MLX81112

Single Channel LIN RGB Controller Gen 2
Short Datasheet

1. Features

Configurations

- MLX81112: 8 pin device in SOIC8 package, 32kB Flash memory + 16kB ROM
- MLX81115: 12 pin device in DFN12 4x4 package, 32kB Flash memory + 16kB ROM

Application Controller

- Internal RC-Oscillator (24 MHz default clock)
- 16-bit MULAN MCU with
  - max. 32kByte Flash
  - 16kB ROM with MLX4 LIN firmware, MLX16 LIN boot-loader and MLX16 Application User Library
  - 2048 Byte RAM
  - 512 Byte NVRAM with ECC (380 Byte for customer purpose)
- Math Co-processor for 32 bit MUL/DIV Operations

LIN Protocol Controller according to LIN 2.x and SAE J2602

- Baudrate up to 19.2 kBaud
- Frame processing
- Low interrupt load to the application

LIN Transceiver according to LIN 2.x and SAE J2602

- Support for Autoconfig according bus shunt method

IO configuration

- MLX81112: 4x high voltage I/Os with free configurable current sources (up to 48mA) for RGBW
- MLX81115: 2 x 3 high voltage I/Os with free configurable current sources (up to 48mA) for RGB
- Diagnostic capability for connected LED
- 4x (81112) or 6x (81115) 16-bit PWM outputs
- Interrupt capability for all inputs
- Configurable wake up sources (LIN and IOs)
- 10 bit ADC with DMA, conversion time <6us, multiple channels and 3 different reference voltages

Voltage Regulator

- Low standby current consumption of typ 25µA (max 50 µA) in sleep mode
- Integrated battery monitor including over- and under-voltage detection

Other Features

- Automotive Temperature Range of –40°C to 125°C
- 28V jump start
- Integrated temperature sensor

2. Technical description

Package data SOIC8-NB

N	[1],[2]	A	A1	A2	D	E	H	L	b	c	e	h	⬚
8	min	1.52	0.10	1.37	4.80	3.81	5.80	0.41	0.35	0.19	1.27 BSC	0.25	0°
	max	1.73	0.25	1.57	4.98	3.99	6.20	1.27	0.49	0.25		0.50	8°

[1]   Dimensions and tolerances conform to ASME Y14.5M-1994
[2]   All dimensions are in millimeters. All angles are in degrees
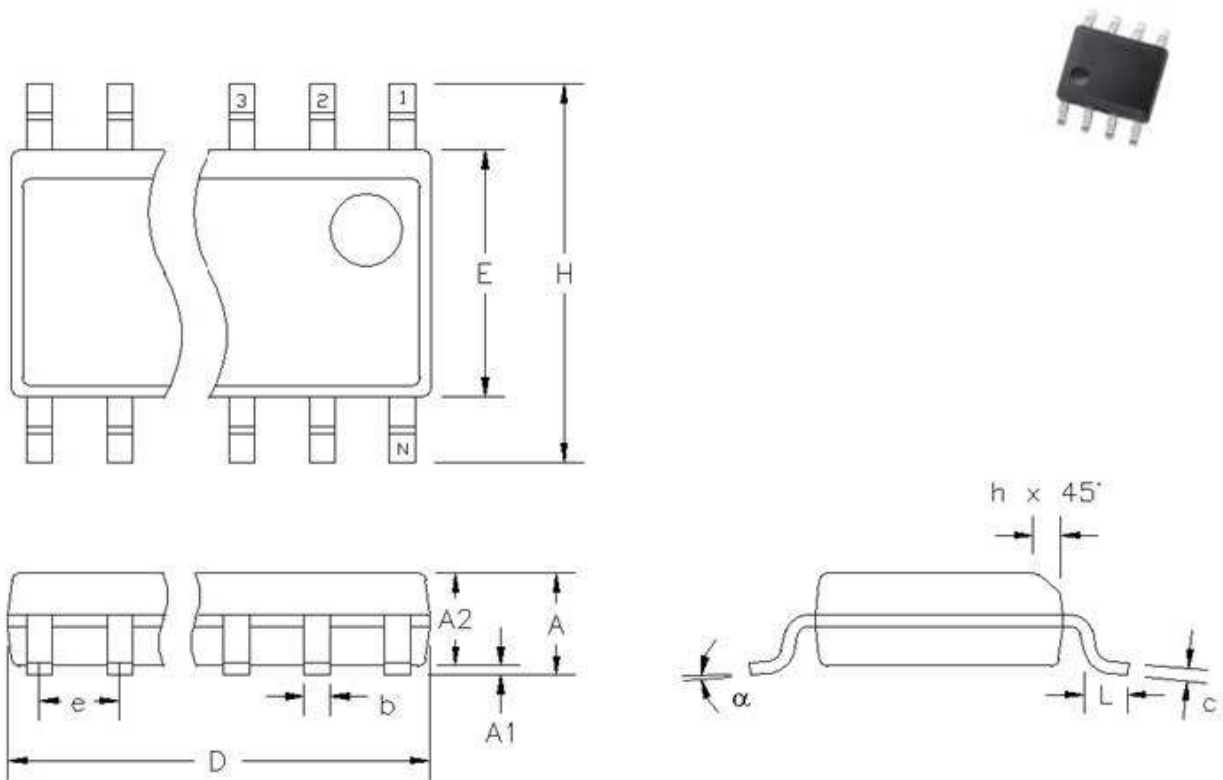[3]   N is the total number of terminals

