

Features and Benefits

Absolute Rotary & Linear Position Sensor IC

Triaxis® Hall Technology

Simple Magnetic Design

Programmable Transfer Characteristic (Multi-Points – Piece-Wise-Linear)

Selectable Output Mode: Analog (Ratiometric) – Pulse Width Modulation (PWM)

12 bit Resolution - 10 bit Thermal Accuracy

Open/Short Diagnostics

On Board Diagnostics

Over-Voltage Protection

Under-Voltage Detection

48 bit ID Number option

Automotive Temperature Range

AEC-Q100 Qualified

Single Die – SOIC-8 Package RoHS Compliant

Dual Die (Full Redundant) – TSSOP-16 Package RoHS Compliant

Triaxis®



Applications

Absolute Rotary Position Sensor Absolute Linear Position Sensor

Pedal Position Sensor Steering Wheel Position Sensor

Throttle Position Sensor Float-Level Sensor

Ride Height Position Sensor Non-Contacting Potentiometer

Ordering Information

Part No.	Temperature Suffix	Package Code	Die Revision	Option code	Packing
MLX90365	E (– 40°C to + 85°C)	DC [SOIC-8]	ABD	000 ¹	RE
MLX90365	E (– 40°C to + 85°C)	DC [SOIC-8]	ABD	000	TU
MLX90365	K (– 40°C to + 125°C)	DC [SOIC-8]	ABD	000	RE
MLX90365	K (– 40°C to + 125°C)	DC [SOIC-8]	ABD	000	TU
MLX90365	L (– 40°C to + 150°C)	DC [SOIC-8]	ABD	000	RE
MLX90365	L (– 40°C to + 150°C)	DC [SOIC-8]	ABD	000	TU
MLX90365	L (– 40°C to + 150°C)	DC [SOIC-8]	ABD	200	RE
MLX90365	L (– 40°C to + 150°C)	DC [SOIC-8]	ABD	200	TU
MLX90365	E (– 40°C to + 85°C)	GO [TSSOP-16]	ABD	000	RE
MLX90365	E (– 40°C to + 85°C)	GO [TSSOP-16]	ABD	000	TU
MLX90365	K (– 40°C to + 125°C)	GO [TSSOP-16]	ABD	000	RE
MLX90365	K (– 40°C to + 125°C)	GO [TSSOP-16]	ABD	000	TU
MLX90365	L (– 40°C to + 150°C)	GO [TSSOP-16]	ABD	000	RE
MLX90365	L (– 40°C to + 150°C)	GO [TSSOP-16]	ABD	000	TU

Legend:

Temperature Code:	E for Temperature Range -40°C to 85°C K for Temperature Range -40°C to 125°C L for Temperature Range -40°C to 150°C
Package Code:	DC for SOIC-8 Package GO for TSSOP-16 Package (Dual Die – Full Redundant)
Option Code:	XXX-000 – Standard XXX-200 – Preprogrammed – See Section 13 for Default Settings.
Packing Form:	RE for Reel TU for Tube
Ordering example:	MLX90365EDC-ABD-000-RE

¹ Other option code and packing form are available; see your sales representative for more details

1. Functional Diagram

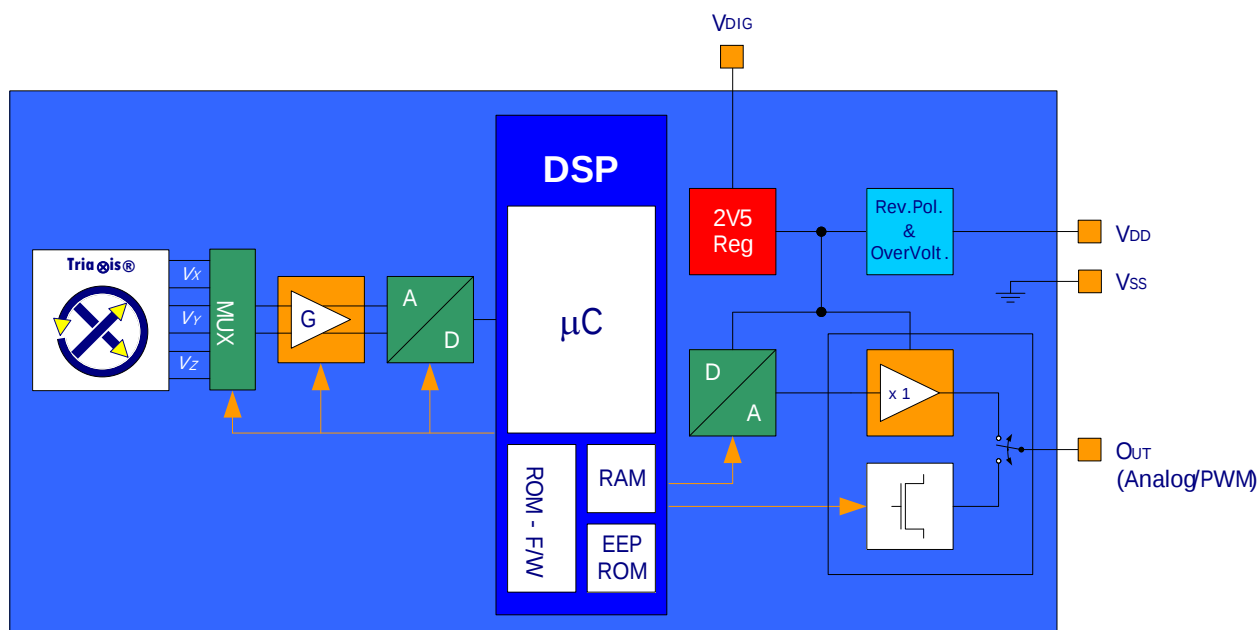


Figure 1 - MLX90365 Block Diagram

2. Description

The MLX90365 is a monolithic sensor IC sensitive to the flux density applied orthogonally and parallel to the IC surface.

The MLX90365 is sensitive to the three components of the flux density applied to the IC (i.e. B_x , B_y and B_z). This allows the MLX90365 with the correct magnetic circuit to decode the absolute position of any moving magnet (e.g. rotary position from 0 to 360 Degrees or linear displacement, stroke - Figure 2). It enables the design of novel generation of non-contacting position sensors that are frequently required for both automotive and industrial applications.

MLX90365 reports a programmable ratiometric analog output signal compatible with any resistive potentiometer or programmable linear Hall sensor. Through programming, the MLX90365 provides also a digital PWM (Pulse Width Modulation) output characteristic.

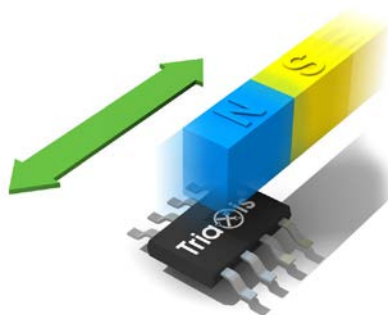


Figure 2 - Typical application of MLX90365 – Linear

TABLE of CONTENTS

FEATURES AND BENEFITS	1
APPLICATIONS.....	1
ORDERING INFORMATION.....	2
1. FUNCTIONAL DIAGRAM.....	3
2. DESCRIPTION.....	3
3. GLOSSARY OF TERMS – ABBREVIATIONS – ACRONYMS	6
4. PINOUT	6
5. ABSOLUTE MAXIMUM RATINGS	7
6. DESCRIPTION.....	7
7. MLX90365 ELECTRICAL SPECIFICATION.....	9
8. MLX90365 ISOLATION SPECIFICATION	11
9. MLX90365 TIMING SPECIFICATION	11
10. MLX90365 ACCURACY SPECIFICATION	13
11. MLX90365 MAGNETIC SPECIFICATION	16
12. MLX90365 CPU & MEMORY SPECIFICATION	16
13. MLX90365 END-USER PROGRAMMABLE ITEMS.....	17
14. DESCRIPTION OF END-USER PROGRAMMABLE ITEMS.....	18
14.1. OUTPUT MODES.....	18
14.1.1. OUT mode	18
14.1.2. PWM Output Mode.....	18
14.2. OUTPUT TRANSFER CHARACTERISTIC.....	19
14.2.1. Enable scaling Parameter (only for LNR type 4 pts)	19
14.2.2. CLOCKWISE Parameter.....	19
14.2.3. Discontinuity Point (or Zero Degree Point).....	20
14.2.4. 4-Pts LNR Parameters.....	20
14.2.5. 17-Pts LNR Parameters.....	21
14.2.6. CLAMPING Parameters	22
14.3. IDENTIFICATION	22
14.4. LOCK.....	22
14.5. SENSOR FRONT-END	22
14.5.1. MAPXYZ.....	22
14.5.2. SMISM, k and SEL_k Parameters	23
14.5.3. GAINMIN and GAINMAX Parameters	23
14.6. FILTER	23
14.6.1. Hysteresis Filter	24
14.6.2. FIR Filters.....	24
14.7. PROGRAMMABLE DIAGNOSTIC SETTINGS	25
14.7.1. DIAG mode.....	25
14.7.2. DIAG Level.....	25
14.7.3. Field Strength Diagnostic	26
14.7.4. PWM Diagnostic	26
14.7.5. Diagnostic Features	26
14.8. EEPROM ENDURANCE	26
15. MLX90365 SELF DIAGNOSTIC.....	27
16. RECOMMENDED APPLICATION DIAGRAMS.....	29

16.1.	WIRING WITH THE MLX90365 IN SOIC-8 PACKAGE	29
16.2.	WIRING WITH THE MLX90365 IN TSSOP-16 PACKAGE	29
17.	STANDARD INFORMATION REGARDING MANUFACTURABILITY OF MELEXIS PRODUCTS WITH DIFFERENT SOLDERING PROCESSES	30
18.	ESD PRECAUTIONS.....	30
19.	PACKAGE INFORMATION.....	31
19.1.	SOIC8 - PACKAGE DIMENSIONS	31
19.2.	SOIC8 - PINOUT AND MARKING	31
19.3.	SOIC8 - SENSITIVE SPOT POSITIONING	32
19.4.	TSSOP16 - PACKAGE DIMENSIONS	33
19.5.	TSSOP16 - PINOUT AND MARKING	34
19.6.	TSSOP16 - SENSITIVE SPOT POSITIONING	34
20.	DISCLAIMER.....	36

