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### **Embedded - Microcontrollers - Application Specific: Tailored Solutions for Precision and Performance**

**Embedded - Microcontrollers - Application Specific** represents a category of microcontrollers designed with unique features and capabilities tailored to specific application needs. Unlike general-purpose microcontrollers, application-specific microcontrollers are optimized for particular tasks, offering enhanced performance, efficiency, and functionality to meet the demands of specialized applications.

### **What Are Embedded - Microcontrollers - Application Specific?**

Application specific microcontrollers are engineered to

#### **Details**

Product Status	Active
Applications	LIN Controller
Core Processor	16-Bit RISC
Program Memory Type	FLASH (32kB), EEPROM (380 B)
Controller Series	-
RAM Size	2K x 8
Interface	PWM, SPI
Number of I/O	8
Voltage - Supply	5.5V ~ 18V
Operating Temperature	-40°C ~ 105°C (TA)
Mounting Type	Surface Mount
Package / Case	32-VFQFN Exposed Pad
Supplier Device Package	32-QFN (5x5)
Purchase URL	<a href="https://www.e-xfl.com/product-detail/melexis/mlx81150llw-daa-000-sp">https://www.e-xfl.com/product-detail/melexis/mlx81150llw-daa-000-sp</a>

## **Ordering Information**

Order Code <sup>[1]</sup>	Temp. Range	Package	Delivery	Remark
MLX81150 LLQ-xAA-000-TU	-40 - 150 °C	QFN32 5x5	Tube	
MLX81150 LLQ-xAA-000-RE	-40 - 150 °C	QFN32 5x5	Reel	
MLX81150 LPF-xAA-000-TR	-40 - 150 °C	TQFP EP 48 7x7	Tray	
MLX81150 LPF-xAA-000-RE	-40 - 150 °C	TQFP EP 48 7x7	Reel	

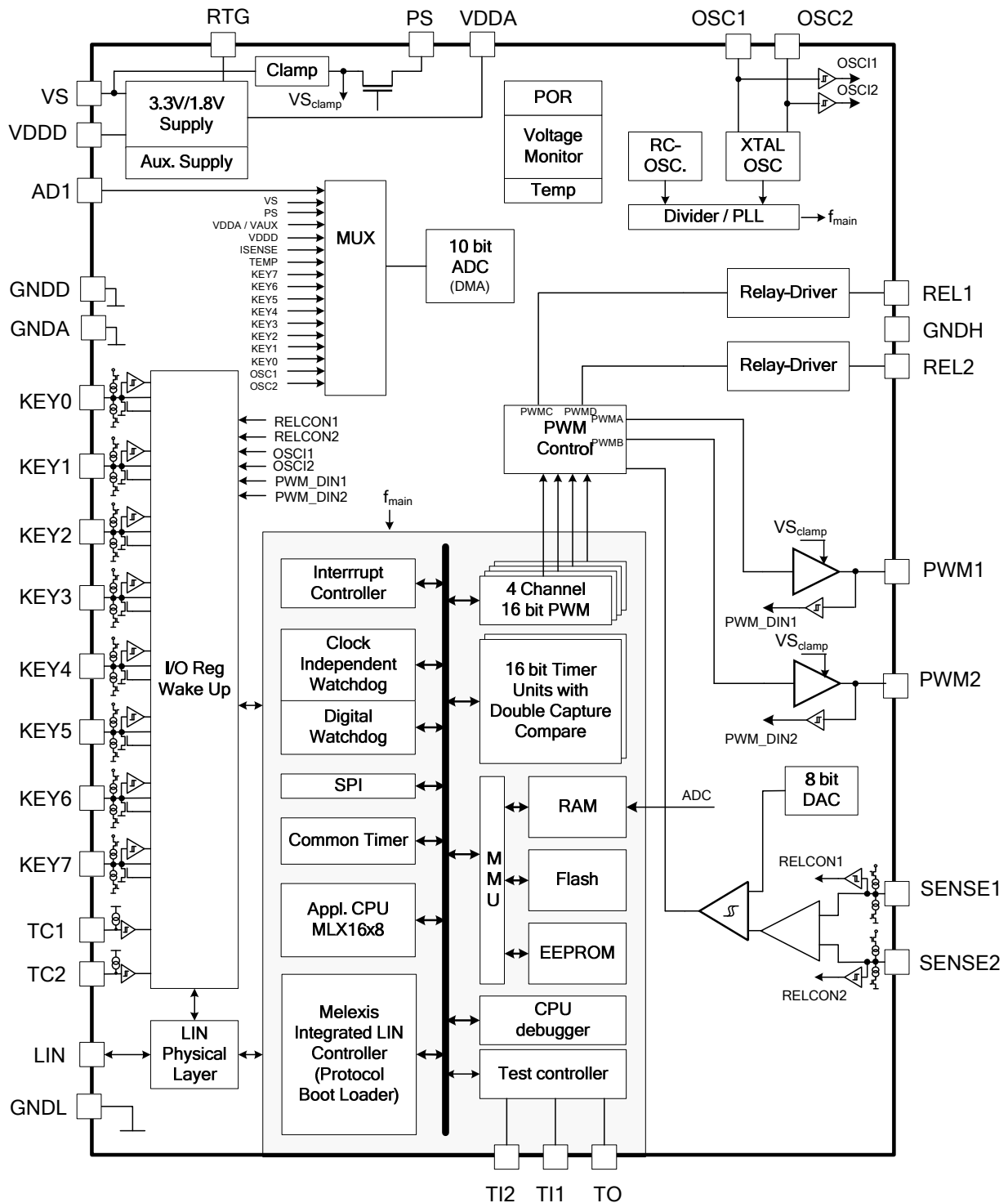
**Table 1 – Ordering Information**

<sup>[1]</sup>.See Marking/Order Code.