Figure 1 – Generic Package data SOIC-NB

Package data DFN12 4x4

The chip will be assembled in a 12Pin DFN 4x4 package with wettable flanks.

Please keep in mind that the package has tie bars. Landing pattern recommendations can be requested from Melexis.
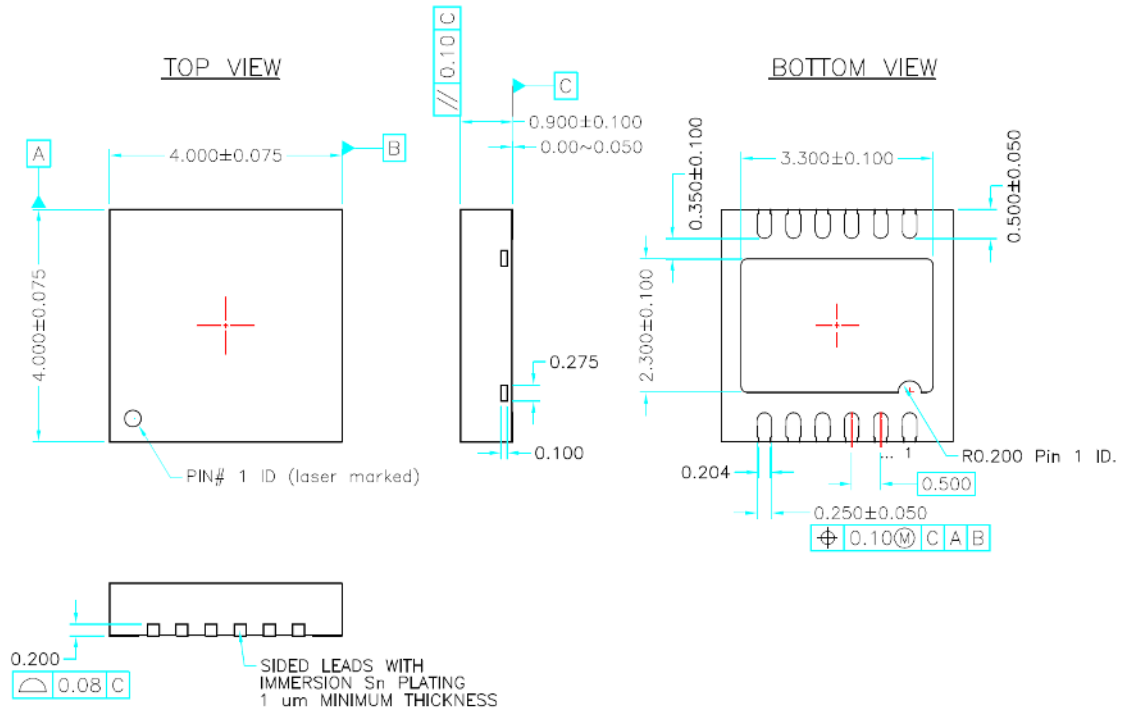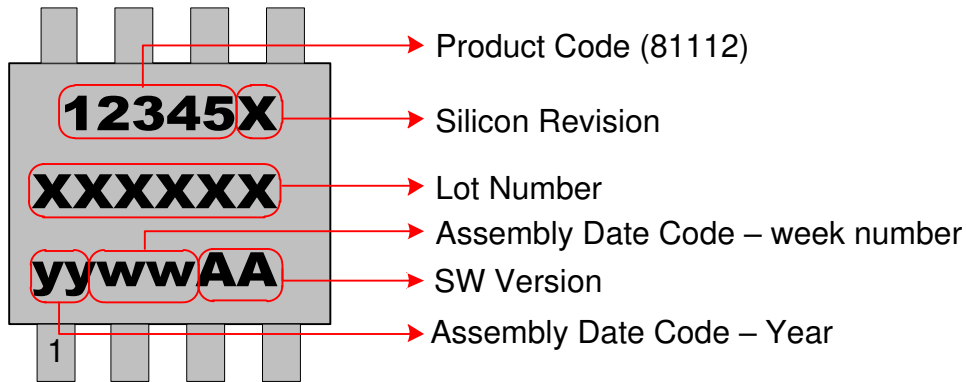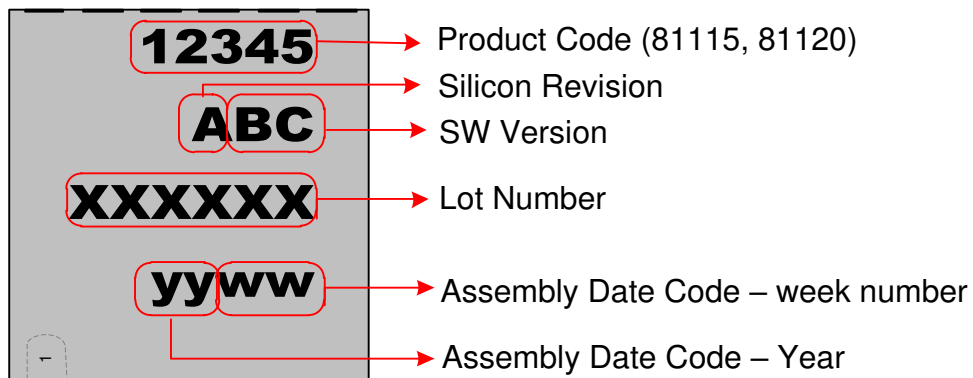

Figure 2 - DFN12 4x4 Package

IC Marking

SOIC8 NB

12345X	Product Code (81112)
	Silicon Revision
XXXXXX	Lot Number
	Assembly Date Code – week number
yywwAA	SW Version
1	Assembly Date Code – Year

DFN12 4x4

12345	Product Code (81115, 81120)
	Silicon Revision
ABC	SW Version
XXXXXX	Lot Number
yyww	Assembly Date Code – week number
	Assembly Date Code – Year

Pin out description

| Pin No. MLX81112	Pin No. MLX81115	Pin name	Voltage range	Remarks and description
1	2	HV0	IO HV	High voltage I/O
2	4	HV1	IO HV	High voltage I/O
3	5	HV2	IO HV	High voltage I/O
4	12	HV3	IO HV	High voltage I/O
-	11	HV4	IO HV	High voltage I/O
-	10	HV5	IO HV	High voltage I/O
5	3	GND	Pwr	Ground pin
6	8	LIN_IN	Ana HV	Connection to LIN bus, bus shunt Input
7	7	LIN_OUT	Ana HV	Bus shunt output
		LIN_M	Ana HV	Connection to LIN bus, LIN Gateway
8	1	VS	Pwr HV	Battery supply voltage; external protection against reverse polarity needed, external blocking capacitors
-	6, 9	GND	Pwr	Power Ground