3. Glossary of Terms – Abbreviations – Acronyms

- Gauss (G), Tesla (T): Units for the magnetic flux density – 1 mT = 10 G
- TC: **T**emperature **C**oefficient (in ppm/Deg.C.)
- NC: **N**ot **C**onnected
- PWM: **P**ulse **W**idth **M**odulation
- %DC: **D**uty **C**ycle of the output signal i.e. $T_{ON} / (T_{ON} + T_{OFF})$
- ADC: **A**nalog-to-**D**igital **C**onverter
- DAC: **D**igital-to-**A**nalog **C**onverter
- LSB: **L**east **S**ignificant **B**it
- MSB: **M**ost **S**ignificant **B**it
- DNL: **D**ifferential **N**on-**L**inearity
- INL: **I**ntegral **N**on-**L**inearity
- RISC: **R**educed **I**nstruction **S**et **C**omputer
- ASP: **A**nalog **S**ignal **P**rocessing
- DSP: **D**igital **S**ignal **P**rocessing
- EMC: **E**lectro-**M**agnetic **C**ompatibility
- IMC: **I**ntegrated-**M**agneto **C**oncentrator
- MT3V: **M**ore **T**han **3V** internal analog voltage check

4. Pinout

Pin #	SOIC-8	TSSOP-16
1	VDD	VDIG ₁
2	Test 0	VSS ₁ (Ground ₁)
3	Test 2	VDD ₁
4	Not Used	Test 0 ₁
5	OUT	Test 2 ₂
6	Test 1	OUT ₂
7	VDIG	Not Used ₂
8	VSS (Ground)	Test 1 ₂
9		VDIG ₂
10		VSS ₂ (Ground ₂)
11		VDD ₂
12		Test 0 ₂
13		Test 2 ₁
14		Not Used ₁
15		OUT ₁
16		Test 1 ₁

For optimal EMC behavior, it is recommended to connect the unused pins (Not Used and Test) to the Ground (see section 16).

5. Absolute Maximum Ratings

Parameter	Value
Supply Voltage, V _{DD} (overvoltage)	+ 24 V
Reverse Voltage Protection	– 12 V (breakdown at -14 V)
Positive Output Voltage	+ 18 V (breakdown at 24 V)
Output Current (I _{OUT})	+ 30 mA (in breakdown)
Reverse Output Voltage	– 0.3 V
Reverse Output Current	– 50 mA (in breakdown)
Operating Ambient Temperature Range, T _A	– 40°C ... + 150°C
Storage Temperature Range, T _S	– 40°C ... + 150°C
Magnetic Flux Density	± 1 T

Exceeding the absolute maximum ratings may cause permanent damage. Exposure to absolute maximum rated conditions for extended periods may affect device reliability.

6. Description

As described on the block diagram the three vector components of the magnetic flux density (B_x, B_y and B_z) applied to the IC are sensed through the sensor front-end. The respective Hall signals (V_x, V_y and V_z) are generated at the Hall plates and amplified.

The analog signal processing is based on a fully differential analog chain featuring the classic offset cancellation technique (Hall plate 2-Phases spinning and chopper-stabilized amplifier).

The conditioned analog signals are converted through an ADC (15 bits) and provided to a DSP block for further processing. The DSP stage is based on a 16 bit RISC micro-controller whose primary function is the extraction of the position from two (out of three) raw signals (after so-called front-end compensation steps) through the following function:

$$\alpha = \angle(V_1, k \cdot V_2)$$

where alpha is the magnetic angle $\angle(B_1, B_2)$, V₁ = V_x or V_y or V_z, V₂ = V_x or V_y or V_z and k is a programmable factor to match the amplitude of V₁ and k V₂.

The DSP functionality is governed by the micro-code (firmware – F/W) of the micro-controller which is stored into the ROM (mask programmable). In addition to the magnetic angle extraction, the F/W controls the whole analog chain, the output transfer characteristic, the output protocol, the programming/calibration and also the self-diagnostic modes.

The magnetic angular information is intrinsically self-compensated vs. flux density variations. This feature allows therefore an improved thermal accuracy vs position sensor based on conventional linear Hall sensors.

In addition to the improved thermal accuracy, the realized position sensor features excellent linearity performances taking into account typical manufacturing tolerances (e.g. relative placement between the Hall IC and the magnet).

Once the position (angular or linear stroke) information is computed, it is further conditioned (mapped) vs. the target transfer characteristic and it is provided at the output(s) as either a ratiometric analog output level through a 12 bit DAC followed by a buffer or a digital PWM output.

For instance, the analog output can be programmed for offset, gain and clamping to meet any rotary position sensor output transfer characteristic:

$$\begin{array}{ll} V_{out}(\alpha) = \text{ClampLo} & \text{for } \alpha \leq \alpha_{min} \\ V_{out}(\alpha) = V_{offset} + \text{Gain} \times \alpha & \text{for } \alpha_{min} \leq \alpha \leq \alpha_{max} \\ V_{out}(\alpha) = \text{ClampHi} & \text{for } \alpha \geq \alpha_{max} \end{array}$$

where V_{offset} , Gain, ClampLo and ClampHi are the main adjustable parameters for the end-user.

The linear part of the transfer curve can be adjusted through a multi-point calibration:

This back-end step consists into either

- up to 4 arbitrary points (5 segments + clamping levels) calibration or
- a Piece-Wise-Linear (PWL) output transfer characteristics - 17 equidistant points w/ programmable origin over 16 different angle ranges from 65 to 360 degrees.

The calibration parameters are stored in EEPROM featuring a Hamming Error Correction Coding (ECC).

The programming steps do not require any dedicated pins. The operation is done using the supply and output nodes of the IC. The programming of the MLX90365 is handled at both engineering lab and production line levels by the Melexis Programming Unit PTC-04 with the dedicated MLX90316 daughterboard and software tools (DLL – User Interface).

7. MLX90365 Electrical Specification

DC Operating Parameters at $V_{DD} = 5V$ (unless otherwise specified) and for T_A as specified by the Temperature suffix (E or K or L).

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Nominal Supply Voltage	VDD		4.5	5	5.5	V
Supply Current ⁽²⁾	I _{dd}				10	mA
Isurge Current ⁽³⁾	I _{surge}				20	mA
Power-On reset (rising)	HPOR_LH	Refer to internal voltage Vdig	2	2.25	2.5	V
Power-On reset Hysteresis	HPOR_Hyst		50		200	mV
Start-up Level (rising)	MT4V_LH		3.8	4.0	4.2	V
Start-up Hysteresis	MT4V_Hyst		50		200	mV
PTC Entry Level (rising)	MT7V_LH		5.8	6.2	6.6	V
PTC Entry Level Hysteresis	MT7V_Hyst		50		200	mV
Output Short Circuit Current	I _{short}	V _{out} = 0 V V _{out} = 5 V V _{out} = 18 V (T _A = 25°C)			15 15 18	mA mA mA
Output Load	R _L	Pull-down to Ground Pull-up to 5V	4.7 4.7	10 10	∞ ∞	kΩ kΩ
Analog Saturation Output Level	V _{sat_lo}	Pull-up load R _L ≥ 10 kΩ to 5 V Pull-up load R _L ≥ 5 kΩ to 18V		0.5 2	2 3	%VDD
	V _{sat_hi}	Pull-down load R _L ≥ 5 kΩ Pull-down load R _L ≥ 10 kΩ	94 96	96 98		%VDD
Active Diagnostic Output Level Digital Saturation Output Level	D _{sat_lo}	Pull-up load R _L ≥ 10 kΩ to 5 V Pull-up load R _L ≥ 5 kΩ to 18V		0.5 2	2 3	%VDD
	D _{sat_hi}	Pull-down load R _L ≥ 5 kΩ Pull-down load R _L ≥ 10 kΩ	94 96	96 98		%VDD
Passive Diagnostic Output Level (Broken Track Diagnostic) ⁽⁴⁾	BV _{ssPD}	Broken V _{ss} & Pull-down load R _L ≥ 10 kΩ	97.5			%VDD
	BV _{ssPU}	Broken V _{ss} & Pull-up load R _L ≥ 1kΩ	99.5	100		%VDD
	BV _{DDPD}	Broken V _{DD} & Pull-down load R _L ≥ 1kΩ		0	0.5	%VDD
	BV _{DDPU}	Broken V _{DD} & Pull-up load R _L ≥ 5kΩ			2	%VDD
Clamped Output Level	Clamp_lo	Programmable	0		100	%VDD ⁽⁵⁾
	Clamp_hi	Programmable	0		100	%VDD ⁽⁶⁾

² For the dual version, the supply current is multiplied by 2.

³ The specified value is valid during early start-up time only; the current might dynamically exceed the specified value, shortly, during the Start-up phase.

⁴ For detailed information, see also section 15

⁵ Clamping levels need to be considered vs the saturation of the output stage (see V_{sat_lo} and V_{sat_hi})

As an illustration of the previous table, the MLX90365 fits the typical classification of the output span described on the Figure 6.

