove the micro-SD card from the “Melexis Universal Master” SD-card slot.
9. Reconnect the Universal Master to the power supply.
10. Now the new software will be booted. After the flash process was successfully finished, the “Ready LED” will switch from red to green.



Figure 13: Location of SD-card Slot

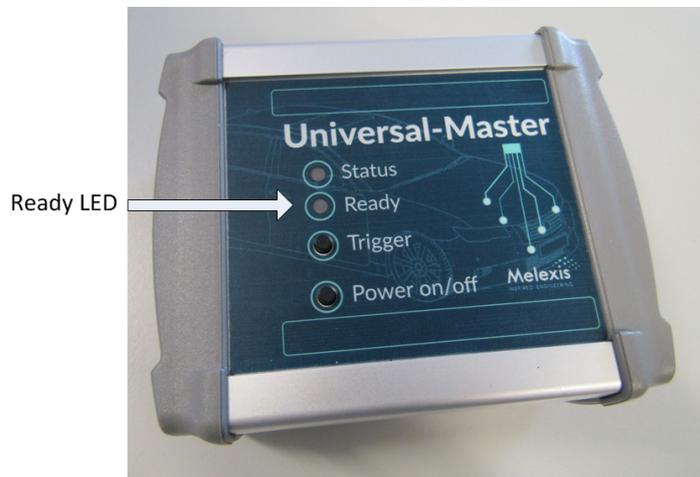


Figure 14: Location of Ready LED

## 9.3 Software changelog

### 9.3.1 Release v1.14.2

- Bug: Melibu: overflow of variable while calculating timestamp

### 9.3.2 Release v1.14.1

- PPM: Fix frame timeout for custom frames

### 9.3.3 Release v1.14.0

- Add: command line protocol selection (TCP/UDP)
- Add: LIN: wake up pulse detection
- Add: PPM: option to send custom frame/sessions from client
- Update: PRU firmware to v0.13.0
- Fix: Melibu: tracing framing error overflow
- Add: LIN: wakeup pulse detection
- Update: PPM: Decrease flash prog keys session page0 timeout for correct error reporting

### 9.3.4 Release v1.13.0

- Add: CAPE v5.0 support
- Add: Command for reading power out current level

### 9.3.5 Release v1.12.1

- Update: PPM: explicitly set baudrate in setup

### 9.3.6 Release v1.12.0

- Update: PPM: increase low speed communication robustness
- Update: Melibu: use breakfield setting immediately
- Update: PRU firmware to v0.12.1

### 9.3.7 Release v1.11.0

- Update: PRU firmware to v0.10.0
- Update: LIN: support inter-byte times up to 51.1 Tbit
- Update: coverity fixes

### 9.3.8 Release v1.10.1

- Bug: FAST multi frame response has incorrect payload length

### 9.3.9 Release v1.10.0

- Add: Basic Melexis loader support
- Add: Melibu send free data
- Add: Melibu write flash sector
- Add: Melibu erase flash sector
- Update: PRU stopping time decreased
- Update: FAST protocol support
- Update: PRU firmware to v0.9.1
- Update: several Coverity issue fixes

### 9.3.10 Release v1.9.2

- Bug: LIN: potential incorrect checksum for extended M2S frame

### 9.3.11 Release v1.9.1

- Update: PRU firmware to v0.8.0

### 9.3.12 Release v1.9.0

- Add: Melibu tracing support
- Add: LIN Extended frame support

### 9.3.13 Release v1.8.1

- Fix: correct LIN frame transmission timeout calculation
- Update: Melibu start script documentation

### 9.3.14 Release v1.8.0

- Add: PPM margin to enter PPM pattern timeout
- Update: automatically deploy to stable repositories
- Update: Melibu make flash erase timeout configurable
- Fix: Melibu add BLLR pattern for enable write erase RAM command
- Fix: Melibu do not check ACK for S2M messages

### 9.3.15 Release v1.7.0

- Add: Web interface
- Add: Autorun melibu script feature
- Fix: PPM page 0 timeout to better fit 64k devices
- Fix: Melibu command length error not reported
- Add: PPM wait for response on bus command
- Update: PRU firmware from v0.6.0 to v0.7.0
- Update: PPM increase RX to TX time to 50us

