MLX81100

LIN Slave for FET Control

Features

CPU

- MelexCM CPU
  - Dual RISC CPU MLX4/16 – 5MIPS
  - 4-bit LIN protocol controller
  - 16-bit application CPU
- Internal RC-Oscillator

Memories

- 2kbyte RAM, 32kbyte Flash, 128 byte EEPROM
- Flash for series production

Periphery

- Three 16-bit timer with capture and compare
- Full duplex SPI interface
- 100-kBaud UART
- 2 high and 2 low side FET driver with protection
  - Over temperature control
  - Short circuit protection
  - Current control
- 8-bit PWM control with programmable base frequency of 100Hz to 100kHz
- 8 high voltage I/Os
- 16-channel 10-bit ADC with high voltage option
- Independent analog watchdog
- Temperature sensor

Voltage Regulator

- Direct powered from 12V boardnet with low voltage detection
- Operating voltage V_S = 7V to 18V
- Internal voltage regulator with external load capability of 20mA
- External Load transistor for higher 5V loads possible
- Very low standby current, < 50µA in sleep mode

Bus Interface

- LIN transceiver
- Supporting of LIN 2.x and SAE J2602
- LIN protocol software provided by Melexis
- Wake up by LIN traffic or local sources

Additional Features

- On-chip CPU debugger
- Jump start and 40V load dump protected

Applications

LIN slaves for all kind of high current DC Motor control like

- Seat heating control
- Seat climatisation
- Wiper control
- Valve control
- Seat movement
- I-Drive