Ana – analogue pin, Pwr – power/supply pin, IO HV – multifunctional pin (configurable pin), HV – high voltage, VBAT or VS related

Package view

Top view of the package SOIC8
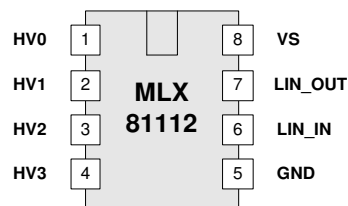
Top view of the package DFN12
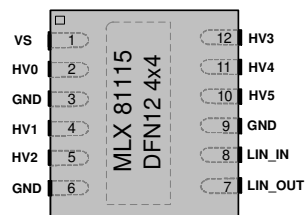
3. Electrical characteristics

Absolute maximum ratings

All voltages are referenced to ground (GND). Positive currents flow into the IC. The absolute maximum ratings given in the table below are limiting values that do not lead to a permanent damage of the device but exceeding any of these limits may do so. Long term exposure to limiting values may affect the reliability of the device. Reliable operation of the controller is only specified within the limits shown in "Operating conditions".

Parameter	Symbol	Condition	Limit Min	Limit Max	Unit
Supply voltage	VS	t < 5 min	-0.3	+28	
		t < 500 ms	-0.3	+45	
	VS.tr1	ISO 7637-2 pulse 1 [1] VS=13.5V, TA=(23 ⬜⬜5)°C	-100		
	VS.tr2	ISO 7637-2 pulse 2 [1] VS=13.5V, TA=(23 ⬜⬜5)°C		+75	
	VS.tr3	ISO 7637-2 pulses 3A, 3B [1] VS=13.5V, TA=(23 ⬜⬜5)°C	-150	+100	
	VS.tr5	ISO 7637-2 pulses 5b [1] VS=13.5V, TA=(23 ⬜⬜5)°C		+45	V
LIN Bus	VLIN	T < 500ms	-40	+40	
	VLIN.tr1	ISO 7637-2 pulse 1 [2] VS=13.5V, TA=(23 ⬜⬜5)°C	-100		
	VLIN.tr2	ISO 7637-2 pulse 2 [2] VS=13.5V, TA=(23 ⬜⬜5)°C		+75	
	VLIN.tr3	ISO 7637-2 pulses 3A, 3B [2] VS=13.5V, TA=(23 ⬜⬜5)°C	-150	+100	
Voltage on HV IOs	VIN_HV	Pins HV[3:0],	-0.3	+45	
Maximum latch–up free current at any pin	ILATCH	according to JEDEC JESD78, AEC-Q100-004	-250	250	mA
ESD capability of pin VS	ESDIEC_VS	Acc. To IEC 61000-4-2 [6]	-6	+6	
ESD capability of pin LIN	ESDHBM_LIN	Human body model [7]	-6	+6	kV
ESD capability of pin LIN	ESDIEC_LIN	Acc. To IEC 61000-4-2 [6]	-6	+6	kV
ESD capability of any other pin, except LIN	ESDHBM	Human body model [7]	-2	+2	kV
ESD capability at any pin	ESDCDM	Charge Device Model	-750	+750	kV
Storage temperature	Tstg		-55	150	V
Junction Temperature	TJ		-40	150	°C
Thermal resistance DFN12 4x4	Rth	JEDEC 2s2p board [3] Junction Ambient (JA)		43	K/W
Thermal resistance DFN12 4x4	Rth	JEDEC 2s2p board [3] Junction Ambient (JA)		43	K/W
Thermal resistance SOIC8	Rth	JEDEC 1s0p board [3] Junction Ambient (JA)		100	K/W
		Junction Board (JB)		46	

[1] ISO 7637 test pulses are applied to VS via a reverse polarity diode and >1µF blocking capacitor;
[2] ISO 7637 test pulses are applied to LIN via a coupling capacitance of 1nF;
[3] Simulated value for low conductance board (JEDEC).
[4] Equivalent to discharging a 150pF capacitor through a 330Ω resistor;
[5] Based on the evaluation results, additional external protection components might be recommended to reach the specified system ESD levels.
[6] Equivalent to discharging a 100pF capacitor through a 1.5kΩ resistor conform to MIL STD 883 method 3015.7.