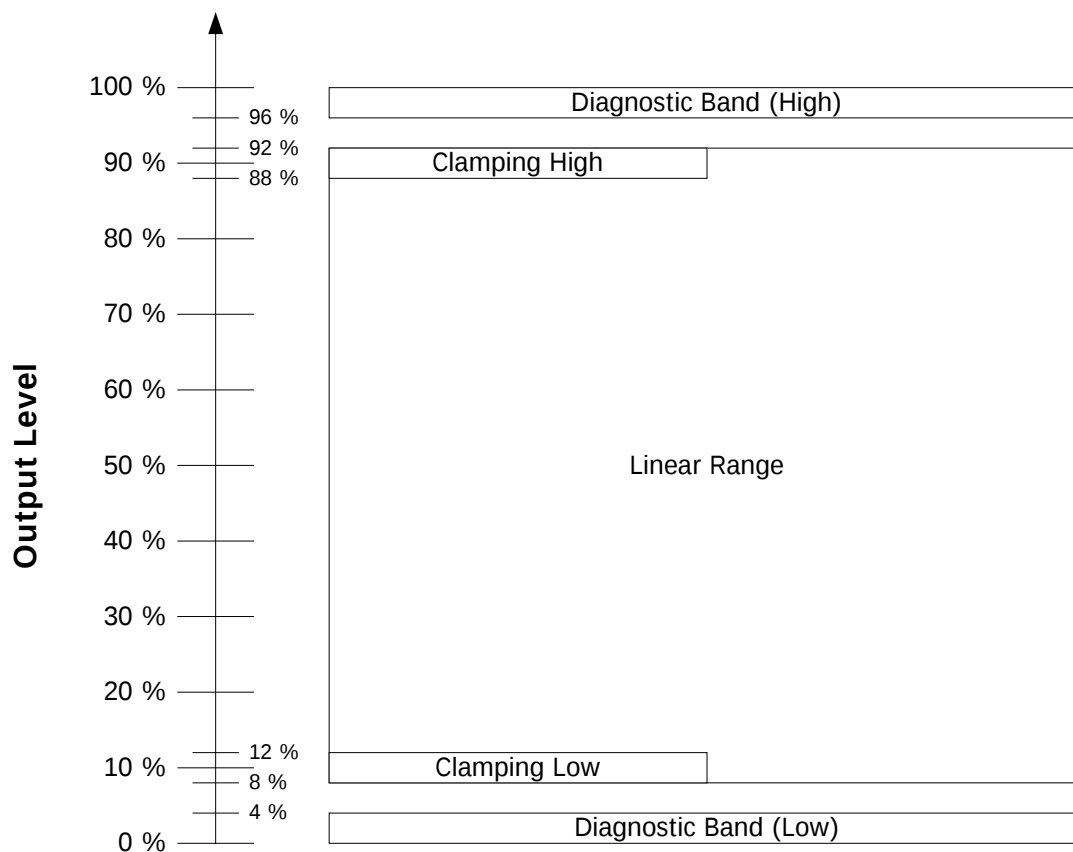


Figure 6 – Example of Output Span Classification for typical application.

8. MLX90365 Isolation Specification

DC Operating Parameters at $V_{DD} = 5V$ (unless otherwise specified) and for T_A as specified by the Temperature suffix (E or K or L). Only valid for the package code GO i.e. dual die version.

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Isolation Resistance		Between 2 dies	4			MΩ

9. MLX90365 Timing Specification

ANALOG OUTPUT - DC Operating Parameters at $V_{DD} = 5V$ (unless otherwise specified) and for T_A as specified by the Temperature suffix (E or K or L).

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Main Clock Frequency	Ck	All contributors included thermal drift	12.6	13.3	14	MHz
Main Clock Frequency Thermal Drift	ΔT_{Ck}				$\pm 3\%$	Ck _{NOM}
Refresh Rate			281	290	299	μs
Step Response Time	Ts	Filter=0 ⁽⁶⁾	844	870	896	μs
		Filter=1	1125	1160	1195	
		Filter=2	1407	1450	1494	
Watchdog	Twd		114.5	118	121.5	ms
Start-up Cycle	Tsu	Analog OUT Slew-rate excluded			5	ms
Analog OUT Slew-rate		Mode 1 from C _{OUT} = 47 nF to 330 nF	25	37		V/ms
		Mode 2 up to C _{OUT} = 10 nF	300	320		
		Mode 3 up to C _{OUT} = 47 nF	17	19		
		Mode 4 up to C _{OUT} = 330 nF	1.8	2.5		

⁶ See section 14 for details concerning Filter parameter

PWM OUTPUT - DC Operating Parameters at $V_{DD} = V_{PU} = 5V$ (unless otherwise specified) and for T_A as specified by the Temperature suffix L.

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
PWM Frequency	F_{PWM}	Programmable Range (PWM Output Enabled)	100		1000	Hz
		Initial Tolerance (25 Deg.C.)			$\pm 2\%$	F_{PWM}
		After EOL tuning (25 Deg.C.)			$\pm 1\%$	F_{PWM}
		Thermal/Lifetime drift			$\pm 3\%$	F_{PWM}
Digital Output Rise Time		LSD – Mode 5				
		4.7nF, $R_L = 1\text{ k}\Omega$ PU		10	12	μs
		4.7nF, $R_L = 10\text{ k}\Omega$ PU		100	120	μs
		10nF, $R_L = 1\text{ k}\Omega$ PU		20	24	μs
		PP – Mode 7				
		4.7nF, $R_L = 1\text{ k}\Omega$ PU		3	5	μs
		4.7nF, $R_L = 10\text{ k}\Omega$ PU		3	5	μs
		10nF, $R_L = 1\text{ k}\Omega$ PU		4	7	μs
Digital Output Fall Time		LSD – Mode 5				
		4.7nF, $R_L = 1\text{ k}\Omega$ PU		2	3	μs
		4.7nF, $R_L = 10\text{ k}\Omega$ PU		2	3	μs
		10nF, $R_L = 1\text{ k}\Omega$ PU		4	7	μs
		PP – Mode 7				
		4.7nF, $R_L = 1\text{ k}\Omega$ PU		2	3	μs
		4.7nF, $R_L = 10\text{ k}\Omega$ PU		2	3	μs
		10nF, $R_L = 1\text{ k}\Omega$ PU		4	7	μs

10. MLX90365 Accuracy Specification

ANALOG OUTPUT - DC Operating Parameters at $V_{DD} = 5V$ (unless otherwise specified) and for T_A as specified by the Temperature suffix (E or K or L).

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
ADC Resolution on the raw signals sine and cosine ⁽⁷⁾	R_{ADC}			15		bits
Thermal Offset Drift #1 ⁽⁸⁾ at the DSP input (excl. DAC and output stage)		Temperature suffix E Temperature suffix K Temperature suffix L	-60 -60 -90		+60 +60 +90	LSB ₁₅
Thermal Offset Drift #2 (DAC and Output Stage)			-0.2		+0.2	%VDD
Thermal Drift of Sensitivity Mismatch ⁽⁹⁾		XY axis – Temp. suffix E XY axis – Temp. suffix K & L XZ (YZ) axis – Temp. suffix E XZ (YZ) axis – Temp. suffix K & L	-0.3 -0.5 -1 -1		+0.3 +0.5 +1 +1	%
Magnetic Angle phase error		$T_A = 25^\circ C$ – XY axis $T_A = 25^\circ C$ – XZ axis $T_A = 25^\circ C$ – YZ axis	-0.3 -2 -2		0.3 2 2	Deg.
Thermal Drift of Magnetic Angle phase error		XY axis, XZ (YZ) axis		0.01		Deg.
XY – Intrinsic Linearity Error ⁽¹⁰⁾	Le	$T_A = 25^\circ C$ – factory trim. “SMISM”	-1		1	Deg
XZ - Intrinsic Lin. Error ⁽¹¹⁾	Le	$T_A = 25^\circ C$ – “k” trimmed for XZ	-2.5	± 1.25	+2.5	Deg
YZ - Intrinsic Lin. Error ⁽¹¹⁾	Le	$T_A = 25^\circ C$ – “k” trimmed for YZ	-2.5	± 1.25	+2.5	Deg
Analog Output Resolution	R_{DAC}	12b DAC (Theoretical, Noise free) INL (before EOL calibration) DNL	-4 0.05	0.025 1	+4 3	%VDD/LSB ₁₂ LSB ₁₂ LSB ₁₂
Output stage Noise		Clamped Output		0.05	0.075	%VDD
Noise pk-pk ⁽¹¹⁾		Filter = 0, 40mT Filter = 2, 20mT		0.10 0.10	0.2 0.2	Deg
Ratiometry Error (Analog output only)		$4.5V \leq V_{DD} \leq 5.5V$ $LT4V \leq V_{DD} \leq MT7V$	-0.05 -0.1		+0.05 +0.1	%VDD

⁷ 16 bits corresponds to 15 bits + sign. Internal computation is performed using 16 bits.

⁸ For instance, in case of a rotary position sensor application, Thermal Offset Drift #1 equal $\pm 60\text{LSB}_{15}$ yields to max. ± 0.3 Deg. angular error for the computed angular information (output of the DSP). This is only valid if $k = 1$. “MLX90365 Front-End Application Note” will be released for more details.

⁹ For instance, in case of a rotary position sensor application, Thermal Drift of Sensitivity Mismatch equal $\pm 0.5\%$ yields to max. ± 0.15 Deg. angular error for the computed angular information (output of the DSP).

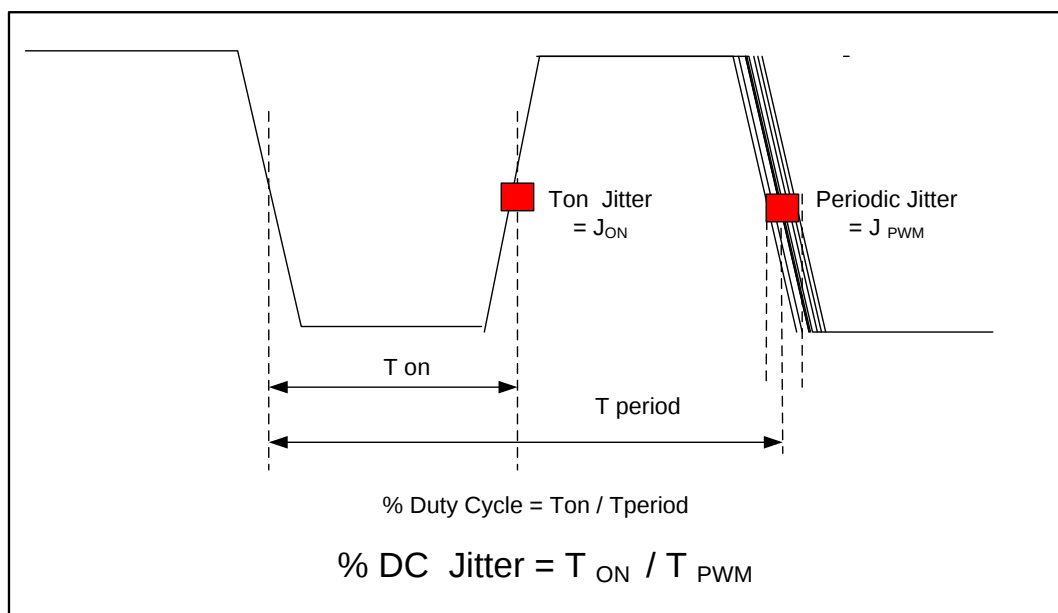
¹⁰ The Intrinsic Linearity Error refers to the IC itself (offset, sensitivity mismatch, orthogonality) taking into account an ideal rotating field for B_x and B_y . Once associated to a practical magnetic construction and the associated mechanical and magnetic tolerances, the output linearity error increases. However, it can be improved with the multi-point end-user calibration.