Contents

1. Functional Diagram

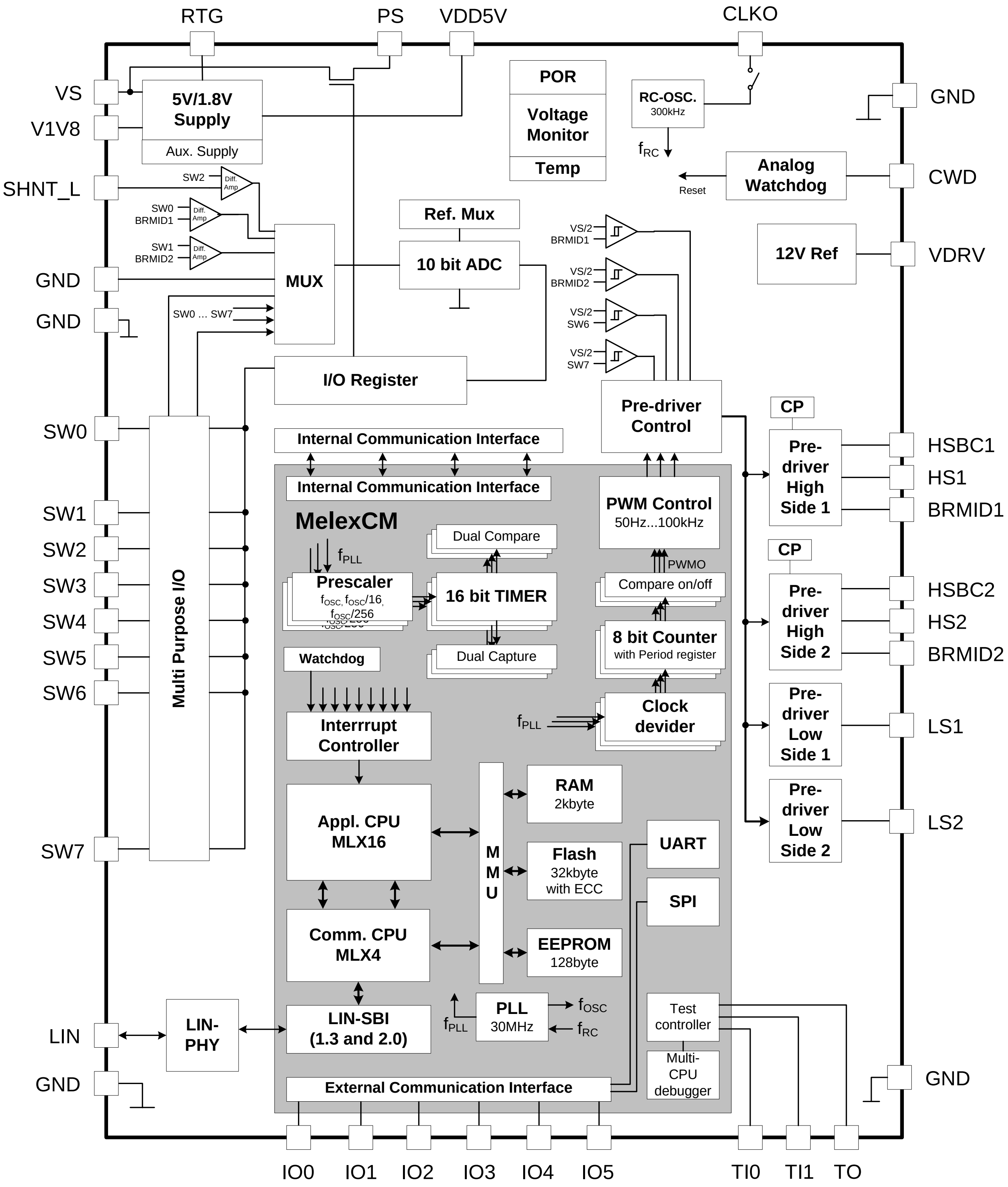


Figure 1- Block diagram

2. *Electrical Characteristics*

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 MLX81100 is only specified within the limits shown in "Operating conditions".

2.1 Operating Conditions

Parameter	Symbol	Min	Max	Unit
Battery supply voltage	V_S	7.3	18	V
Operation Current	I_{VS}		30	mA
Standby current	I_{SBY}		50	µA
Operating ambient temperature	T_{amb}	-40	+125 (150) [1]	°C

Table 1 - Operating Conditions

2.2 Absolute Maximum Ratings

Parameter	Symbol	Condition	Min	Max	Unit
Battery supply voltage	V_S	t < 60s	-1.0	26	V
		t < 500 ms	-0.5	40	
BUS voltage	V_{BUS}	t < 500 ms	-20	VBAT	V
Transient supply voltage	$V_{S.tr1}$	ISO 7637/1 pulse 1 [2]	-150		V
Transient supply voltage	$V_{S.tr2}$	ISO 7637/1 pulses 2 [2]		+100	V
Transient supply voltage	$V_{S.tr3}$	ISO 7637/1 pulses 3A, 3B	-150	+150	V
Transient bus voltage	$V_{BUS.tr1}$	ISO 7637/1 pulse 1 [3]	-150		V
Transient bus voltage	$V_{BUS.tr2}$	ISO 7637/1 pulses 2 [3]		+100	V
Transient bus voltage	$V_{BUS.tr3}$	ISO 7637/1 pulses 3A, 3B [3]	-150	+150	V
DC voltage on CMOS I/O pins	V_{DC}		-0.3	+7	V
ESD capability of pin LIN	ESD_{BUSHB}	Human body model, equivalent to discharge 100pF with 1.5kΩ,	-4	+4	kV
ESD capability of any other pins	ESD_{HB}	Human body model, equivalent to discharge 100pF with 1.5kΩ,	-2	+2	kV
Thermal Resistance	R_{th}	in free air		40.	K/W
Storage temperature	T_{stg}		-55	+150	°C
Junction temperature	T_{vj}		-40	+150 (155)[1]	°C

Table 2 - Absolute Maximum Ratings

[1] Target temperature after qualification. With temperature applications at TA>125°C a reduction of chip internal power dissipation with external supply transistor is obligatory. The extended temperature range is only allowed for a limited period of time, customers mission profile has to be agreed by Melexis as an obligatory part of the Part Submission Warrant. Some analogue parameters will drift out of limits, but chip function can be guarateed.
[2] ISO 7637 test pulses are applied to VS via a reverse polarity diode and >1µF blocking capacitor .
[3] ISO 7637 test pulses are applied to BUS via a coupling capacitance of 1nF.

3. Application Circuitry

3.1 Single DC-Motor Drive

In this sample application the IC can realize the driving of a DC-motor via an external power N-FET bridge. The high side N-FET driving is done with a bootstrap output stage. The current control of the motor is done via shunt measurement and the reverse polarity protection of the bridge must be realized with an external power FET connected to the ground line. Short circuits of the bridge will be detected from fast comparators and in this case the bridge will be switched off. Weak short circuits are monitored with an external temperature sensor. The actual position can be read with hall sensors, which are connected to the timer capture inputs. The hall sensors are switched off during standby mode via a switchable battery voltage output. Optional it is possible to connect an external serial EEPROM via a SPI interface, if it isn't allowed to use the integrated EEPROM because of security reasons.