4. Operating conditions

- The IC can have 6 different hardware modes. The exact functionality of these modes depends on the hardware and software configuration:

- Reset:
  - Triggered by hardware. When VS or VDDA or VDDD drop below a critical level, the complete chip is powered down.
  - The analogue and digital supply regulators are disabled. No functionality is available in this mode.
- Normal mode. Main application running
  - Microcontroller fully functional
  - Analogue fully functional
- Low power mode (managed via firmware). Digital part running at lower frequency (250kHz)
  - Microcontroller fully functional
  - LIN not possible
  - Analogue fully functional
- Under voltage: triggered by the hardware under voltage detection interrupt
  - Microcontroller fully functional.
  - Power down behavior can be managed via software.
  - Reduced current capability on HVx below VS=5.5V.
- Over voltage: triggered by the hardware over voltage detection interrupt.
  - Microcontroller fully functional
  - Behaviour can be managed via software.
- Sleep Mode: Triggered by the software.
  - Microcontroller powered down
  - Digital and analogue supply powered down.
  - Sleep Mode and wake-up functionality running on help supply Vaux

Parameter	Symbol	Conditions	Limit			Unit
			Min	Typ	Max	
Supply Voltage Range	VS		5.5		18	V
Ambient Temperature	TA		-40		125	°C

Table 1 – Operating conditions

5. Typical application examples

The following section shows typical application examples. Please refer to additional Melexis application notes for more details. The signal order in all application diagrams does not reflect any pin order of the device. The following application diagrams are **only principle examples**, showing how the controller could be embedded into a system. Detailed application data must be worked out by customers to meet the needs of their dedicated application.