## **Contents**

<b>1. FUNCTIONAL DIAGRAM .....</b>	<b>4</b>
<b>2. PIN DESCRIPTION .....</b>	<b>5</b>
<b>3. ELECTRICAL CHARACTERISTICS.....</b>	<b>7</b>
3.1 OPERATING CONDITIONS .....	7
3.2 ABSOLUTE MAXIMUM RATINGS .....	8
<b>4. APPLICATION EXAMPLES.....</b>	<b>10</b>
4.1 SINGLE DC MOTOR DRIVE .....	10
4.2 SINGLE DC MOTOR DRIVE WITH SOFT START / STOP.....	11
4.3 SINGLE DC MOTOR DRIVE IN FET CONTROLLED FULL BRIDGE APPLICATIONS.....	12
4.4 LED-LAMP DRIVER, SWITCH MODE POWER SUPPLY.....	13
4.5 MLX81150 IN 1- AND 2- PHASE BLDC (BRUSH LESS DC) MOTOR CONTROL APPLICATIONS.....	14
4.6 HIGHER VDDA LOADS OR HIGHER AMBIENT TEMPERATURES.....	15
4.7 USE OF EXTERNAL RESONATOR .....	15
4.8 KEY INPUTS WITH DIFFERENT WETTING CURRENTS IN ACTIVE AND SLEEP CONFIGURATION .....	16
<b>5. MECHANICAL SPECIFICATION .....</b>	<b>19</b>
5.1 PACKAGE DATA QFN32 (5X5, 32 LEADS).....	19
5.2 PACKAGE DATA TQFPPEP 48L (7X7, 48 LEADS).....	20
<b>6. MARKING/ORDER CODE .....</b>	<b>21</b>
6.1 MARKING MLX81150 .....	21
6.2 ORDER CODE MLX81150.....	21
<b>7. ASSEMBLY INFORMATION.....</b>	<b>22</b>
<b>8. DISCLAIMER.....</b>	<b>23</b>

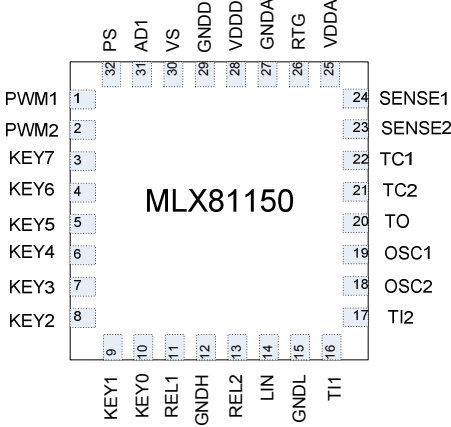
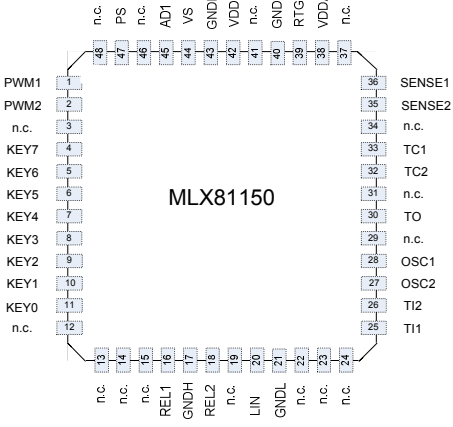
**1. Functional diagram**



**Figure 1- Block diagram**

### 2. Pin description

Pin No. QFN32	Pin No. TQFP48	Pad count	Pin name	voltage range	remarks and description
30	44	1	VS	Pwr HV	Battery supply voltage; external protection against reverse polarity needed, external blocking capacitors
29	43	2	GNDD	Pwr	Ground pin for Digital part
27	40	2	GNDA	Pwr	Ground pin for Analogue part
12	17	2	GNDH	Pwr	Ground pin for Relay Driver
15	21	1	GNDL	Pwr	Ground pin for LIN
25	38	2	VDDA	Pwr LV	Regulator output (~3.3 V), external blocking capacitors
28	42	2	VDDD	Pwr LV	Regulator output (~1.8 V), external blocking capacitors
26	39	1	RTG	Ana LV	Output for external bipolar transistor in case of HT applications
32	47	1	PS	Ana HV	High-side switch with Ron < 40 Ohm at 20mA, Switch-able supply (<15 V) for external components
[3:10]	[4:11]	8	KEY[7:0]	Multi-function HV	High voltage I/O port with wake-up function, Input for high or low active switches, ADC input, Low-side driver output 4mA (15mA), Weak current sources for pin diagnosis and WAKE UP in SLEEP MODE SPI Interface Pins (valid for KEY[3:0], DI, DO, CLK, CS)
31	45	1	AD1	Ana HV	High voltage ADC input (for VBAT measurement), Low side driver 30 uA (only for test purposes)
13, 11	18, 16	2, 2	REL[2:1]	Ana HV	Low-side switch with Ron < 7 Ohm at 150 mA @150°C, Relay driver with free wheel function, PWM controlled output
23, 24	35, 36	2	SENSE[2:1]	Ana HV	High voltage input for read out the status of relay contacts, Current sense function for shunt current
2, 1	2, 1	2	PWM[2:1]	Ana HV	Push pull output with Ron < 50 Ohm at 20mA, high output level is supply related but max approx. 14V, PWM controlled output
21, 22	32, 33	2	TC[2:1]	Ana LV	Input for timer capture unit, Low voltage input
18, 19	27, 28	2	OSC[2:1]	Ana LV	Crystal oscillator pin, Low voltage input, load capacitors external, ADC input
14	20	1	LIN	Ana HV	LIN 2.x transceiver BUS pin, slave only, High voltage I/O
17, 16	26, 25	1	TI[2:1]	Dig input	Test inputs for Melexis, debug interface - connect via resistor to GND in application mode, so that Flashing via these test pins is possible
20	30	1	TO	Dig output	Test output for Melexis, debug interface, unconnected in application mode
-	3, 12, 13, 14, 15, 19, 22, 23, 24, 29, 31, 34, 37, 41, 46, 48	-	not connected	-	not connected pins

<p>Dig     digital input or output or bidirectional</p> <p>Ana     analogue pin</p> <p>Pwr     power/supply pin</p> <p>Multifunction   multifunctional pin (configurable pin)</p> <p>Test     pin for test purposes</p> <p>LV       low voltage, VDDA or VDDD related</p> <p>HV       high voltage, VBAT or VS related</p>	<p>Top view of the package QFN32</p> 	<p>Top view of the package TQFP48</p> 
<p><b>Table 2: Pin Out description</b></p>		

### 3. 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 MLX81150 is only specified within the limits shown in “Operating conditions”.

#### 3.1 Operating conditions

Parameter	Symbol	Conditions	Limit		Unit
			Min	Typ	
Supply Voltage Range	VS		5.5 (3.9 <sup>[1]</sup> )		18 V
Ambient Temperature	TA		-40		105 (150 <sup>[2]</sup> ) °C

**Table 3: Operational 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
- Power Saving Mode
  - Application CPU halted
  - Wake-up by interrupt possible
- Under voltage: triggered by the hardware under voltage detection interrupt. (VS\_UV)
  - Microcontroller fully functional.
  - Analogue functionality under software control.
  - Reduced current capability on VDDA below VS=5.5V.
- Over voltage: triggered by the hardware over voltage detection interrupt. (VS\_OV)
  - Microcontroller fully functional
  - Analogue functionality powered down by hardware or 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

[1] Development target, IC will work down to 3.9V with reduced analogue characteristics, Digital part still works, Memories will keep their content. Some analogue parameter will drift out of limits, but chip function can be guaranteed.