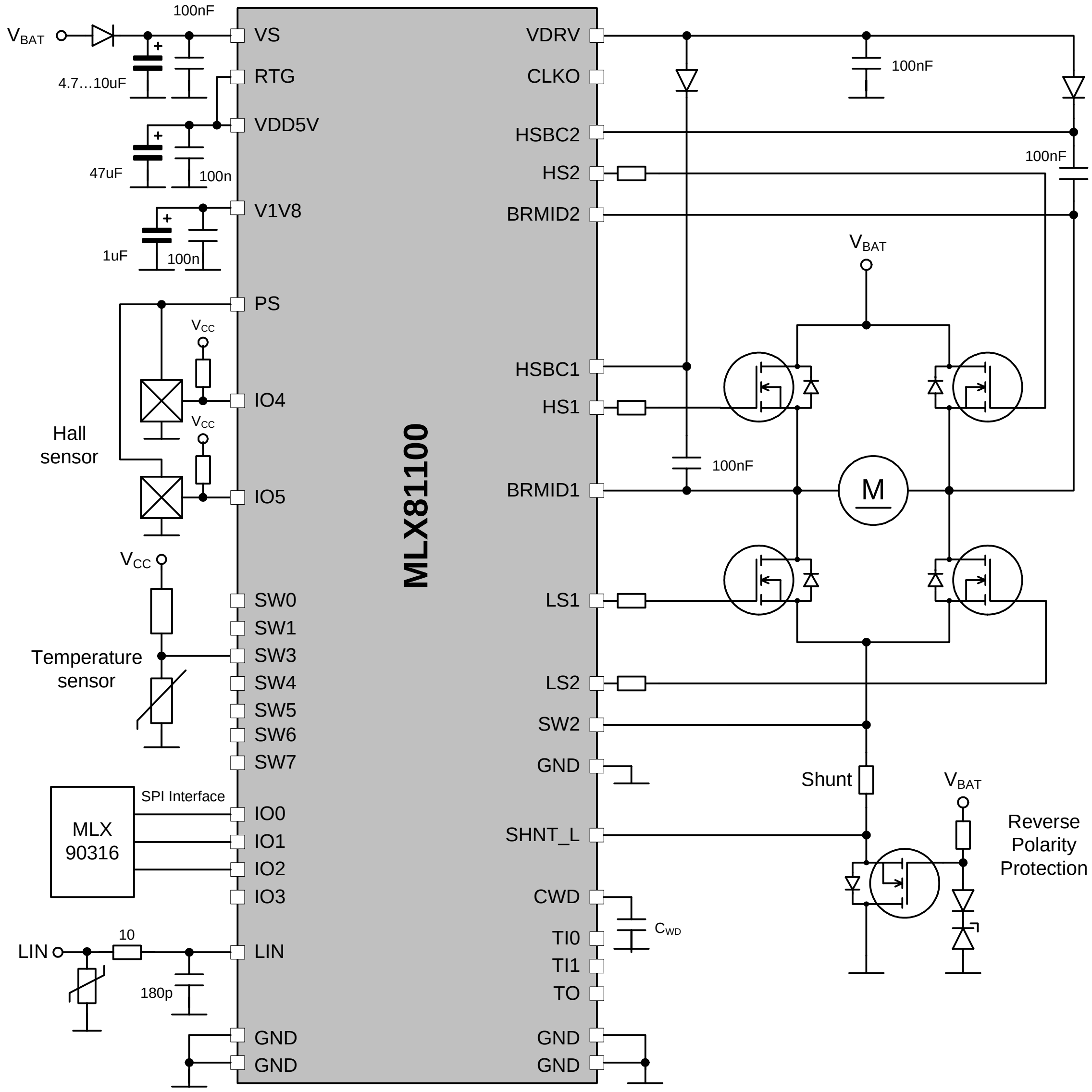


Figure 2 - Application circuitry for single DC-motor control

3.2 Higher VCC Loads and higher Ambient Temperatures

If it is necessary to supply higher currents to external 5V loads it is possible to connect to the RTG pin an external load transistor. This external load transistor decreases also the internal power dissipation which makes it possible to use this IC also for higher ambient temperatures.

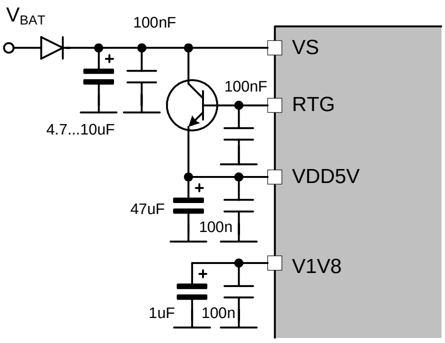


Figure 3 - Application for higher VCC loads and higher ambient temperatures

3.3 High Side Reverse Polarity Protection

With this IC it is also possible to realise a high side reverse polarity protection for the bridge Power-FET with a normal power N-FET.