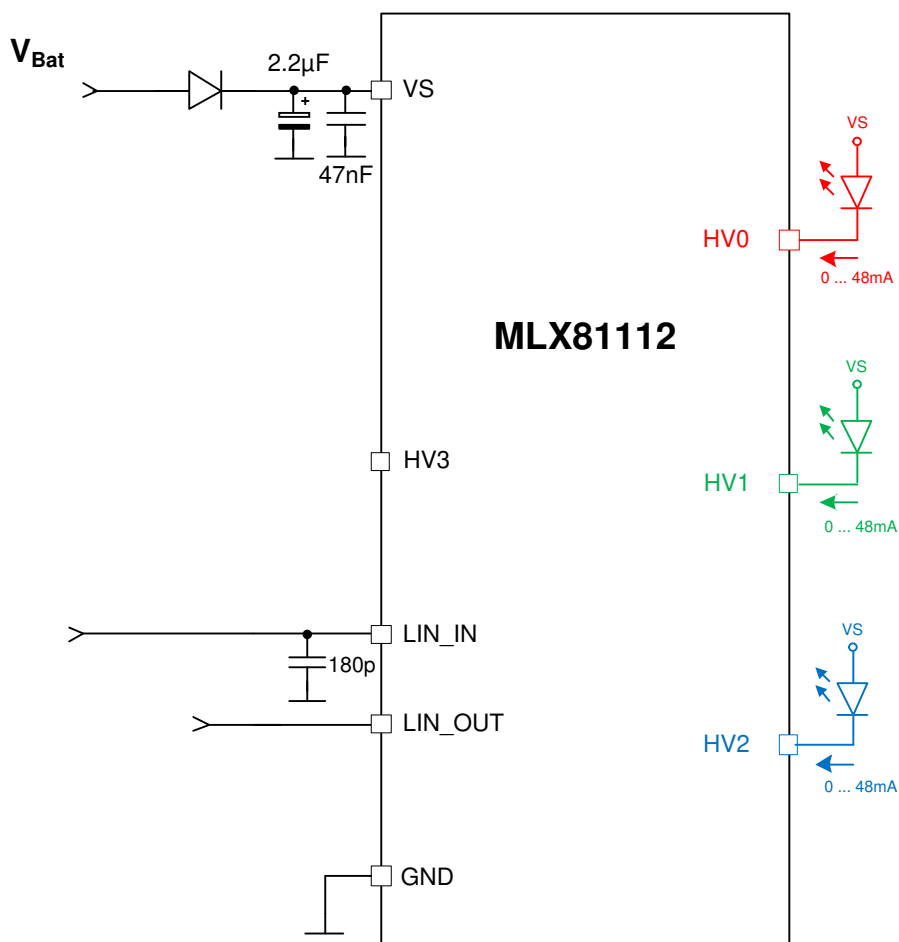## Application Example MLX81112

Figure 3 – RGB LED application controlled via LIN bus

MLX81112 is perfectly suited to build highly integrated RGB LED modules.
The PWM output stages allow excellent color and brightness control. The integrated flow current measurement units can be used to react on aging or other effects of the diodes over life time. For this the initial voltage drop for a certain forward current is stored in the flash during EOL at customer side, which can be used later to detect any change in the diode characteristics and adapt the control algorithms accordingly.
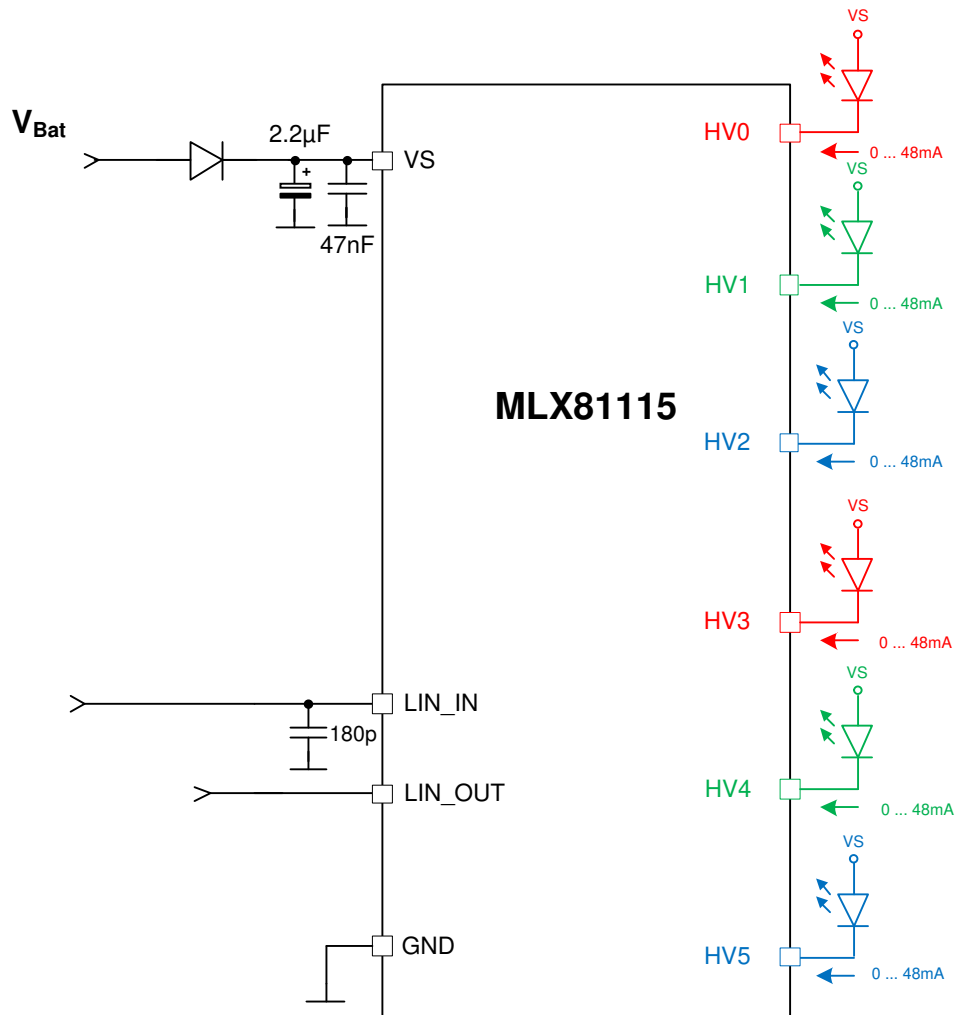
Application Example MLX81115

Figure 4 – Application schematic sample

MLX81115 offers more flexibility due to the higher pin count making 3 additional HV pins available. They can be used to drive a second RGB-LED.