Before going down to 3.9V the VS has to be at the startup of the IC for a certain time > 6V to guarantee a correct reset! Evaluation will only be done on sample basis in the preproduction phase; no production test; no life time test

[2] With temperature applications at TA>105°C a reduction of chip internal power dissipation with an external transistor in the voltage regulator path is obligatory. The extended temperature range is only allowed for a limited period of time, customer's mission profile has to be agreed by Melexis as an obligatory part of the Part Submission Warrant (PSW). Some analogue parameter may drift out of limits, but chip function can be guaranteed.

Junction Temperature	TJ		-40	150 (155) <sup>[4][5]</sup>	°C
Thermal resistance QFN32 <sup>[3]</sup>	Rth	in free air, air flow 0m/s	~ 32		K/W

**Table 4: Absolute maximum ratings**

- [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] 150°C ambient temperature is a target value. For temperatures >105°C an external bipolar regulator transistor in the regulator path should be used. Ambient temperatures of 150°C are only allowed for limited periods of time to be agreed in a mission profile with the customer.
- [5] 155°C is a development target value.
- [6] Equivalent to discharging a 150pF capacitor through a 330Ω resistor;
- [7] The specified values are a target to be verified on first prototypes. Based on the evaluation results, additional external protection components might be recommended to reach the specified system ESD levels.
- [8] Equivalent to discharging a 100pF capacitor through a 1.5kΩ resistor conform to MIL STD 883 method 3015.7.



### 4.2 Single DC motor drive with soft start / stop

For some applications it might be necessary:

- To control the motor speed especially during start / stop,
- To have an independent switching channel in case the relay “hangs”,
- To switch the power via the power transistor and to increase with this the life time of the relay contacts
- To monitor the motor current (current sensing and over current shut off).

This application requires then also a reverse polarity protection in the power path.

Following application diagram shows the practical realization in principle:

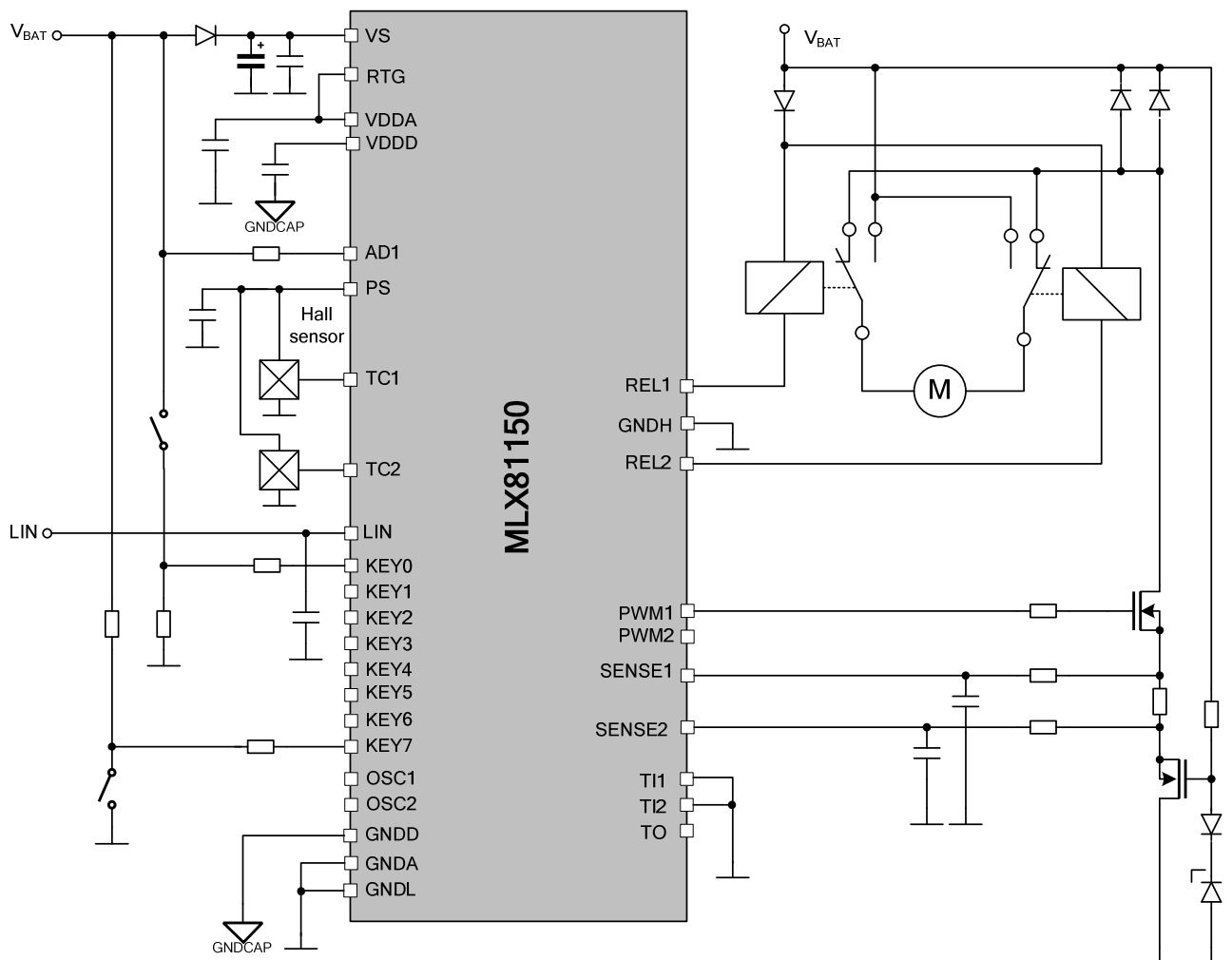


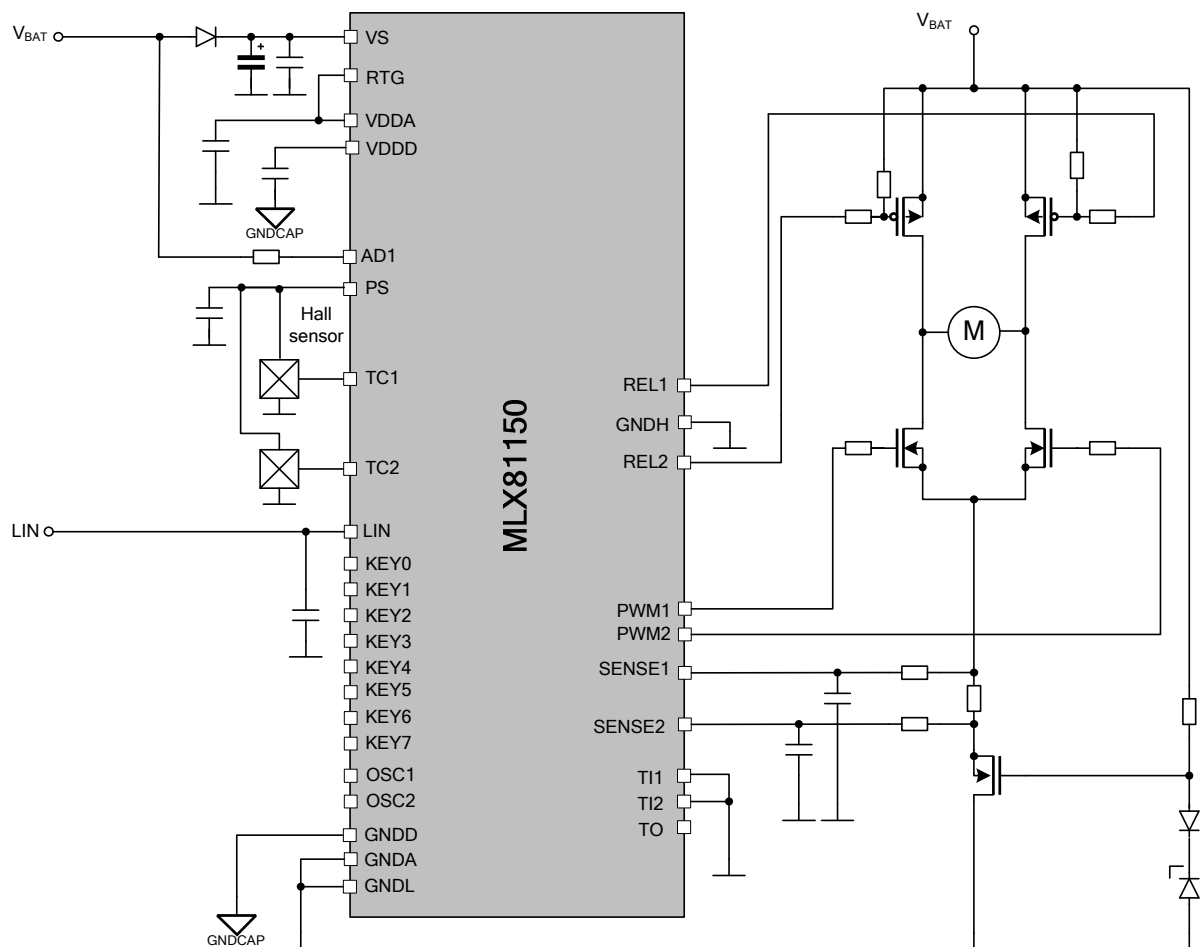
Figure 3 – Principle application diagram showing a common relay driver controlled by external switches and LIN bus, with soft start / stop and motor current sense

### 4.3 Single DC motor drive in FET controlled full bridge applications

By adding some external additional circuitry, the IC will also allow to drive DC motors in full bridge applications. Position, speed and direction sensing is done via external Hall latches. By having one PWM on the low side path of the half bridge and the inverse PWM (with programmable interlock delay in the high side path) the p channel can be actively switched on in case the current wheels out.

Same is for the n-channel Transistor.

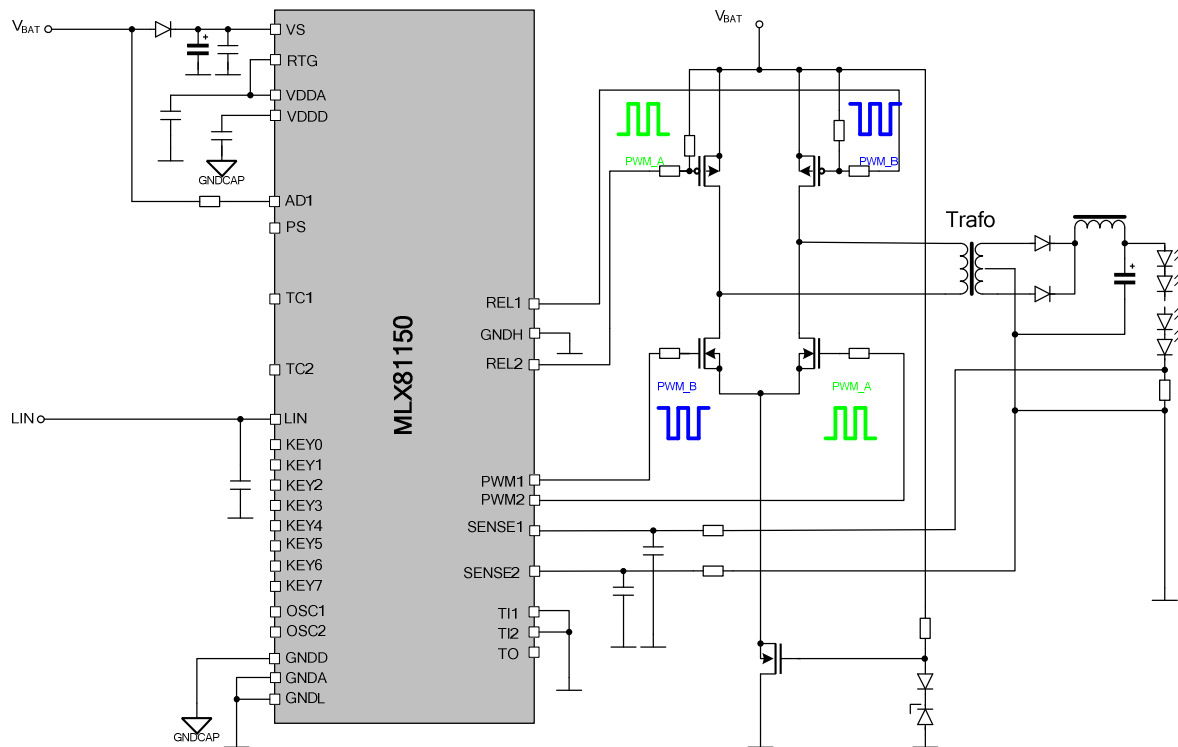
The other side of the full bridge is then statically switched on or off.