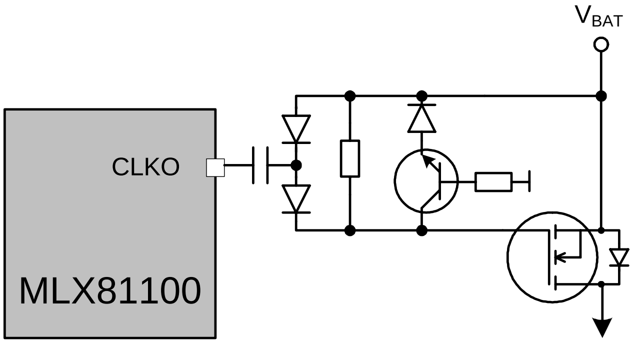


Figure 4 - High side N-FET reverse polarity protection

3.4 Connection to External CAN Controller

If the application requires a connection to the CAN network it can be realized with the help of an external CAN communication CPU. The following circuitry shows a sample how to implement this together with our MLX81100.

The communication between MLX8100 and external CAN controller is done via the SPI interface of the MelexCM.

A bus wake-up will be signalised at the INH pin of the CAN transceiver. This signal will be used from a normal HV-IO pin to wake-up the MLX81100.

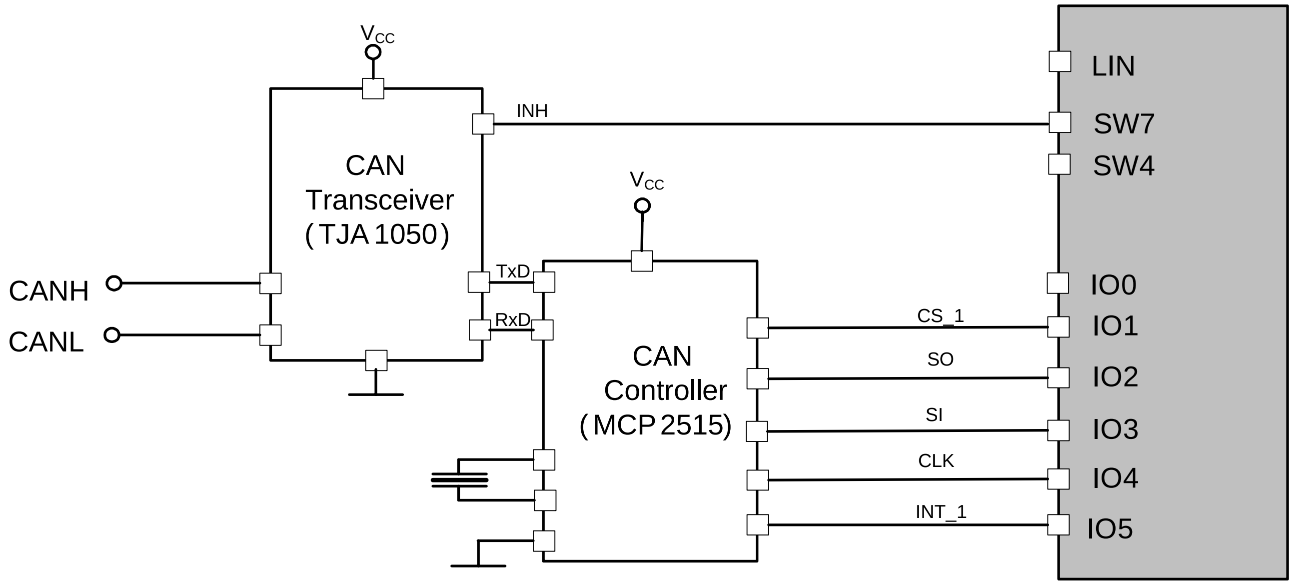
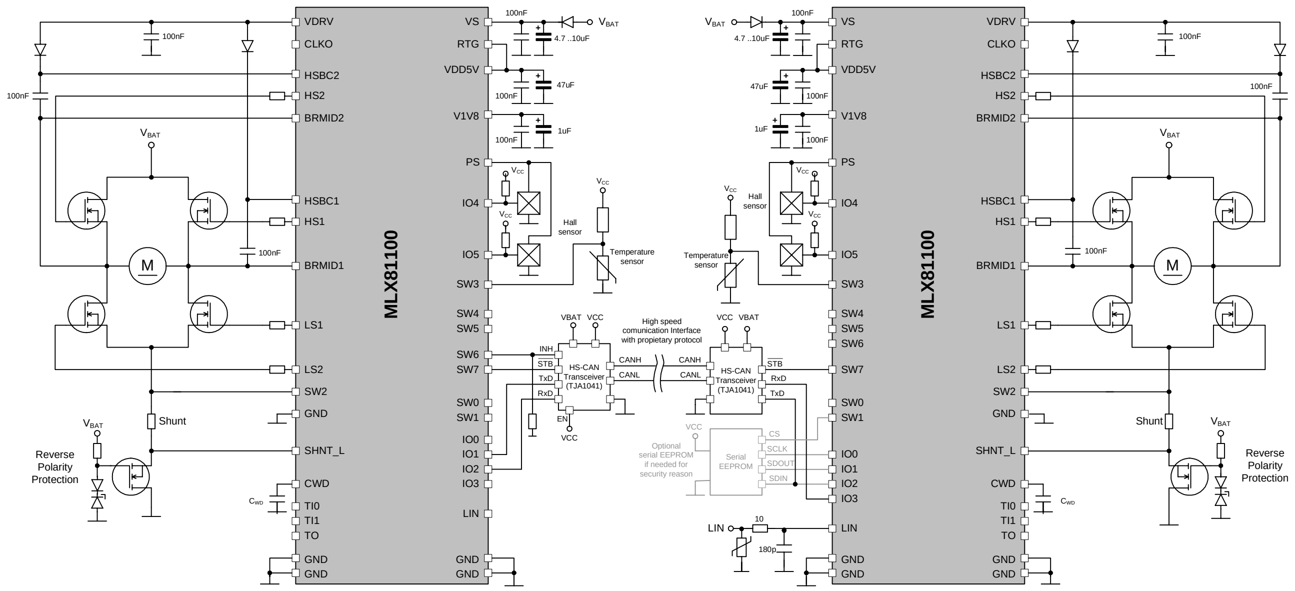