¹¹ Noise pk-pk (peak-to-peak) is here intended as 6 times the Noise standard Deviation. The application diagram used is described in the recommended wiring. For detailed information, refer to section Filter in application mode (Section 14).

PWM OUTPUT - DC Operating Parameters at $V_{DD} = V_{PU} = 5V$ (unless otherwise specified) and for T_A as specified by the Temperature suffix L.

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
PWM Output Resolution	R_{PWM}	12 bits		0.025		%DC/LSB
PWM % DC Jitter	J_{DC}	LSD – Mode5 100Hz, 4.7nF, $R_L = 1\text{ k}\Omega$ PU 200Hz, 4.7nF, $R_L = 1\text{ k}\Omega$ PU 1000Hz, 4.7nF, $R_L = 1\text{ k}\Omega$ PU PP – Mode7 100Hz, 4.7nF, $R_L = 1\text{ k}\Omega$ PU 200Hz, 4.7nF, $R_L = 1\text{ k}\Omega$ PU 1000Hz, 4.7nF, $R_L = 1\text{ k}\Omega$ PU		±0.003 ±0.005 ±0.009 ±0.003 ±0.005 ±0.009	±0.016 ±0.02 ±0.035 ±0.016 ±0.02 ±0.035	%DC
PWM Freq Jitter	J_{PWM}	LSD – Mode5 100-1000 Hz, 4.7nF, $R_L = 1\text{ k}\Omega$ PU PP – Mode7 100-1000 Hz, 4.7nF, $R_L = 1\text{ k}\Omega$ PU		±0.04 ±0.04	±0.15 ±0.15	Hz
PWM % DC thermal drift		LSD – Mode5 100Hz, 4.7nF, $R_L = 1\text{ k}\Omega$ PU 200Hz, 4.7nF, $R_L = 1\text{ k}\Omega$ PU 1000Hz, 4.7nF, $R_L = 1\text{ k}\Omega$ PU PP – Mode7 100Hz, 4.7nF, $R_L = 1\text{ k}\Omega$ PU 200Hz, 4.7nF, $R_L = 1\text{ k}\Omega$ PU 1000Hz, 4.7nF, $R_L = 1\text{ k}\Omega$ PU		±0.02 ±0.02 ±0.02 ±0.02 ±0.02 ±0.02	±0.03 ±0.03 ±0.05 ±0.03 ±0.03 ±0.05	%DC
PWM % DC Level drift (Trigger level= 25/50/75%)		LSD – Mode5 100Hz, 4.7nF, $R_L = 1\text{ k}\Omega$ PU PP – Mode7 100Hz, 4.7nF, $R_L = 1\text{ k}\Omega$ PU		±0.1 ±0.05	±0.15 ±0.1	%DC
PWM % DC Level drift		100Hz – PP Application Diagram (see below) $R_s = 0, 50, 100, 150\text{ Ohm}$ Tolerance on $R \pm 20\%$ Tolerance on $C \pm 30\%$		±0.05	±0.1	%DC

Jitter is defined by $\pm 3 \sigma$ for 1000 successive acquisitions with clamped output, see also jitter definition.



Parameter	Symbol	Test Conditions
PWM TON, Tperiod	T_{ON} T_{PWM}	Trigger level = 50 % Vpp
Rise time, Fall time		10% and 90% of amplitude
Jitter	J_{on} J_{period}	$\pm 3 \sigma$ for 1000 successive acquisitions
Duty Cycle	% DC	T_{on} / T_{Period}

Figure 7 – MLX90365 PWM measurement conditions.

11. MLX90365 Magnetic Specification

DC Operating Parameters at VDD = 5V (unless otherwise specified) and for TA as specified by the Temperature suffix (E or K or L).

Magnetic Flux Density	$B_X, B_Y^{(12)}$	$\sqrt{B_X^2 + B_Y^2}$			70 ⁽¹³⁾	mT
Magnetic Flux Density	$B_Z^{(14)}$				126	mT
Magnetic Flux Norm	Norm	$\sqrt{B_X^2 + B_Y^2 + (B_Z/1.2)^2}$	20 ⁽¹²⁾			mT
IMC Gain ⁽¹⁵⁾	GainIMC		1.2	1.3	1.4	
Magnet Temperature Coefficient	TCm		-2400		0	ppm/°C

12. MLX90365 CPU & Memory Specification

The DSP is based on a 16 bit RISC µController. This CPU provides 2.5 Mips while running at 10 MHz.

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
ROM				10		KB
RAM				384		B
EEPROM				128		B

¹² The condition must be fulfilled for at least one field BX or BY.

¹³ Above 70 mT, the IMC® starts saturating yielding to an increase of the linearity error.

¹⁴ Below 20 mT, the performances slightly degrade due to a reduction of the signal-to-noise ratio, signal-to-offset ratio.

¹⁵ This is the magnetic gain linked to the Integrated Magneto Concentrator (IMC®) structure. It applies to BX and BY and not to BZ. This is the overall variation. Within one lot, the part to part variation is typically $\pm 10\%$ versus the average value of the IMC® gain of that lot

13. MLX90365 End-User Programmable Items

Parameter	Comments	Default Values		
		Standard	PPAR	# bit
OUT mode	Define the output stage mode	1	1	3
DIAG mode	Diagnostic mode	7	7	3
DIAG Level	Diagnostic Level	0	0	1
MAPXYZ	Mapping fields for output angle	0	0	2
CLAMP_HIGH	Clamping High (50%)	50%	10%	16
CLAMP_LOW	Clamping Low (50%)	50%	90%	16
FILTER	Filter mode selection	0	1	2
SMISM	Sensitivity mismatch factor X,Y	MLX	MLX	15
k	Sensitivity mismatch factor X (Y) , Z	MLX	N/A	15
SEL_k	Affected signal component by k: B1 or B2 (in combination of MAPXYZ)	0	0	1
GAINMIN	Low threshold for virtual gain	00h	00h	8
GAINMAX	High threshold for virtual gain	28h	28h	8
GAINSATURATION	Gain Saturates on GAINMIX and GAINMAX	0h	0h	1
FIELDTHRESH_Low	Field limit under which a fault is reported	10mT	10mT	8
FIELDTHRESH_High	Field limit above which a fault is reported	FFh	FFh	8
PWM	PWM function	0h	N/A	1
PWMPOL	PWM polarity	0h	N/A	1
PWMT	PWM Frequency (trimmed at 200Hz)	MLX	N/A	8
DC_FAULT	PWM Duty Cycle if Fault	1h	N/A	8
DC_FTL	PWM Duty Cycle if Field Strength Too Low	1h	N/A	8
DC_WEAK	PWM Duty Cycle if Weak Magnet	1h	N/A	8
WEAKMAGTHRESH	Weak Magnet threshold Byte (1lsb = 1mT)	0h	N/A	8
DP	Discontinuity point	0h	0h	15
CW	Clock Wise	0h	0h	1
FHYST	Hysteresis filter	0h	0h	8
MELEXISID1	Melexis identification reference	MLX	MLX	16
MELEXISID2	Melexis identification reference	MLX	MLX	16
MELEXISID3	Melexis identification reference	MLX	MLX	16
4POINTS	Selection of correction method 4 or 16 pts	1h	1h	1
LNR_S0	4pts – Initial Slope	0 %/deg	0 %/deg	16
LNR_A_X	4pts – AX Coordinate	0 deg	0 deg	16
LNR_A_Y	4pts – AY Coordinate	10 %	10 %	16
LNR_A_S	4pts – AS Coordinate	0.22%/deg	0.22%/deg	16
LNR_B_X	4pts – BX Coordinate	360 deg	360 deg	16
LNR_B_Y	4pts – BY Coordinate	100%	100%	16
LNR_B_S	4pts – BS Coordinate	0 %/deg	0 %/deg	16
LNR_C_X	4pts – CX Coordinate	360 deg	360 deg	16
LNR_C_Y	4pts – CY Coordinate	100%	100%	16
LNR_C_S	4pts – CS Coordinate	0 %/deg	0 %/deg	16
LNR_D_X	4pts – DX Coordinate	360 deg	360 deg	16
LNR_D_Y	4pts – DY Coordinate	100%	100%	16
LNR_D_S	4pts – DS Coordinate	0 %/deg	0 %/deg	16
W	17pts – Output angle range	0h	N/A	4
USERID1	Cust. id reference	Bin1	Bin1	16

USERID2	Cust. id reference	204h	3h	16
USERID3	Cust. id reference	MLX	MLX	16
LNR_Yn	17pts – Y-coordinate point n (n = 2,1,2 ...16)	N/A	N/A	16
DIAG Settings	16 Bit Diagnostics enabling	FDFh	4080h	16
CRC_DISABLE	Enable EERPOM CRC check (3131h= disable)	0h	0h	16
MEMLOCK	Write-protects USER/MLX EEPROM param.	0h	3h	2

Note: Ordering Information for PPAR: MLX90365EDC-ABD-000-RE or TU

14. Description of End-User Programmable Items

14.1. Output modes

14.1.1. OUT mode

Defines the Output Stage mode (analog, digital, high-impedance, standby) in application.

Output mode[2:0]	Type	Descriptions	Comments
0	Disable	Output HiZ	Not recommended
1	Analog	Analog Rail-to-Rail for Cout _{min} = 47nF	Analog Only (Default)
2	Analog	Analog Rail-to-Rail for Cout _{max} = 10nF	Analog Only
3	Analog	Analog Rail-to-Rail for Cout _{max} = 68nF	Analog Only
4	Analog	Analog Rail-to-Rail for Cout _{max} = 330nF	Analog Only
5	Digital	open drain NMOS	PWM
6	Digital	open drain PMOS	PWM
7	Digital	Push-Pull	PWM

14.1.2. PWM Output Mode

If PWM output mode is selected, the output signal is a digital signal with Pulse Width Modulation (PWM). The PWM polarity is selected by the PWMPOL parameter:

- PWMPOL = 1 for a low level at 100%
- PWMPOL = 0 for a high level at 100%

The PWM frequency is selected by the PWMT parameter. The following table provides typical code for different target PWM frequency and for both low and high speed modes.