Further the HV pins support the connection of the internal SPI, which allows connecting to any other controller and smart sensors supporting this standard interface.
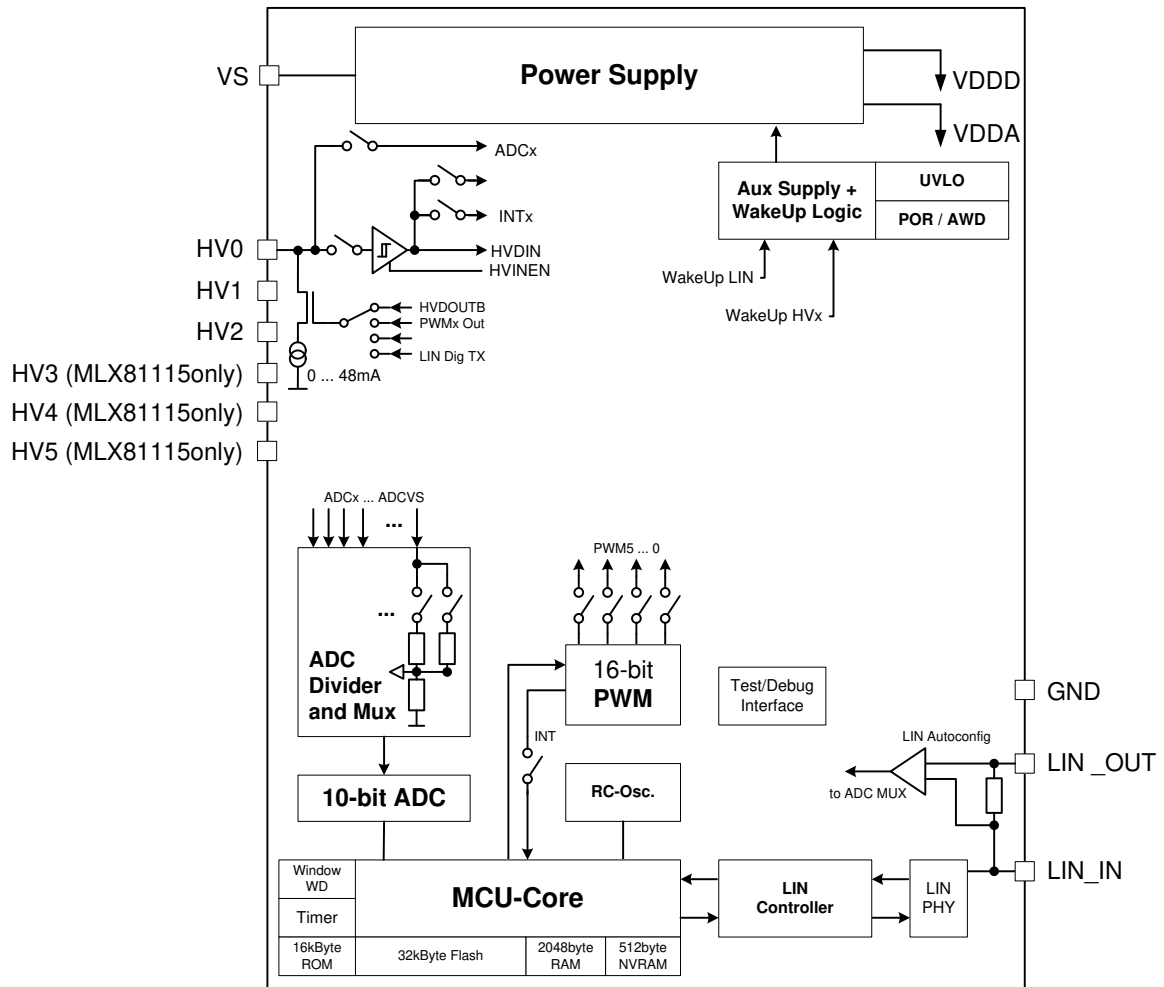
6.   Block diagram