Figure 5 - Connection to external CAN controller

3.5 Dual DC-Motor Drive

In this sample application the IC can realize the driving of two DC-motors via an external power N-FET bridge. The high side N-FET driving is done with a bootstrap output stage. The current control of the motor is done via shunt measurement and the reverse polarity protection of the bridge must be realized with an external power FET connected to the ground line. Short circuits of the bridge will be detected from fast comparators and in this case the bridge will be switched off. Weak short circuits are monitored with an external temperature sensor. The actual position can be read with hall sensors, which are connected to the timer capture inputs. The hall sensors are switched off during standby mode via a switchable battery voltage output. If it is necessary to synchronize the motor movement via longer distances it can be done via the UART interface connected to an external high speed can transceiver. Via this interface together with a proprietary protocol it is possible that both motor-driver exchange real-time position information. Optional it is possible to connect an external serial EEPROM via a SPI interface, if it isn't allowed to use the integrated EEPROM because of security reasons.



Application example for Dual DC motor driver

Figure 6 - Application circuitry for a dual DC-motor system

3.6 Human Interface Device with DC-Motor

In this sample application the IC can realize the driving of a feedback DC-motor via an external power N-FET bridge. The high side N-FET driving is done with a bootstrap output stage. The current control of the motor is done via shunt measurement and the reverse polarity protection of the bridge must be realized with an external power FET connected to the ground line. Short circuits of the bridge will be detected from fast comparators and in this case the bridge will be switched off. Weak short circuits are monitored with an external temperature sensor. The reading of the direction and positions of a rotating encoder can be easy done via the timer capture inputs. With SW0 to SW5 and IO0 to IO3 it is possible to implement a switch matrix or to connect single switches.