PWW F (Hz)	PWMT (LSB) @13.3MHz	PWM res. (us)	PWM res. (%)	PWM res. (bit)
100	44333	0.240	0.0024	15.0
250	17733	0.240	0.006	14.0
500	8866	0.240	0.012	13.0
1000	4433	0.240	0.024	12.0

Notes:

- A more accurate trimming can be performed to take into account initial tolerance of the main clock.
- The PWM frequency is subjected to the same tolerances as the main clock (see $\Delta^T Ck$).

14.2. Output Transfer Characteristic

There are 2 different possibilities to define the transfer function (LNR):

- With 4 arbitrary points (defined on X and Y coordinates) and 5 slopes
- With 17 equidistant points for which only the Y coordinates are defined.

Parameter	LNR type	Value	Unit
CLOCKWISE	Both	0 → CounterClockWise 1 → ClockWise	LSB
DP	Both	0 ... 359.9999	deg
LNR_A_X LNR_B_X LNR_C_X LNR_D_X	Only 4 pts	0 ... 359.9999	deg
LNR_A_Y LNR_B_Y LNR_C_Y LNR_D_Y	Only 4 pts	0 ... 100	%
LNR_S0 LNR_A_S LNR_B_S LNR_C_S LNR_D_S	Only 4 pts	-17 ... 0 ... 17	%/deg
LNR_Y0 LNR_Y1 ... LNR_Y16	Only 17 pts	-50 ... + 150	%
W	Only 17 pts	65.5 ... 360	Deg
CLAMP_LOW	Both	0 ... 100	%
CLAMP_HIGH	Both	0 ... 100	%

14.2.1. Enable scaling Parameter (only for LNR type 4 pts)

This parameter enables to scale LNR_x_Y from -50% - 150% according to the following formula

$$(\text{Scaled Out})\%V_{DD} = 2 \times \text{Out}\%V_{DD} - 50\%$$

14.2.2. CLOCKWISE Parameter

The CLOCKWISE parameter defines the magnet rotation direction.

- CCW is the defined by the 1-4-5-8 pin order direction for the SOIC8 package and 1-8-9-16 pin order direction for the TSSOP16 package.
- CW is defined by the reverse direction: 8-5-4-1 pin order direction for the SOIC8 and 16-9-8-1 pin order direction for the TSSOP16 package.

Refer to the drawing in the sensitive spot positioning sections (Section 19.3)

14.2.3. Discontinuity Point (or Zero Degree Point)

The Discontinuity Point defines the 0° point on the circle. The discontinuity point places the origin at any location of the trigonometric circle. The DP is used as reference for all the angular measurements.

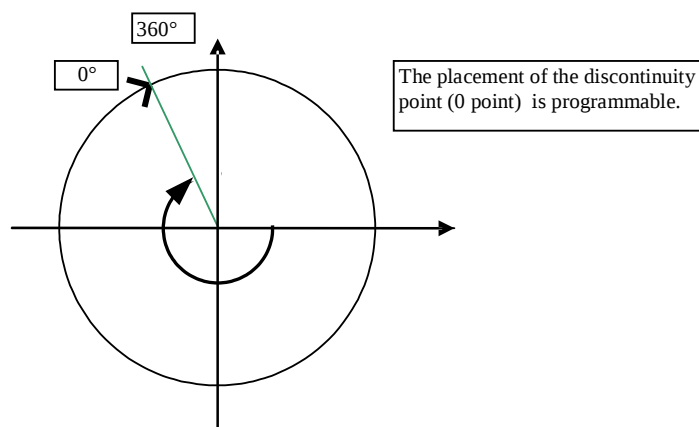


Figure 8 - Discontinuity Point Positioning

14.2.4. 4-Pts LNR Parameters

The LNR parameters, together with the clamping values, fully define the relation (the transfer function) between the digital angle and the output signal.

The shape of the MLX90365 transfer function from the digital angle value to the output voltage is described by the drawing below. Six segments can be programmed but the clamping levels are necessarily flat.

Two, three, or even six calibration points are then available, reducing the overall non-linearity of the IC by almost an order of magnitude each time. Three to six calibration points will be preferred by customers looking for excellent non-linearity figures. Two-point calibrations will be preferred by customers looking for a cheaper calibration set-up and shorter calibration time.

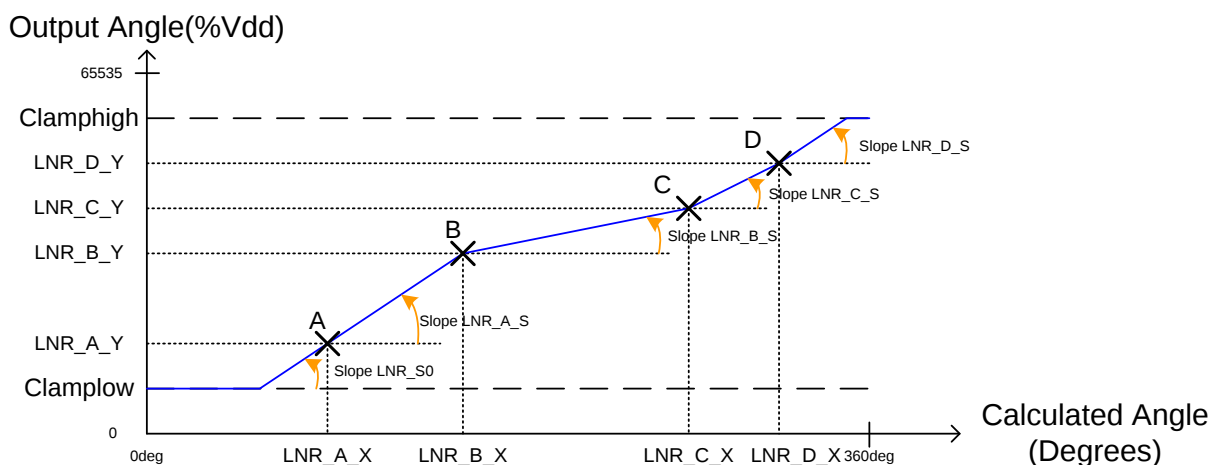


Figure 9

14.2.5. 17-Pts LNR Parameters

The LNR parameters, together with the clamping values, fully define the relation (the transfer function) between the digital angle and the output signal.

The shape of the MLX90365 transfer function from the digital angle value to the output voltage is described by the drawing below. In the 16-Pts mode, the output transfer characteristic is Piece-Wise-Linear (PWL).

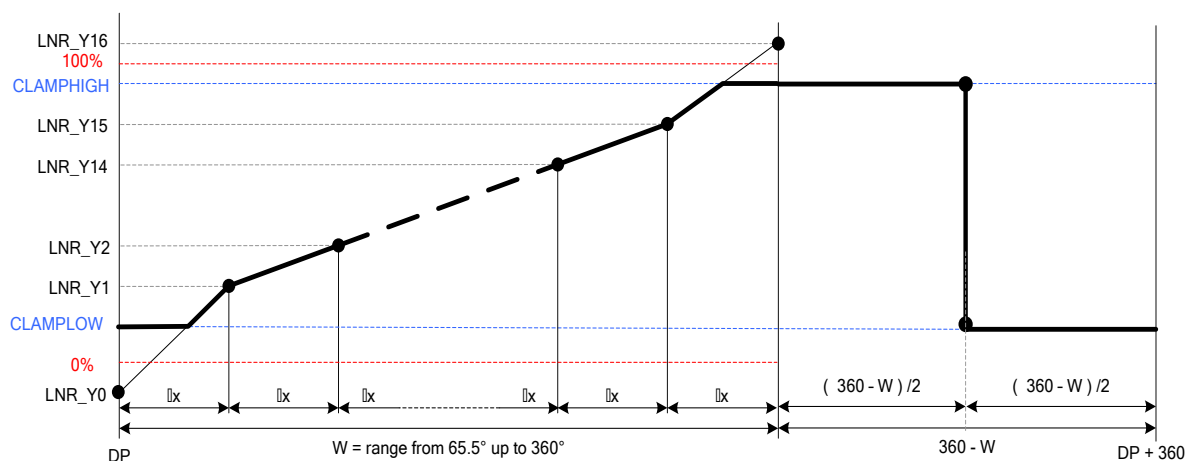


Figure 10 - Input range from 65.5° up to 360°

All the Y-coordinates can be programmed from -50% up to +150% to allow clamping in the middle of one segment (like on the figure), but the output value is limited to CLAMPLOW and CLAMPHIGH values.

Between two consecutive points, the output characteristic is interpolated.

The parameter W determines the input range on which the 17 points (16 segments) are uniformly spread:

W	Range	Δx
0 (0000b)	360.0deg	22.5deg
1	320.0deg	20.0deg
2	288.0deg	18.0deg
3	261.8deg	16.4deg
4	240.0deg	15.0deg
5	221.5deg	13.8deg
6	205.7deg	12.9deg
7	192.0deg	12.0deg

W	Range	Δx
8	180.0deg	11.3deg
9	144.0deg	9.0deg
10	120.0deg	7.5deg
11	102.9deg	6.4deg
12	90.0deg	5.6deg
13	80.0deg	5.0deg
14	72.0deg	4.5deg
15 (1111b)	65.5deg	4.1deg

Outside of the selected range, the output will remain in clamping levels.

14.2.6. CLAMPING Parameters

The clamping levels are two independent values to limit the output voltage range. The CLAMPLOW parameter adjusts the minimum output voltage level. The CLAMPHIGH parameter sets the maximum output voltage level. Both parameters have 16 bits of adjustment and are available for both LNR modes. In analog mode, the resolution will be limited by the D/A converter (12 bits) to 0.024%V_{DD}. In PWM mode, the resolution will be 0.024%DC.

14.3. Identification

Parameter	Value
MELEXISID1	0 ... 65535
MELEXISID2	0 ... 65535
MELEXISID3	0 ... 65535
USERID1	0 ... 65535
USERID2	0 ... 65535
USERID3	0 ... 65535

Identification number: 48 bits (3 words) freely useable by Customer for traceability purpose.

14.4. Lock

The MEMLOCK write protects all the EEPROM parameters set by the Melexis and user. Once the lock is enabled, it is not possible to change the EEPROM values anymore. Note that the Memlock bits should be set by the solver function "MemLock".