**Figure 4 – Principle application diagram showing a DC motor in a full bridge application**

**4.4 LED-Lamp driver, switch mode power supply**

In this application the MLX81150 drives a LED lamp with several high power LEDs in a DC-DC converter configuration. The module itself is controlled via the LIN bus. The current in the LED is regulated to a given value. Adjusting PWM frequency and PWM ratio allow to control the transformer in a very efficient way from EMC perspective as well as from energy point of view.



**Figure 5 – Principle application diagram showing a DC/DC converter for high power LED lamp driving controlled by a LIN bus**

### 4.5 MLX81150 in 1- and 2- phase BLDC (brush less DC) Motor control applications

BLDC motors are used today in several permanent running automotive applications. 1- and 2-phase BLDC motors are applied in several auxiliary applications as small pumps and blowers. In case these pumps request a LIN or PWM interface connection, the MLX81150 is a perfect solution for that. The commutation information for the brush less DC motors is provided by a hall switch/latch reacting on positive and negative magnet field of the permanent magnet rotor.

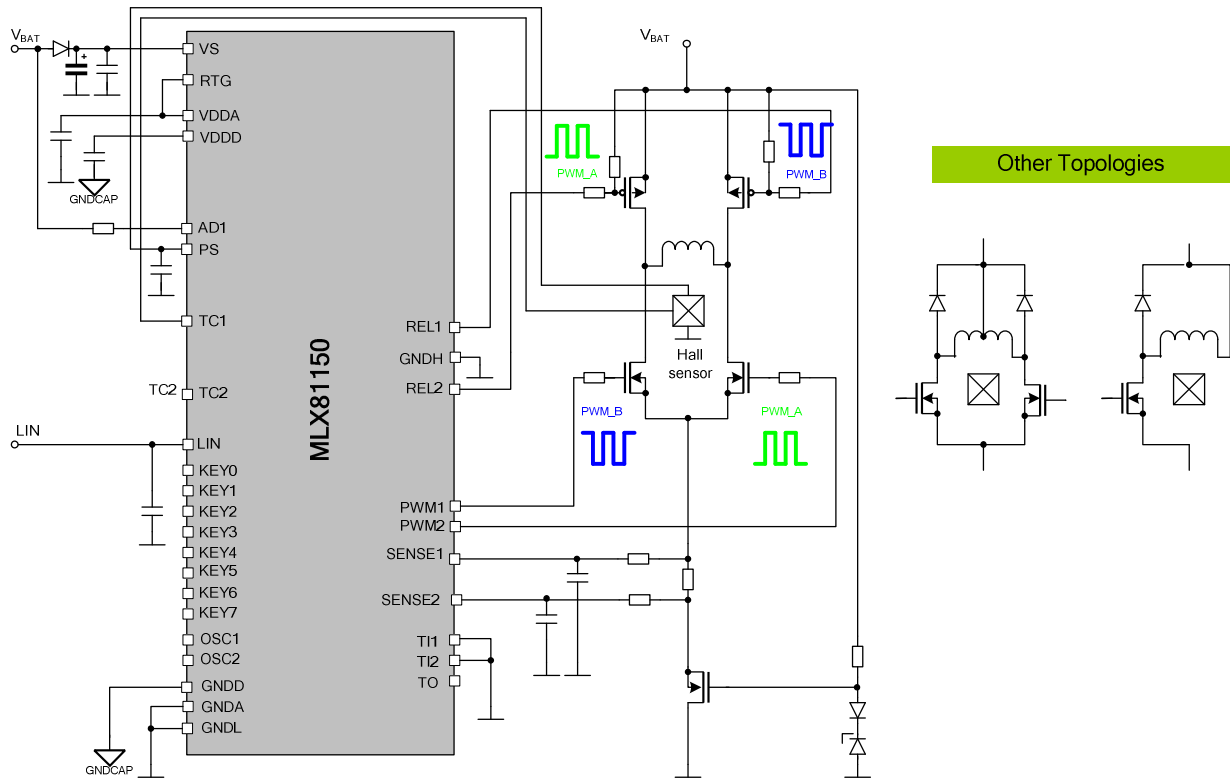
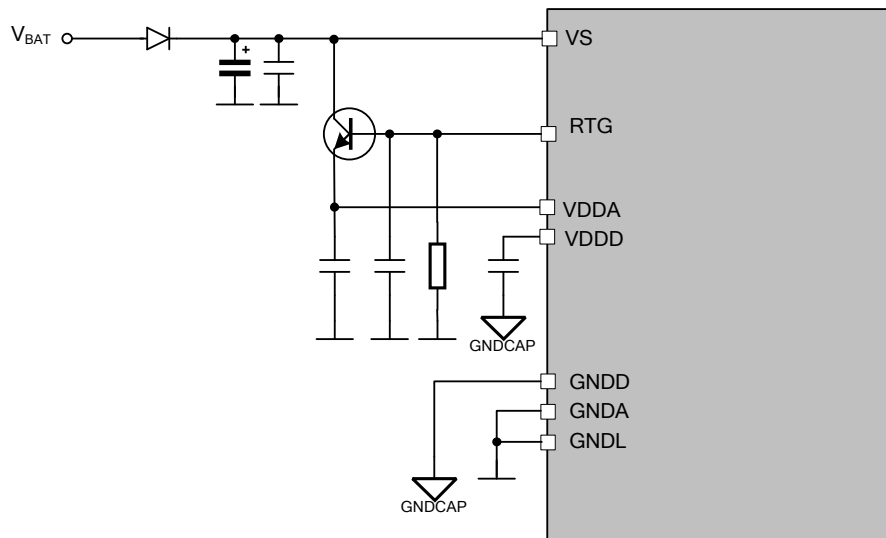


Figure 6 – Principle application diagram showing a 1 / 2 phase BLDC motor drive

#### 4.6 Higher VDDA loads or higher ambient temperatures

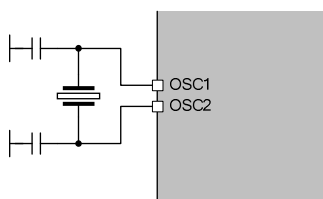
If it is necessary to supply higher currents to external 3.3V loads or if high ambient temperatures >105°C are requested, it is possible to connect to the RTG pin an external load transistor. This external load transistor provides a higher current for possible external devices and also decreases the internal power dissipation.