### 9.3.16 Release v1.6.1

- Update: Melibu read functions do not need number of slaves and first address
- Update: Melibu return “wrong” address in case of invalid address
- Update: Melibu allow address 63 as single address
- Update: Melibu use delay for resetting address after each M2S Frame
- Update: Melibu reset Bootloader timeout-timer by sending message with non-broadcast addresses

### 9.3.17 Release v1.6.0

- Fix: PPM first flash page timeout (issue for 64kB chips)
- Add: LIN transport layer and corresponding send diagnostic request/response session commands
- Update: Melibu error reporting
- Update: PRU firmware from v0.5.0 to v0.6.0
- Update: PPM default enter PPM mode pattern timing for slow busses

### 9.3.18 Release v1.5.0

- Fix: PPM RAM session timeout
- Add: PowerOutManager
- Add: Melibu flash erase command
- Add: Melibu commands to get full frame in response of send frame

### 9.3.19 Release v1.4.0

- Added: PPM EEPROM programming support
- Fix: CRC8 calculation error which rarely fails (PPM EEPROM verify, PPM Frame)
- Add: Melibu separate auto-addressing function
- Add: Melibu server revision function
- Update: PRU firmware from v0.5.0 to v0.5.2
- Update: Increased PRU RAM
- Update: Switch OS from Debian stretch to buster

### 9.3.20 Release v1.3.0

- Fix: Melibu waiting time for sector erase
- Add: Melibu script support
- Update: Melibu separate enter EPM command
- Update: Eth socket increase max packet size from 130kb to 20mb
- Update: PRU firmware v0.4.0 to v0.5.0

### 9.3.21 Release v1.2.1

- Added: PPM EEPROM programming support
- Added: PPM flash crc verification support
- Fixed: PPM incorrect session crc
- Added: Melibu support for different baudrates of bootloader vs application
- Added: Melibu extra delay after EPM frame

## 9.3.22 Release v1.1.1

- Fixed: PPM block erase in broadcast mode not working
- Added: FAST basic support

## 10 Absolute maximum ratings

Table 3: Absolute maximum ratings

Parameter	Symbol	Min	Max	Unit
POWER_IN voltage	$V_{POWER\_IN}$	-0.5	27	V
POWER_OUT current	$I_{POWER\_OUT}$	0	2.5	A
INPUTx voltage	$V_{IN\_DIG}$	-0.7	50	V

## 11 Electrical specifications

Table 4: Electrical specifications

Parameter	Symbol	Min	Typ	Max	Unit
INPUTx threshold level L => H	$V_{IN\_H}$	.	2.3	.	V
INPUTx threshold level H => L	$V_{IN\_L}$	.	0.9	.	V
OUTPUT0 low voltage	$V_{OUT0\_L}$	.	0	.	V
OUTPUT0 high voltage	$V_{OUT0\_H}$	.	3.3	.	V
OUTPUT1 low voltage	$V_{OUT1\_L}$	.	0	.	V
OUTPUT1 high voltage	$V_{OUT1\_H}$	.	5.0	.	V

## 12 Revision history

Table 5: Revision history

Version	Changes	Date
011	Update changelog for “Melexis Universal Master” software image Release v1.13.0-v1.14.2.	2021-06-09
010	Update changelog for “Melexis Universal Master” software image Release v1.11.0-v1.13.0.	2021-03-25
009	Update changelog for “Melexis Universal Master” software image Release v1.9.2-v1.11.0.	2021-02-23
008	Add digital IO electrical ratings	2021-01-05
007	Update changelog for “Melexis Universal Master” software image Release v1.8.0-v1.9.1.	2020-09-11
006	Add absolute maximum ratings	2020-07-03
005	Add description for using the device on the Ethernet, the webinterface and pictures.	2020-06-29
004	Update changelog for “Melexis Universal Master” software image Release v1.5.0-v1.7.0.	2020-06-04
003	Update changelog for “Melexis Universal Master” software image Release v1.4.0.	2019-09-25
002	Update changelog for “Melexis Universal Master” software image Release v1.2.1.	2019-06-25
001	Initial release	2019-05-21

## 13 Disclaimer

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