14.5. Sensor Front-End

Parameter	Value
MAPXYZ	0 .. 3
SMISM	0 .. 32768
k	0 .. 32768
SEL_k	0 or 1
GAINMIN	0 ... 41
GAINMAX	0 ... 41
GAINSATURATION	0.. 1

14.5.1. MAPXYZ

The MAPXYZ parameter defines which fields are used to calculate the angle. The different possibilities are described in the tables below. This 2 bits value selects the first (B1) and second (B2) field components according the table below.

MAPXYZ	B1	B2	Angular
0 – 00b	X	Y	XY mode
1 – 01b	Zx	X	XZx mode
2 – 10b	Y	Zx	YZx mode
3 – 11b	Y	Zy	YZy mode

Note: MAPXYZ = 3 is not recommended.

14.5.2. SMISM, k and SEL_k Parameters

(i) SMISM

When the mapping (B1=X, B2=Y) is selected, SMISM defines the sensitivity mismatch factor that is applied on B1, B2; When another B1, B2 mapping is selected, this parameter is “don’t care”. This parameter is trimmed at factory; Melexis strongly recommends TO NOT overwrite it for optimal performances.

(ii) k

When the mapping (B1=X, B2=Y) is **NOT** selected, k defines the sensitivity mismatch factor that is applied on B1 or B2 (according to parameter SEL_k – see below). When the mapping (B1=X, B2=Y) is selected, this parameter is “don’t care”.

This parameter is trimmed at factory for mapping (B1=Z, B2=X). Melexis recommends to fine trim it when a smaller linearity error (Le) is required and a different mapping than (B1=X, B2=Y) is selected.

(iii) SEL_k

When the mapping (B1=X, B2=Y) is **NOT** selected, SEL_k defines the component on which the sensitivity mismatch factor k (see above): SEL_k = 0 means $B1 \rightarrow k \cdot B1$ and SEL_k = 1 means $B2 \rightarrow k \cdot B2$.

14.5.3. GAINMIN and GAINMAX Parameters

GAINMIN and GAINMAX define the thresholds on the gain code outside which the fault “GAIN out of Spec.” is set;

If GAINSATURATION is set, then the virtual gain code is saturated at GAINMIN and GAINMAX, and no Diagnostic fault is set since the saturations applies before the Diag. check.

14.6. Filter

Parameter	Value
FILTER	0 ... 2
FHYST	0 ... 255

The MLX90365 includes 2 types of filters:

- Hysteresis Filter: programmable by the FHYST parameter
- Low Pass FIR Filters controlled with the FILTER parameter

14.6.1. Hysteresis Filter

The FHYST parameter is a hysteresis filter. The output value of the IC is not updated when the digital step is smaller than the programmed FHYST parameter value. The output value is modified when the increment is bigger than the hysteresis. The hysteresis filter reduces therefore the resolution to a level compatible with the internal noise of the IC. The hysteresis must be programmed to a value close to the noise level. (1 lsb = +/- 0.012%)

14.6.2. FIR Filters

The MLX90365 features 2 FIR filter modes controlled with Filter = 1...2. Filter = 0 corresponds to no filtering. The transfer function is described below:

$$y_n = \frac{1}{\sum_{i=0}^j a_i} \sum_{i=0}^j a_i x_{n-i}$$

The filters characteristic is given in the following table:

Filter No	0	1	2
J	0	1	3
Type	Disable	Finite Impulse Response	
Coefficients a_i	1	11	1111
Title	No filter	ExtraLight	Light
99% Response Time	1	2	4
Efficiency RMS (dB)	0	3.0	6.0

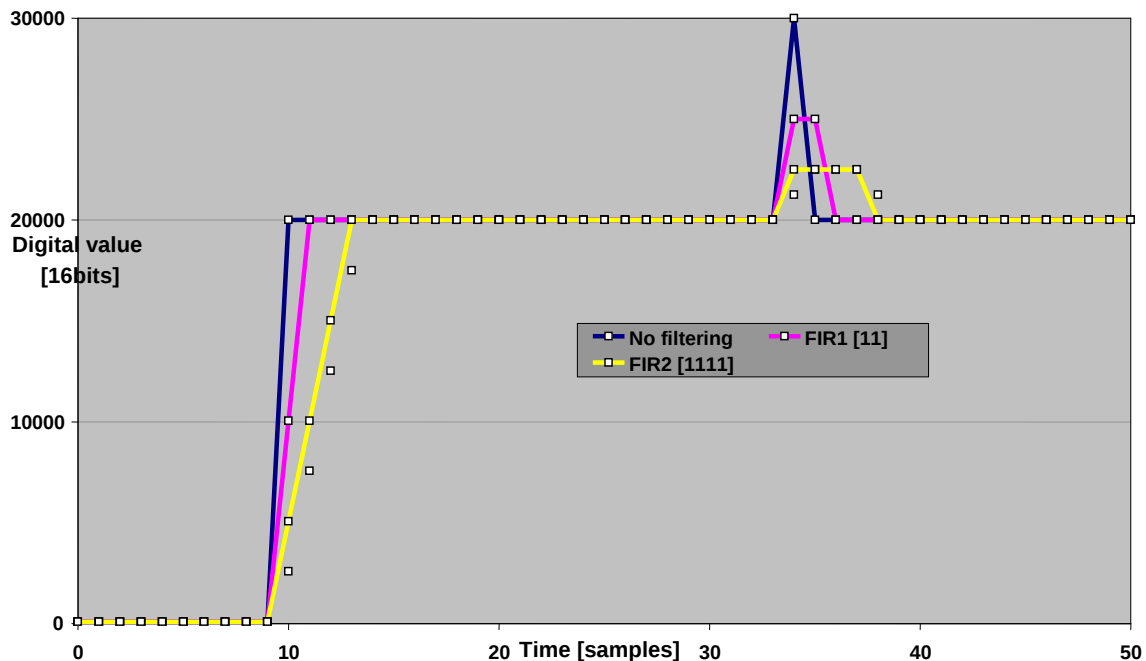


Figure 11 - Step and impulse response of the different filters

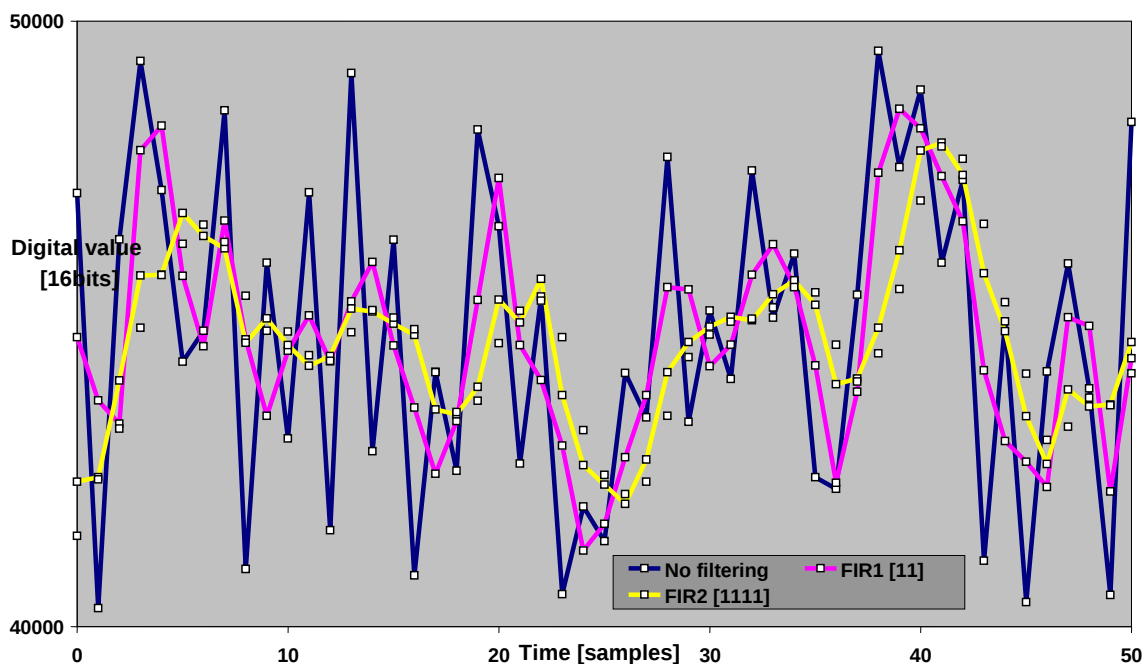


Figure 12 - Noise response of the different filter

14.7. Programmable Diagnostic Settings

14.7.1. DIAG mode

Defines the Output Stage mode in case of Diag.

DIAG mode [2:0]	Type	Descriptions	Comments
0	Disable	Output HiZ	Not recommended
5	Digital	open drain NMOS	
6	Digital	open drain PMOS	
7	Digital	Push-Pull	

14.7.2. DIAG Level

Determines the reporting level (diagnostic low, diagnostic high) during start-up (both analog and PWM mode), or during a fault reporting (Only in Analog mode).

In PWM mode, the fault reporting level shall in principle be 0 when the leading edge is a rising edge, (resp. 1 for a falling edge) in order to detect the first cycle after start-up. MLX recommends then DIAG Level = PWMPOL.

14.7.3. Field Strength Diagnostic

(i) FIELDTHRESHLOW

Defines the field strength limit under which a fault is reported.

The run-time field strength estimation (FieldStrength) is compared to $2^8 * \text{FIELDTHRESHLOW}$.

The sensitivity of FIELDTHRESHLOW is typically 1mT/LSB. By default it is programmed to 10mT

(ii) FIELDTHRESHHIGH

Defines the field strength limit under which a fault is reported. See above for more details.

14.7.4. PWM Diagnostic

(i) DC_FAULT

Defines the duty-cycle that is outputted in case of diagnostic reporting.

(ii) WEAKMAGTHRESH

Defines the threshold on the field strength which determines the weak magnet condition; when WEAKMAGTHRESH = 0, there is no reporting of weak magnet condition.

(iii) DC_FTL

Defines the duty-cycle that is outputted in case of Field Too Low; the Field Too Low Diagnostic is stronger than the Weak Magnet Diagnostic, from 0% till 255% by steps of (100/256)%

(iv) DC_WEAK

Defines the duty-cycle that is outputted in case of Weak Magnet, from 0% till 255% by steps of (100/256)%

14.7.5. Diagnostic Features

Refer to Application_note_Diagnostic_Behavior_90365 for EE_CRC_Enable function description and for Diagnostic features which can be enabled at user.