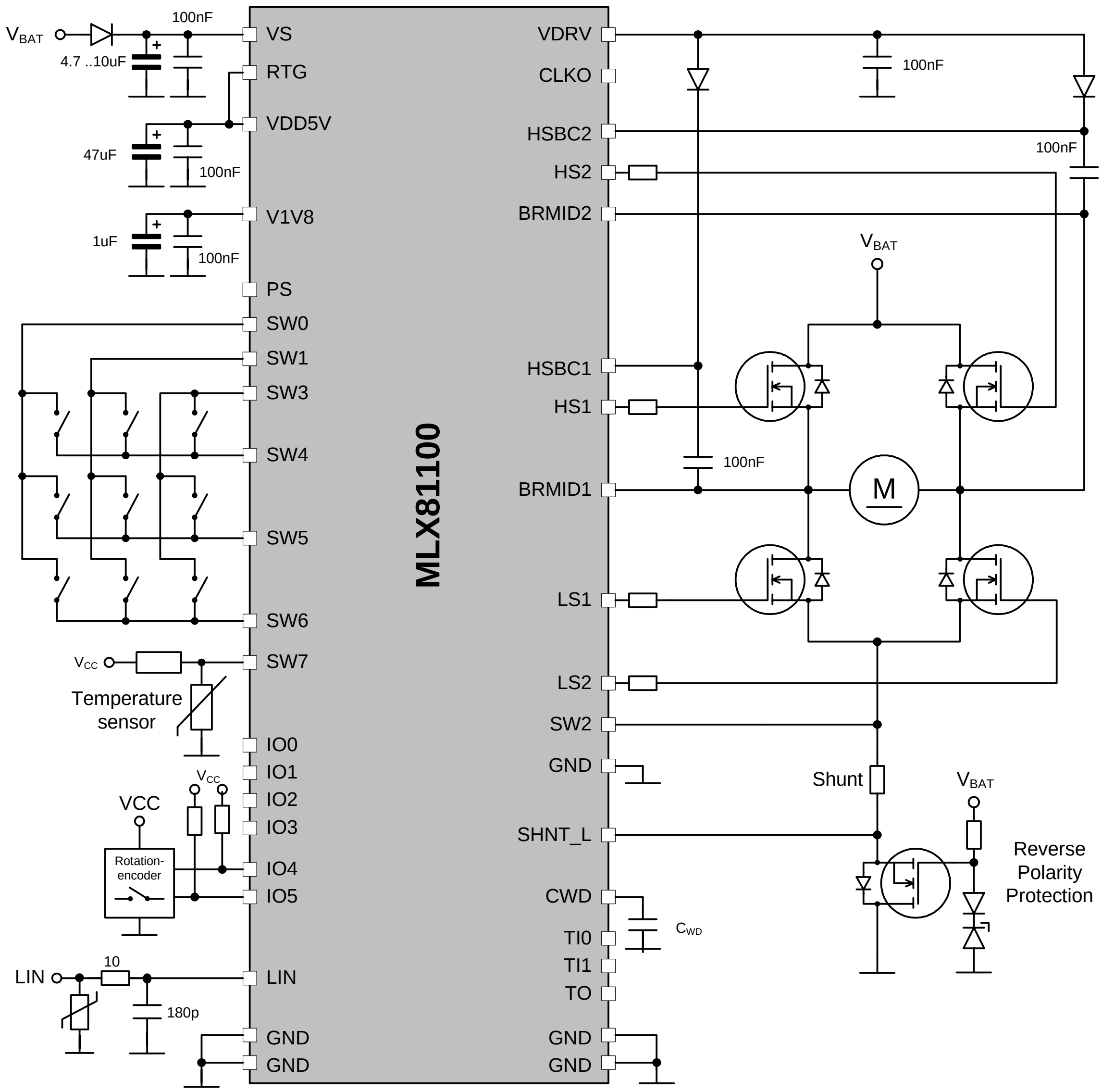


Figure 7 - Application circuitry for human interface device with DC-motor

3.7 Seat Heating and Climatisation

In this sample application is implemented the driving of two heat elements via the high side and two DC-motors via the low side N-FET drivers. The high side N-FET driving is done with a bootstrap output stage. The current control of the high side FETs will be done via shunt measurement and the shunt voltage is amplified with a differential amplifier connected to the ADC. The reverse polarity protection of the low side FETs is implemented with an external power FET connected to the ground line. Short circuits of the single FETs will be detected from fast comparators and in this case the FETs will be switched off. Weak short circuits are monitored with an external temperature sensor.