**Figure 7 – Principle application diagram in case of higher VDDA loads or if high ambient temperatures are applied**

#### 4.7 Use of external resonator

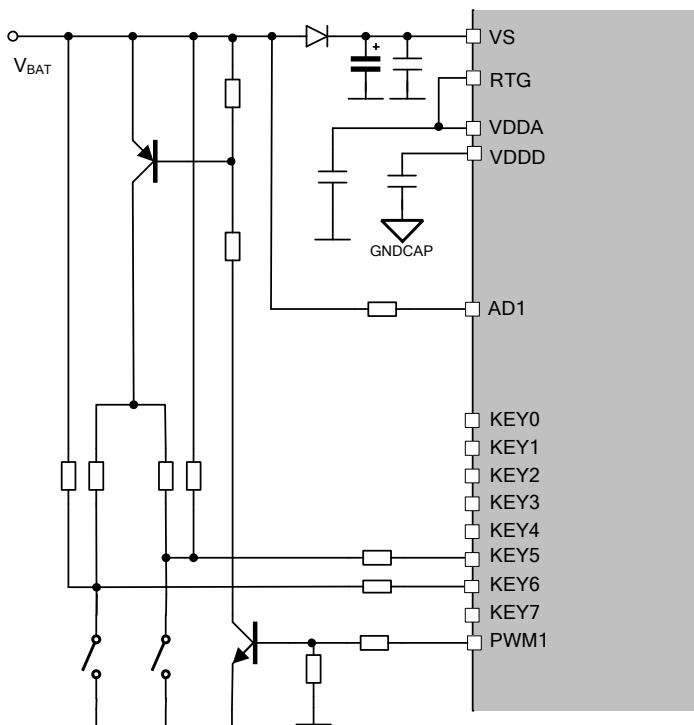
It is possible to use an external resonator in case a higher precision of the frequency is requested.



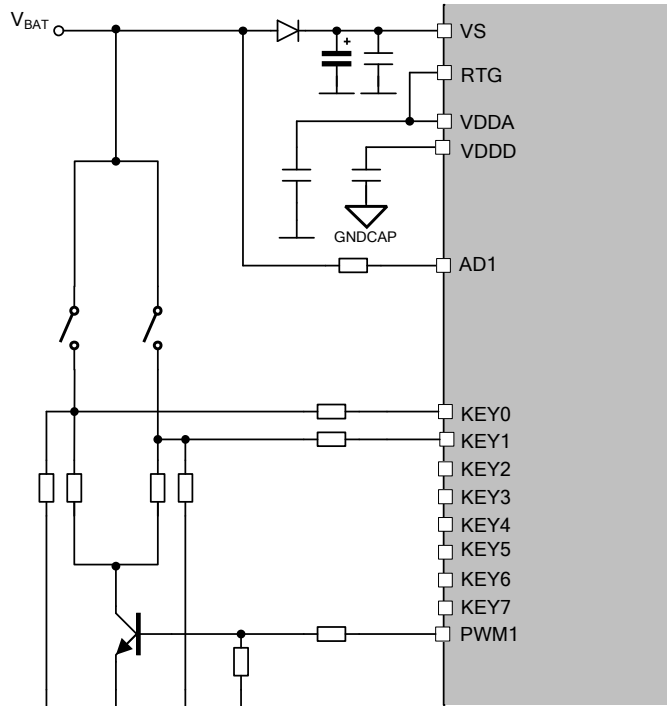
**Figure 8 – Principle application diagram using an external resonator**

### 4.8 Key inputs with different wetting currents in active and sleep configuration

Depending on different application requests for the key inputs it might be necessary to use in active mode relatively high wetting currents for the external switches. These currents will be provided by external pull up / pull down resistors. The IC will read the switches then with suitable threshold levels. In SLEEP MODE relatively low wetting currents might be necessary. These currents will also be provided by external pull up / pull down resistors. Wake up will be then just with a rising or falling edge of the incoming signal. An external bipolar transistor will just select the suitable series resistor for active mode or sleep mode.

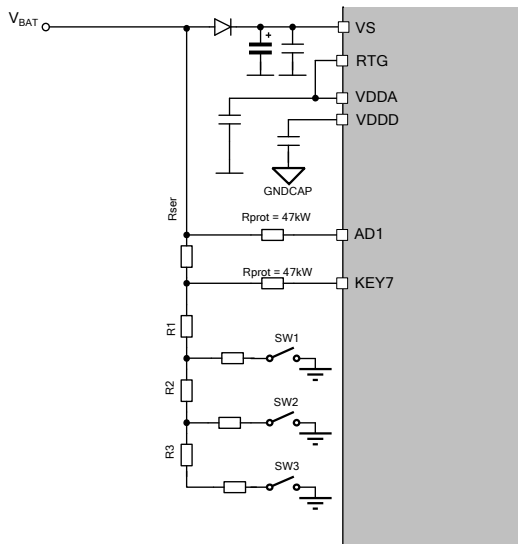


**Figure 9 – Principle application diagram using different wetting currents in active and sleep mode configuration, switches are related to GND; PWM1 pin provides steady state voltage level, pull up currents**



**Figure 10 – Principle application diagram using different wetting currents in active and sleep mode configuration, switches are related to supply; PWM1 pin provides steady state voltage level, pull down currents**

Via a 2-stage measurement, first at pin AD1 to check the  $V_{BAT}$  and second at pin KEY7, it is possible to check also the status of so called 'Matrix Switches'