Figure 5 – Block Diagram

7. Functional Description

MCU

- 16-bit RISC MCU

LIN Transceiver and Controller

- Compliant to LIN 2.x and J2602
- Support Autoconfig according bus shunt

Memory

- 32kByte User Flash
- 16kByte ROM used for Bootloader, LIN Driver and Software Library Functions
- 2kByte RAM
- 380Byte User EEPROM
- 128byte MLX EEPROM for LIN IDs, Calibration data

HV0..5 IO

- High voltage capable open drain output (max 60Ohm RDSON)
- High voltage capable constant current output of 30mA per IO (max. 48mA short term)
- 16-bit PWM Output
- Digital output (5V)
- High voltage capable input
- Digital (5V) input
- 10-bit ADC Input inc.pre-devider for direct measurement of VS
- Differential SC-Amplifier for detection of very small voltage changes for LED threshold measurement
- SPI Interface
- Interrupt capable input

Software Debug Interface

- Available at HV0..3pins
- For full debug function a special packaged version will be available with additionl pins to be used as software development device.

ADC

- 10-bit ADC
- Multiple channels (HV0..5, VS, internal references, temp sensor, difference voltage HVx, LIN AA)
- Full Scale 5V via internal pre-divider
- Continuous Mode: Automatic measuring of enabled channels. Result stored via DMA. If new result available old will be overwritten

PWM

- Max 16-bit resolution, min 370Hz
- Configurable from 8-bit to 16-bit, 8-bit mode with max possible frequency – approx 60kHz
- Up to 6 undependent PWM channels
- Programmable PWM frequency per channel
- Programmable interrupt generation at the beginning and/or end of every PWM period
- Synchronuous switch of duty cycle change

Power Supply

- Internal compensated
- Primary Cap min 2.2uF

8. Standard information regarding manufacturability of Melexis products with different soldering processes

Our products are classified and qualified regarding soldering technology, solderability and moisture sensitivity level according to following test methods:

Reflow Soldering SMD's (Surface Mount Devices)

- IPC/JEDEC J-STD-020
  Moisture/Reflow Sensitivity Classification for Nonhermetic Solid State Surface Mount Devices
  (classification reflow profiles according to table 5-2)
- EIA/JEDEC JESD22-A113
  Preconditioning of Nonhermetic Surface Mount Devices Prior to Reliability Testing
  (reflow profiles according to table 2)

Wave Soldering SMD's (Surface Mount Devices) and THD's (Through Hole Devices)

- EN60749-20
  Resistance of plastic- encapsulated SMD's to combined effect of moisture and soldering heat
- EIA/JEDEC JESD22-B106 and EN60749-15
  Resistance to soldering temperature for through-hole mounted devices

Iron Soldering THD's (Through Hole Devices)

- EN60749-15
  Resistance to soldering temperature for through-hole mounted devices

Solderability SMD's (Surface Mount Devices) and THD's (Through Hole Devices)

- EIA/JEDEC JESD22-B102 and EN60749-21
  Solderability

For all soldering technologies deviating from above mentioned standard conditions (regarding peak temperature, temperature gradient, temperature profile etc) additional classification and qualification tests have to be agreed upon with Melexis.

The application of Wave Soldering for SMD's is allowed only after consulting Melexis regarding assurance of adhesive strength between device and board.

Melexis recommends reviewing on our web site the General Guidelines soldering recommendation (http://www.melexis.com/Quality_soldering.aspx) as well as trim&form recommendations (http://www.melexis.com/Assets/Trim-and-form-recommendations-5565.aspx).

Melexis is contributing to global environmental conservation by promoting lead free solutions. For more information on qualifications of RoHS compliant products (RoHS = European directive on the Restriction Of the use of certain Hazardous Substances) please visit the quality page on our website: http://www.melexis.com/quality.aspx

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