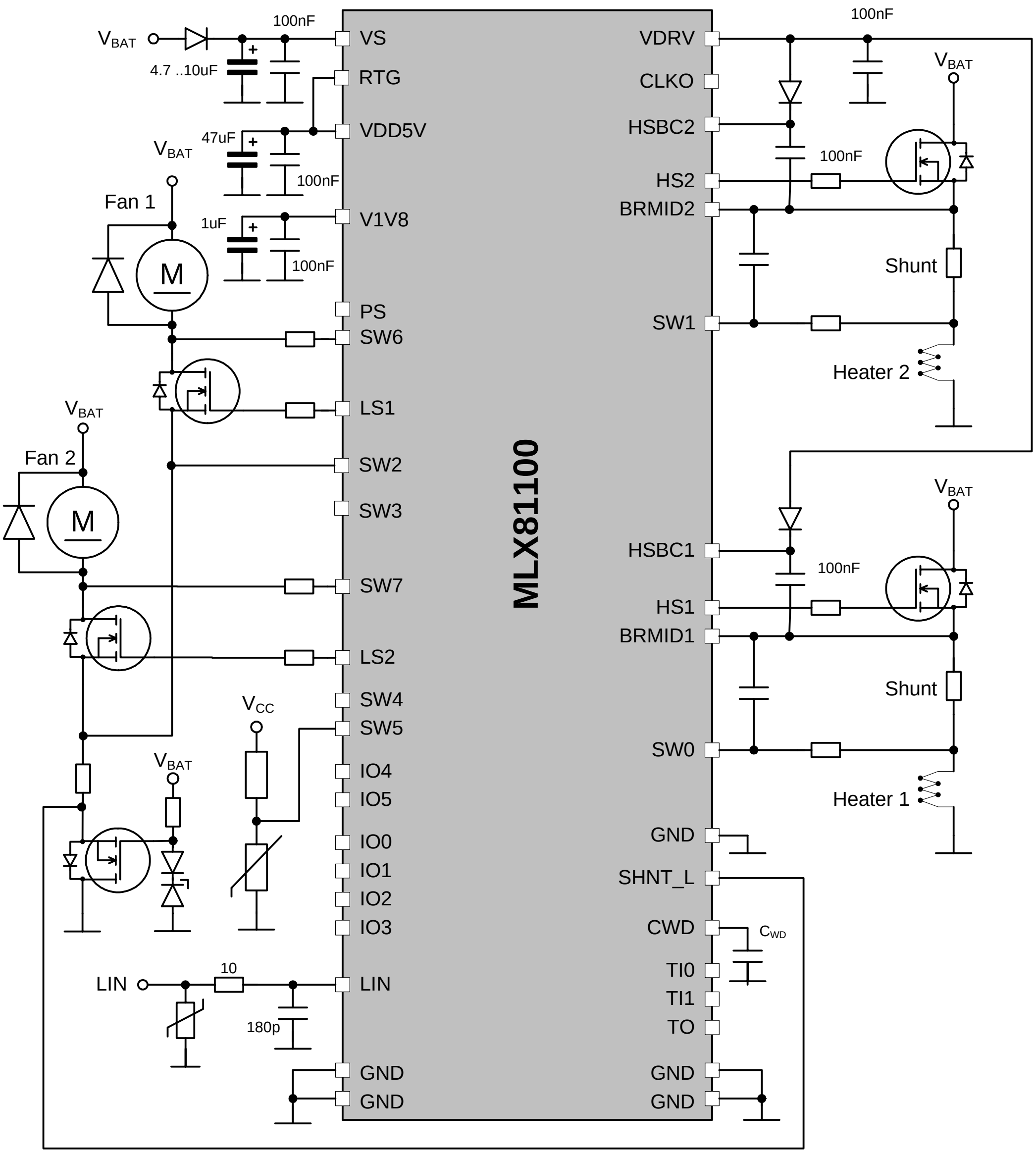


Figure 8 - Application circuitry for seat heating and seat climatisation

4. Pin Description

Table 3 – Pin Description MLX81100 MLF 6x6 40

Name	Function	I/O Type
VS	HV supply, battery voltage	P
VDD5V	Internal regulated voltage supply, 5V supply output	P
V1V8	Internal regulated voltage supply, 1.8V supply output	P
GND	Ground	P
PS	Switchable battery supply	P
GND	Ground	P
SHNT_L	Low shunt input for differential ADC measurement	I
GND	Ground	GND
SW1	HV in- or output, ADC-input	IO
SW2	HV in- or output, ADC-input	IO
SW3	HV in- or output, ADC-input	IO
SW4	HV in- or output, ADC-input	IO
SW5	HV in- or output, ADC-input	IO
SW6	HV in- or output, ADC-input	IO
SW7	HV in- or output, ADC-input	IO
SW8	HV in- or output, ADC-input	IO
LIN	Connection to LIN bus	IO
GND	Ground	GND
CWD	Watchdog capacitor	IO
VDRV	Clamped 12V reference voltage for bootstrap	P
HSBC1	High side bootstrap capacitor driver 1	O
HS1	N-FET high side gate driver 1	O
BRMID1	Source connection of HS1	I
HSBC2	High side bootstrap capacitor driver 2	O
HS2	N-FET high side gate driver 2	O
BRMID2	Source connection of HS2	I
LS1	N-FET low side gate driver 1	O
LS2	N-FET low side gate driver 2	O
GND	Ground	GND