**Figure 11 – Principle application diagram with matrix switch detection via KEY7 and AD1**



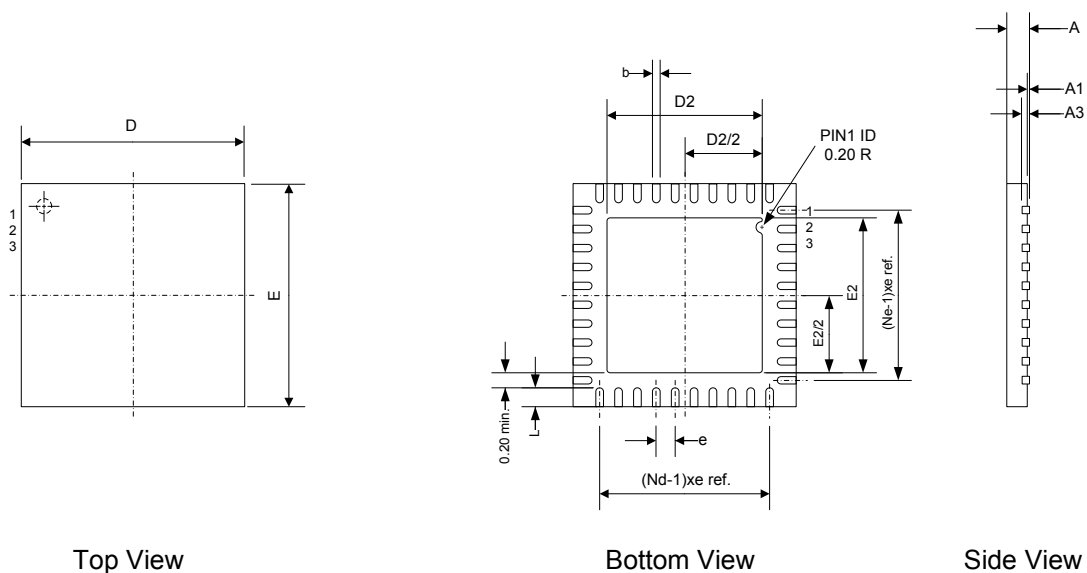
### 5. Mechanical Specification

#### 5.1 Package data QFN32 (5x5, 32 leads)

[1][2]	A	A1	A3	b	D	D2	E	E2	e	L	N[3]	ND [4]	NE[4]
min	0.80	0.00	0.20	0.18	5.00	3.50	5.00	3.50	0.50	0.3	32	8	8
nom	0.85	0.02		0.25		3.60		3.60		0.4			
max	1.00	0.05		0.30		3.70		3.70		0.5			

**Table 5: Mechanical Dimensions QFN32 5x5**

- [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 total number of terminals
- [4] ND and NE refer to the number of terminals on each D and E side respectively



**Figure 12: Package data QFN32**

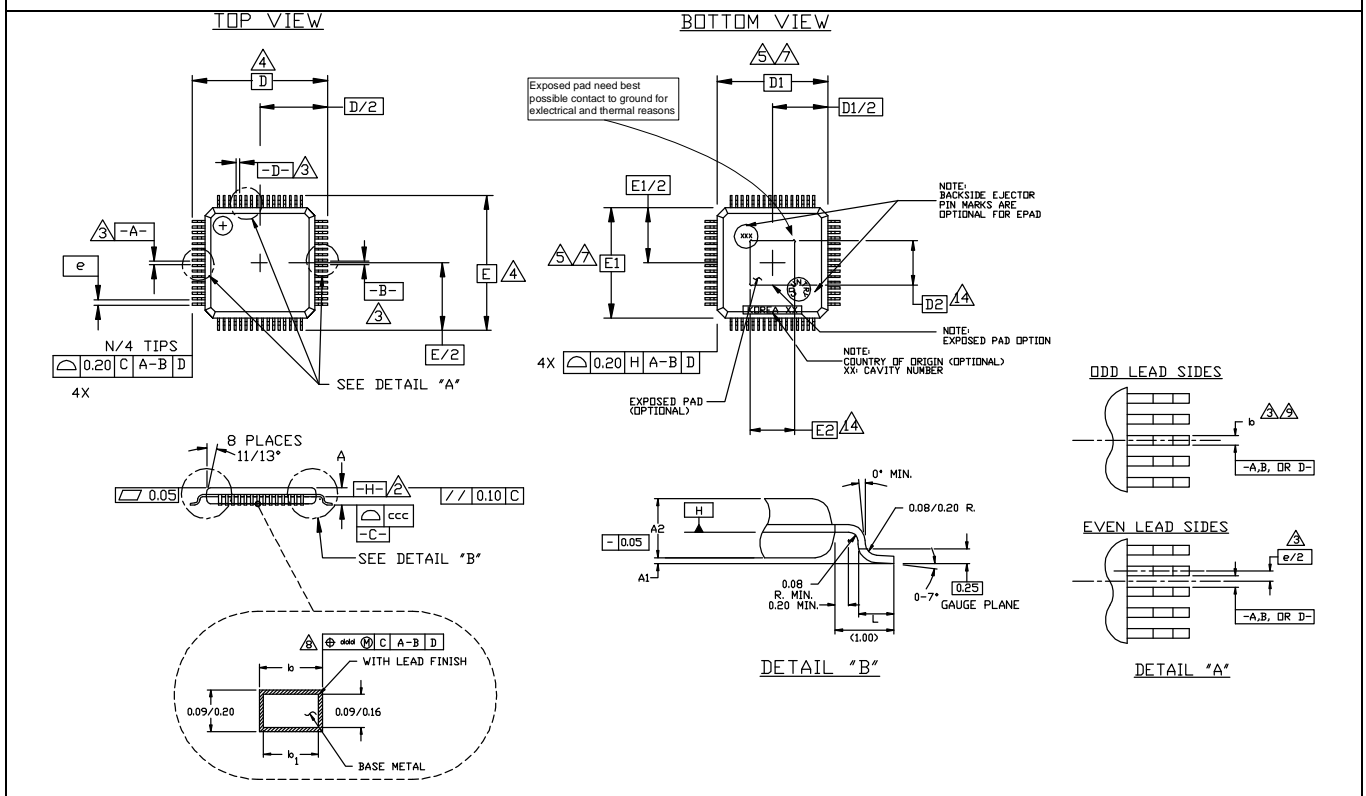
### 5.2 Package data TQFPeP 48L (7x7, 48 leads)

	A	A1	A2	b	b1	D	D1	D2	E	E1	E2	e	L	N	ccc	ddd
Min	-	0.05	0.95	0.17	0.17	9.00	7.00	4.00	9.00	7.00	4.00	0.50	0.45	48	-	-
Nom	-	-	1.00	0.22	0.20								0.60		-	-
Max	1.20	0.15	1.05	0.27	0.23								0.75		0.08	0.08

**Table 6: Mechanical Dimensions TQFPeP(48) 7x7**

**Notes:**

1. All Dimensioning and Tolerances conform to ASME Y14.5M-1994,
- Δ2. Datum Plane [-|-] located at Mould Parting Line and coincident with Lead, where Lead exists, plastic body at bottom of parting line.
- Δ3. Datum [A-B] and [-D-] to be determined at centreline between leads where leads exist, plastic body at datum plane [-|-]
- Δ4. To be determined at seating plane [-C-]
- Δ5. Dimensions D1 and E1 do not include Mould protrusion. Dimensions D1 and E1 do not include mould protrusion. Allowable mould protrusion is 0.254 mm on D1 and E1 dimensions.
6. 'N' is the total number of terminals
- Δ7. These dimensions to be determined at datum plane [-|-]
8. Package top dimensions are smaller than bottom dimensions and top of package will not overhang bottom of package.
- Δ9. Dimension b does not include dam bar protrusion, allowable dam bar protrusion shall be 0.08mm total in excess of the "b" dimension at maximum material condition, dam bar can not be located on the lower radius of the foot.
10. Controlling dimension millimeter.
11. maximum allowable die thickness to be assembled in this package family is 0.38mm
12. This outline conforms to JEDEC publication 95 Registration MS-026, Variation ABA, ABC & ABD.
- Δ13. A1 is defined as the distance from the seating plane to the lowest point of the package body.
- Δ14. Dimension D2 and E2 represent the size of the exposed pad. The actual dimensions are specified ion the bonding diagram, and are independent from die size.
15. Exposed pad shall be coplanar with bottom of package within 0.05.