14.8. EEPROM endurance

Although the EEPROM is used for Calibration Data Storage (similarly to an OTPROM), the MLX90365 embedded EEPROM is qualified to guarantee an endurance of minimum 1000 write cycles at 125°C for (engineering/calibration purpose).

15. MLX90365 Self Diagnostic

The MLX90365 provides numerous self-diagnostic features. Those features increase the robustness of the IC functionality as it will prevent the IC to provide erroneous output signal in case of internal or external failure modes (“fail-safe”).

Diagnostic Item	Action	Effect on Outputs	Type	Monitoring Rate	Reporting Rate
ST-up phase Diagnostics					
RAM March C- 10N Test	Fail-safe mode ** ** CPU reset after 120ms	Diagnostic low/ high Reporting (optional)	Digi HW	n/applicable (start-up only)	n/applicable (start-up only)
Watchdog BIST	Fail-safe mode ** ** CPU reset after 120ms	Diagnostic low/ high Reporting (optional)	Digi HW	n/applicable (start-up only)	n/applicable (start-up only)
FieldTooLow, W/ Programmable Threshold	Diag. (No Debouncing)	Diagnostic low/high Reporting (optional)	Environ &Analog	n/applicable (start-up only)	n/applicable (start-up only)
FieldTooHigh w/ Programmable Threshold	Diag. (No Debouncing)	Diagnostic low/high Reporting (optional)	Environ &Analog	n/applicable (start-up only)	n/applicable (start-up only)
WeakMagnet Diagnostic	Diag. (No Debouncing)	Diagnostic low/high Reporting (optional)	Environ	n/applicable (start-up only)	n/applicable (start-up only)
Under Voltage Monitoring SUPPLYMONI = (MT3VB) OR (MT4VB)	St-up on Hold	Diagnostic low/high	Environ &Analog	n/applicable (start-up only)	n/applicable (start-up only)
Over Voltage Monitoring MT7V	PTC entry	OUT in HiZ	Environ	n/applicable (start-up only)	n/applicable (start-up only)
BG Loop Diag.					
ROM 16bit checksum (continuous)	Fail-safe mode ** ** CPU reset after 120ms	Diagnostic low/high Reporting (optional)	Digi HW	800ms	800ms
RAM Test (continuous)	Fail-safe mode ** ** CPU reset after 120ms	Diagnostic low/high Reporting (optional)	Digi HW	160ms	160ms
EEPROM 8 bit CRC Check (continuous)	Fail-safe mode ** ** CPU reset after 120ms	Diagnostic low/high Reporting (optional)	Digi HW	10ms	10ms
Watchdog (continuous)	CPU reset	--	Digi HW	120ms	n/a
DSP Loop Diag.					
ADC Clipping ADCClip	Debouncing (prog.)	Diagnostic low/high Reporting (optional)	Environ &Analog	5/DSP	6ms x INT (THRES/STEP_UP)
FieldTooLow, W/ Programmable Threshold	Debouncing (prog.)	Diagnostic low/high Reporting (optional)	Environ &Analog	1/DSP	6ms x INT (THRES/STEP_UP)
FieldTooHigh w/ Programmable Threshold	Debouncing (prog.)	Diagnostic low/high Reporting (optional)	Environ &Analog	1/DSP	6ms x INT (THRES/STEP_UP)
WeakMagnet Diagnostic	Debouncing (prog.)	Diagnostic low/high Reporting (optional)	Environ	1/DSP	6ms x INT (THRES/STEP_UP)
Virtual Gain Code Out-of-spec GAINOOS	Debouncing (prog.)	Diagnostic low/high Reporting (optional)	Environ &Analog	1/DSP	6ms x INT (THRES/STEP_UP)
Virtual Gain Code Saturation [GAINMIN..GAINMAX]	Saturation (optional)	Gain Saturated @ GAINMIN- GAINMAX	Environ &Analog	n/applicable Not a diagnostic	n/applicable Not a diagnostic

ADC Monitor (Analog to Digital Converter) <i>ADCMONI</i>	Debouncing (prog.)	Diagnostic low/high Reporting (optional)	Analog HW	1/DSP	6ms x INT (THRES/STEP_UP)
Under Voltage Monitoring <i>SUPPLYMONI = (MT3VB) OR (MT4VB)</i>	Supply Debouncing (prog.)	Diagnostic low/high Reporting (optional)	Environ & Analog	1/DSP	6ms x INT (THRES/STEP_UP)
Over Voltage Monitoring <i>MT7V</i>	PTC entry after PTC Debouncing	OUT in HiZ	Environ	2ms	2ms
Temperature Sensor Monitor <i>TEMPMONI</i>	Debouncing (prog.)	Diagnostic low/high Reporting (optional)	Analog	1/DSP	6ms x INT (THRES/STEP_UP)
Temperature > 170degC (± 20) Temperature < -60degC (± 20)	Saturate value used for the compensations to -40degC and +150degC resp.	No effect	Environ & Analog		n/applicable Not a diagnostic
Hardware Diag. (continuously checked by dedicated Logic)					
Read/Write Access out of physical memory	Fail-safe mode ** ** CPU reset after 120ms	Diagnostic Low/High	Digi HW	n/a immediate Diag	n/a immediate Diag
Write Access to protected area (IO and RAM Words)	Fail-safe mode ** ** CPU reset after 120ms	Diagnostic low/high	Digi HW	n/a immediate Diag.	n/a immediate Diag.
Unauthorized Mode Entry	Fail-safe mode ** ** CPU reset after 120ms	Diagnostic low/high	Digi HW	n/a immediate Diag	n/a immediate Diag
EEPROM Error Correcting Code (Hamming correction)	(Transparent) Error Correction	no effect	Digi HW	n/a.	n/a
Hardware Diag. (continuously checked by dedicated Analog circuits)					
Broken VSS	CPU Reset on recovery	Pull down load => Diag. High Pull up load => Diag. High	Environ	n/a immediate Diag.	n/a immediate Diag.
Broken VDD	CPU Reset on recovery	Pull down load => Diag. Low Pull up load => Diag. Low	Environ	n/a immediate Diag	n/a immediate Diag
Resistive Cable Test	St-up on Hold	Diagnostic low/high	Environ	n/a immediate Diag.	n/a immediate Diag.

16. Recommended Application Diagrams

16.1. Wiring with the MLX90365 in SOIC-8 Package

Compact PCB routing		
C1, C2, C3	100nF	Analog Out
C1, C3	100nF	PWM Out
C2	4.7nF	
Optimal EMC/ESD performances		
C1, C2	1nF	Close to IC terminals
C3, C4, C5	100nF	Analog Out - Close to connector
C5	4.7nF	PWM Out - Close to connector
R1	10 Ω	Not recommended for Analog Out Recommended for PWM Out
R2	50 Ω	Optional for Analog Out Recommended for PWM Out

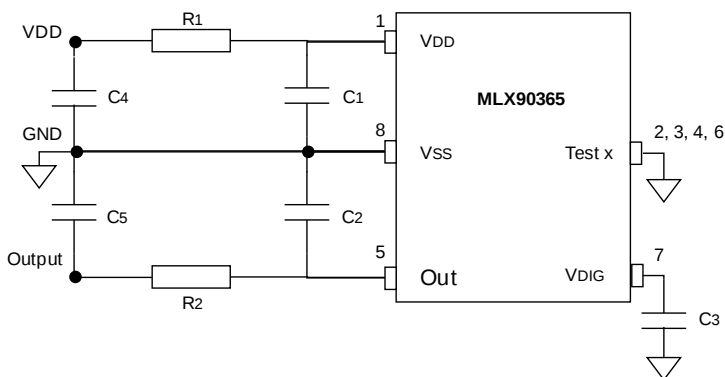


Figure 13 – Recommended wiring for the MLX90365 in SOIC8 package

16.2. Wiring with the MLX90365 in TSSOP-16 Package

Compact PCB routing		
C11, C12, C13 C21, C22, C23	100nF	Analog Out
C11, C13, C21, C23 C12, C22	100nF 4.7nF	PWM Out
Optimal EMC/ESD performance		
C11, C12 C21, C22	1nF	Close to IC terminals
C13, C14, C15 C23, C24, C25	100nF	Analog Out - Close to connector
C15 C25	4.7nF	PWM Out - Close to connector
R11 R21	10 Ω	Not recommended for Analog Out Recommended for PWM Out
R12 R22	50 Ω	Optional for Analog Out Recommended for PWM Out

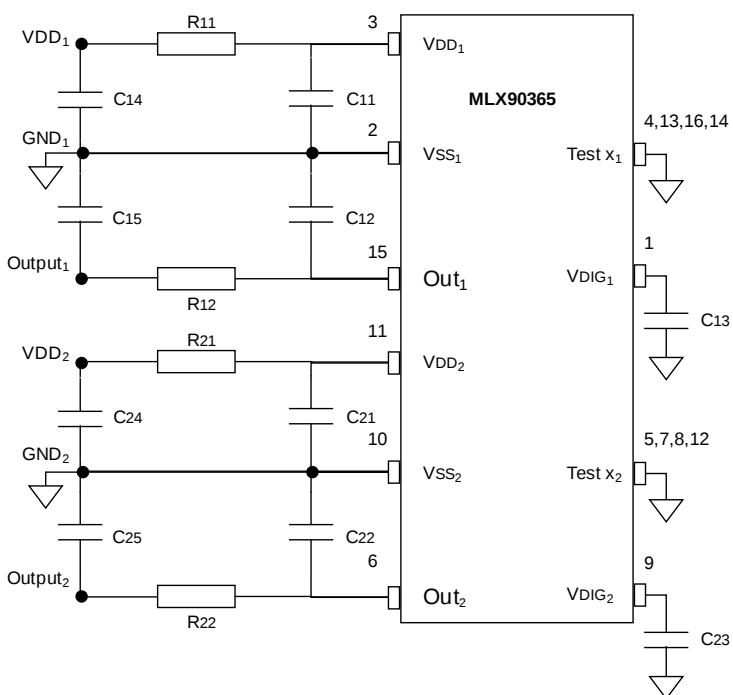


Figure 14 – Recommended wiring for the MLX90365 in TSSOP16 package (dual die)

17. 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 Developes)

- 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)
- Melexis Working Instruction 341901308

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

- 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
- Melexis Working Instruction 341901309

Iron Soldering THD's (Through Hole Developes)

- EN60749-15
Resistance to soldering temperature for through-hole mounted devices
- Melexis Working Instruction 341901309

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

- EIA/JEDEC JESD22-B102 and EN60749-21
Solderability
- Melexis Working Instruction 3304312

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.