Name	Function	I/O Type
IO0	General purpose in- or output, SPI, UART	IO
IO1	General purpose in- or output, SPI, UART	IO
IO2	General purpose in- or output, SPI, UART	IO
IO3	General purpose in- or output, SPI, UART	IO
IO4	Timer capture input 1, general purpose in- or output	IO
IO5	Timer capture input 2, general purpose in- or output	IO
TI0	Test input, debug interface	I
TI1	Test input, debug interface	I
TO	Test output, debug interface	O
RTG	Output for external voltage regulation transistor	O
CLKO	Clock Output	O

5. Mechanical Specification

5.1 MLF 6x6 40 leads

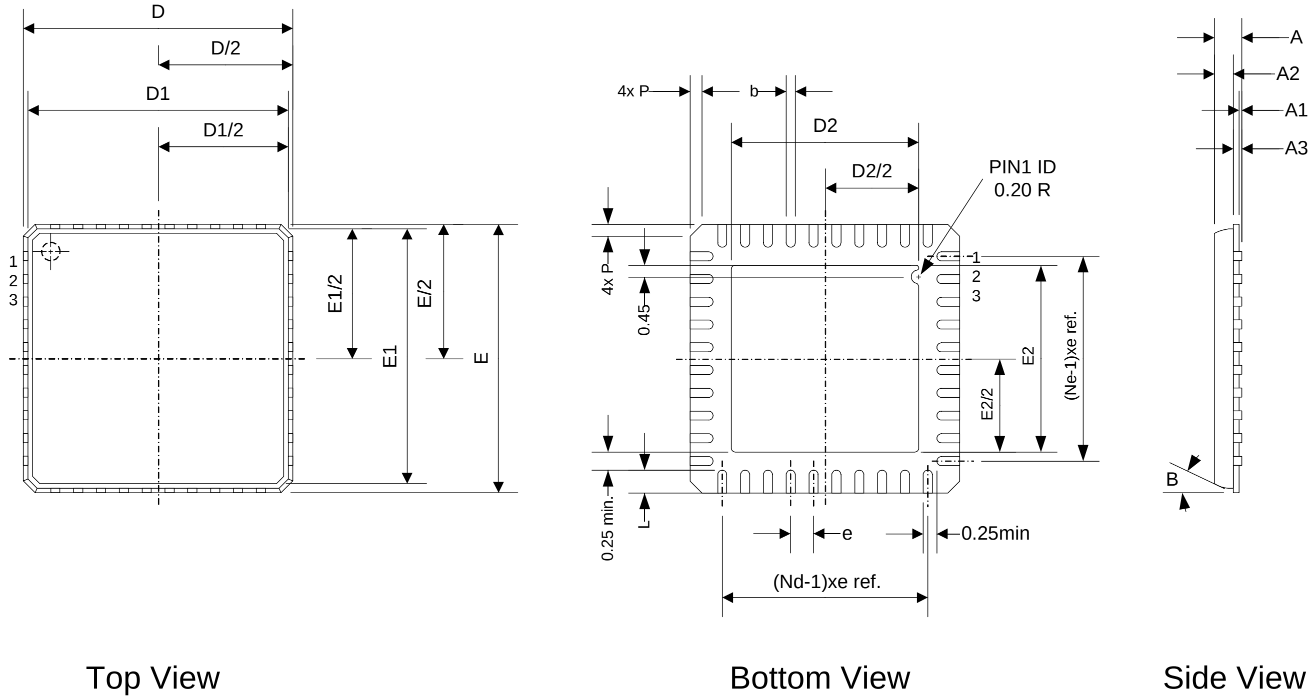


Figure 9 – MLF 6x6 40 Drawing

Table 4 – MLF40 Package Dimensions

Symbol		A	A1	A2	A3	B [4]	D	D1	D2	E	E1	E2	e	L	
MLF40	min	-	0	-					3.95			3.95		0.30	[1]
	nom	0.85	0.01	0.65	0.20		6.00	5.75	4.10	6.00	5.75	4.10	0.50	0.40	[2]
	max	0.90	0.05	0.70		12°			4.25			4.25		0.50	

Symbol		P	N [3]	Nd [5]	Ne [5]	
MLF40	min	0.24				[1]
	nom	0.42	40	10	10	[2]
	max	0.60				

[1] Dimensions and tolerances conform to ASME Y14.5M-1994
[2] All dimensions are in millimeters. All angels are in degrees
[3] N is the number of terminals
[4] Dimension b applies to metallized terminal and is measured between 0.25 and 0.30mm from terminal tip
[5] Nd and Ne refer to the number of terminals on each D and E side respectively

6. Assembly Information

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 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.asp

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