**Figure 13: Package data TQFPeP48**

## 6. Marking/Order Code

### 6.1 Marking MLX81150

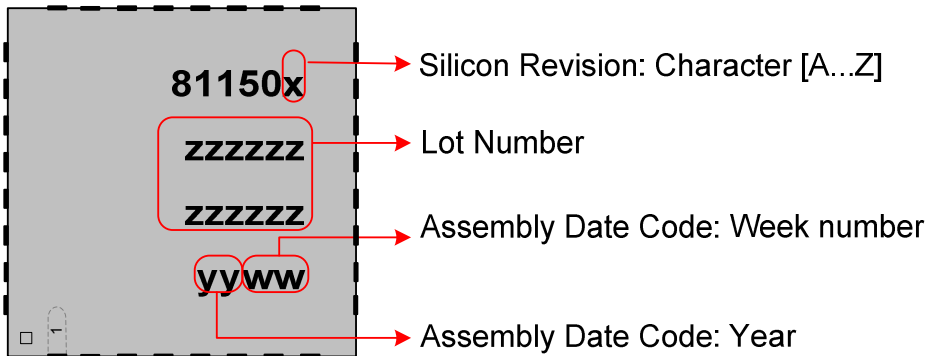


Figure 14: Marking example on IC package QFN32 5x5 package

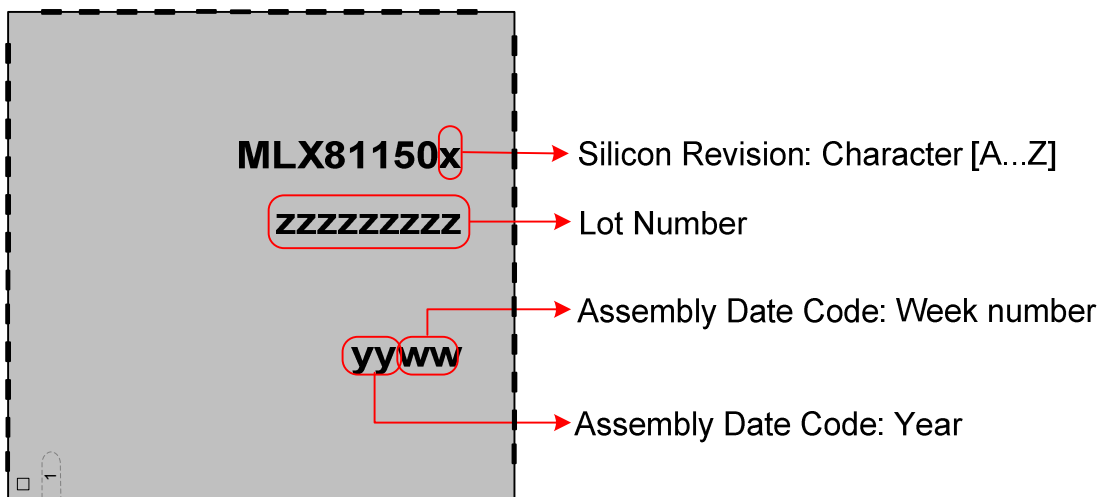
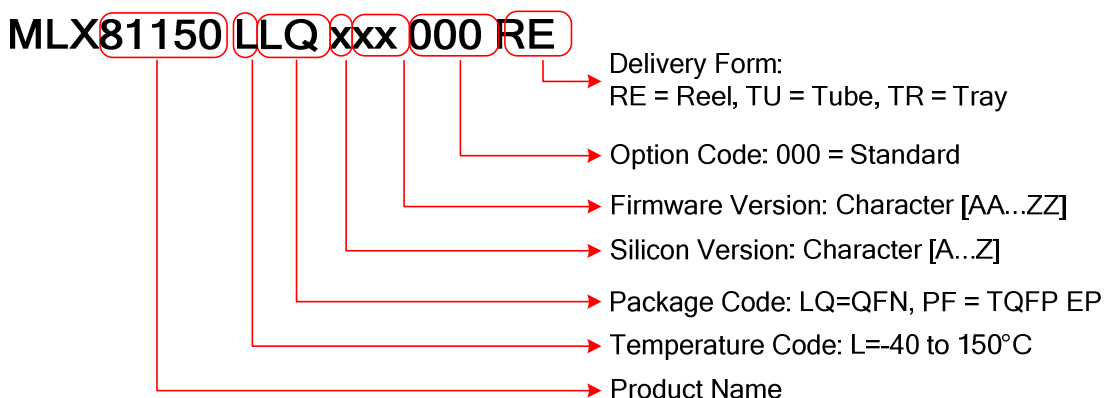


Figure 15: Marking example on IC package TQFP EP 7x7 package

### 6.2 Order Code MLX81150



## **7. 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 recommends reviewing on our web site the General Guidelines soldering recommendation ([http://www.melexis.com/Quality\\_soldering.aspx](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>

## **8. Disclaimer**

The product abstract just provides an overview of the described devices. Please consult the complete product specification/datasheet in its latest revision for any detailed information.

Devices sold by Melexis are covered by the warranty and patent indemnification provisions appearing in its Term of Sale. Melexis makes no warranty, express, statutory, implied, or by description regarding the information set forth herein or regarding the freedom of the described devices from patent infringement. Melexis reserves the right to change specifications and prices at any time and without notice. Therefore, prior to designing this product into a system, it is necessary to check with Melexis for current information. This product is intended for use in normal commercial applications. Applications requiring extended temperature range, unusual environmental requirements, or high reliability applications, such as military, medical life-support or life-sustaining equipment are specifically not recommended without additional processing by Melexis for each application.

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