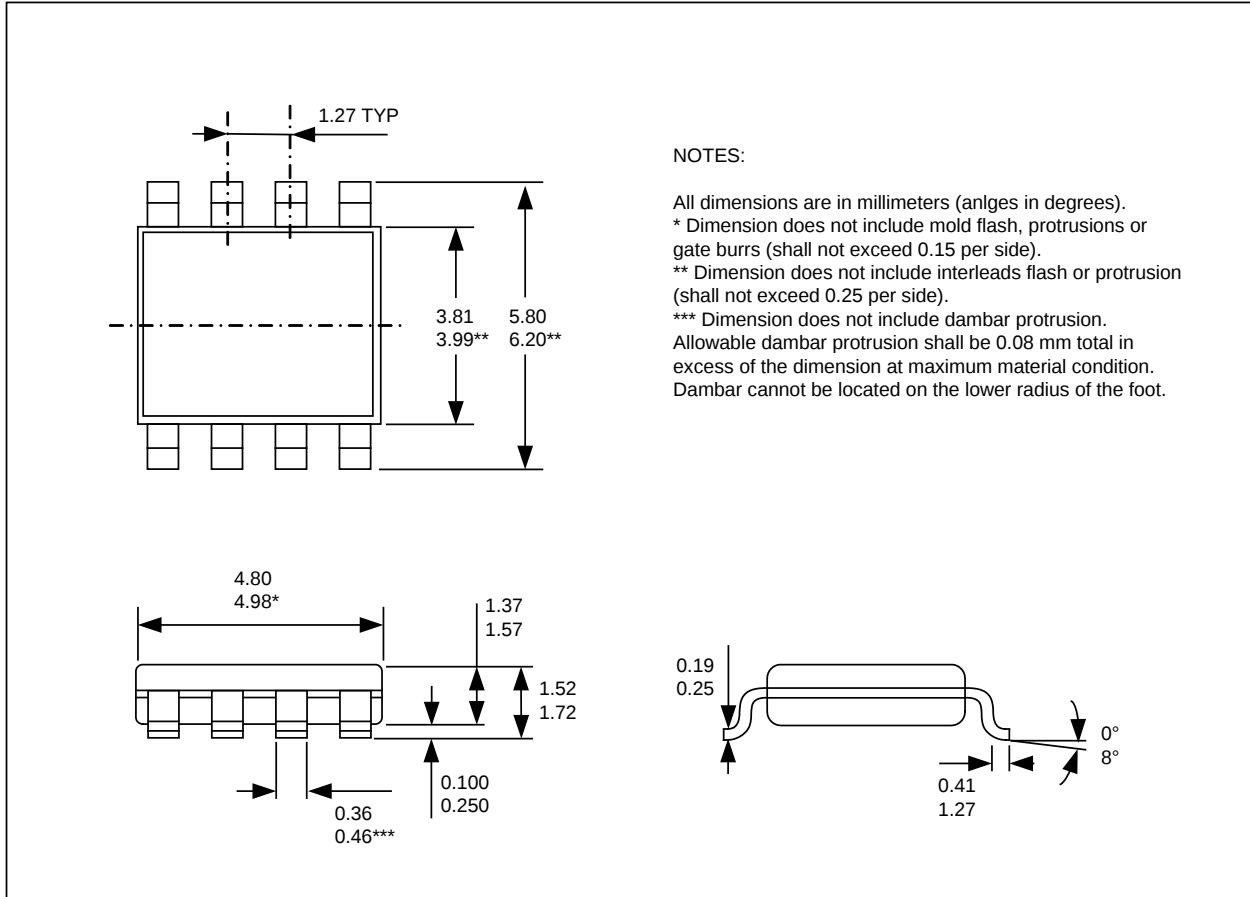
For more information on the lead free topic please see quality page at our website:
<http://www.melexis.com/quality.aspx>

18. ESD Precautions

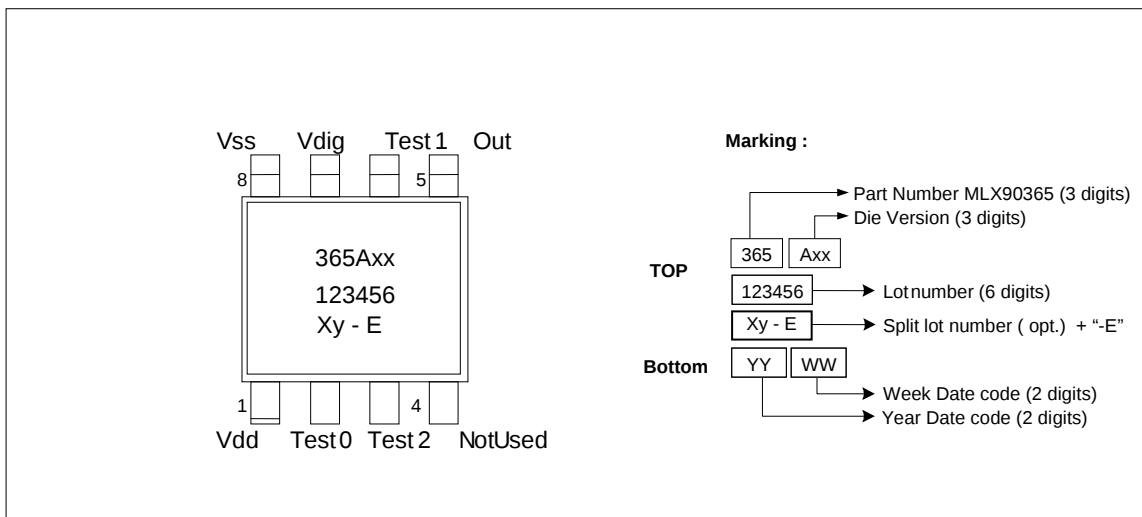
Electronic semiconductor products are sensitive to Electro Static Discharge (ESD).
Always observe Electro Static Discharge control procedures whenever handling semiconductor products.

19. Package Information

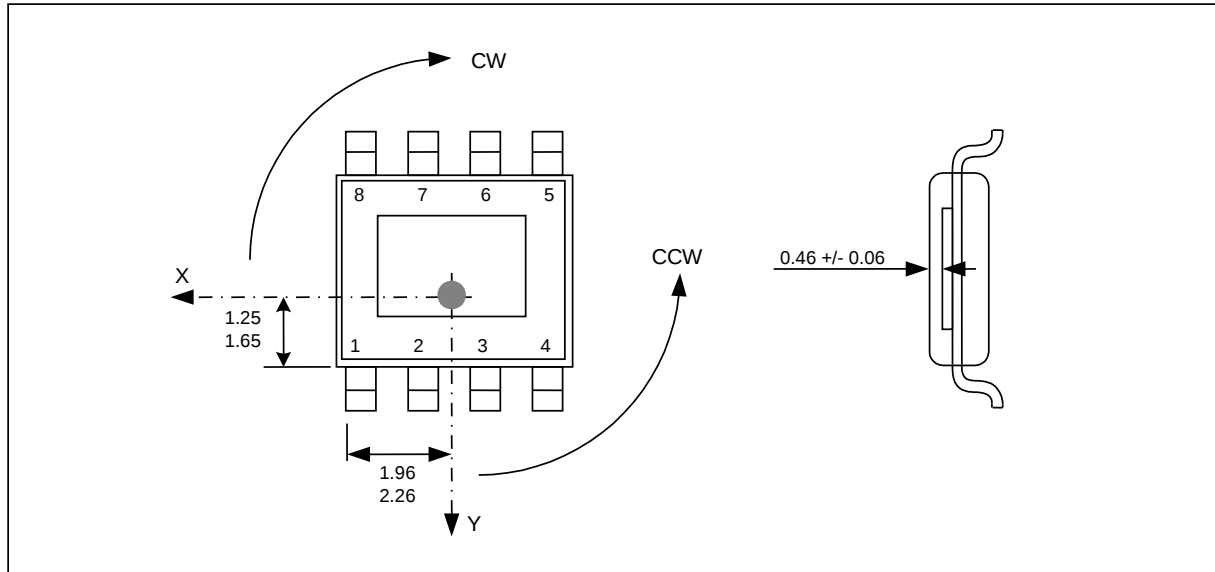
19.1. SOIC8 - Package Dimensions



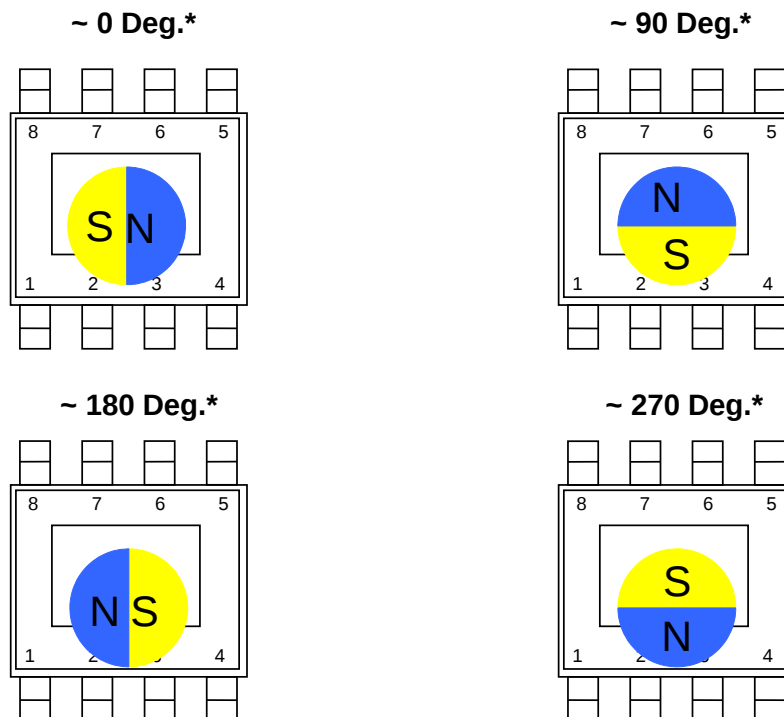
19.2. SOIC8 - Pinout and Marking



19.3. SOIC8 - Sensitive spot Positioning



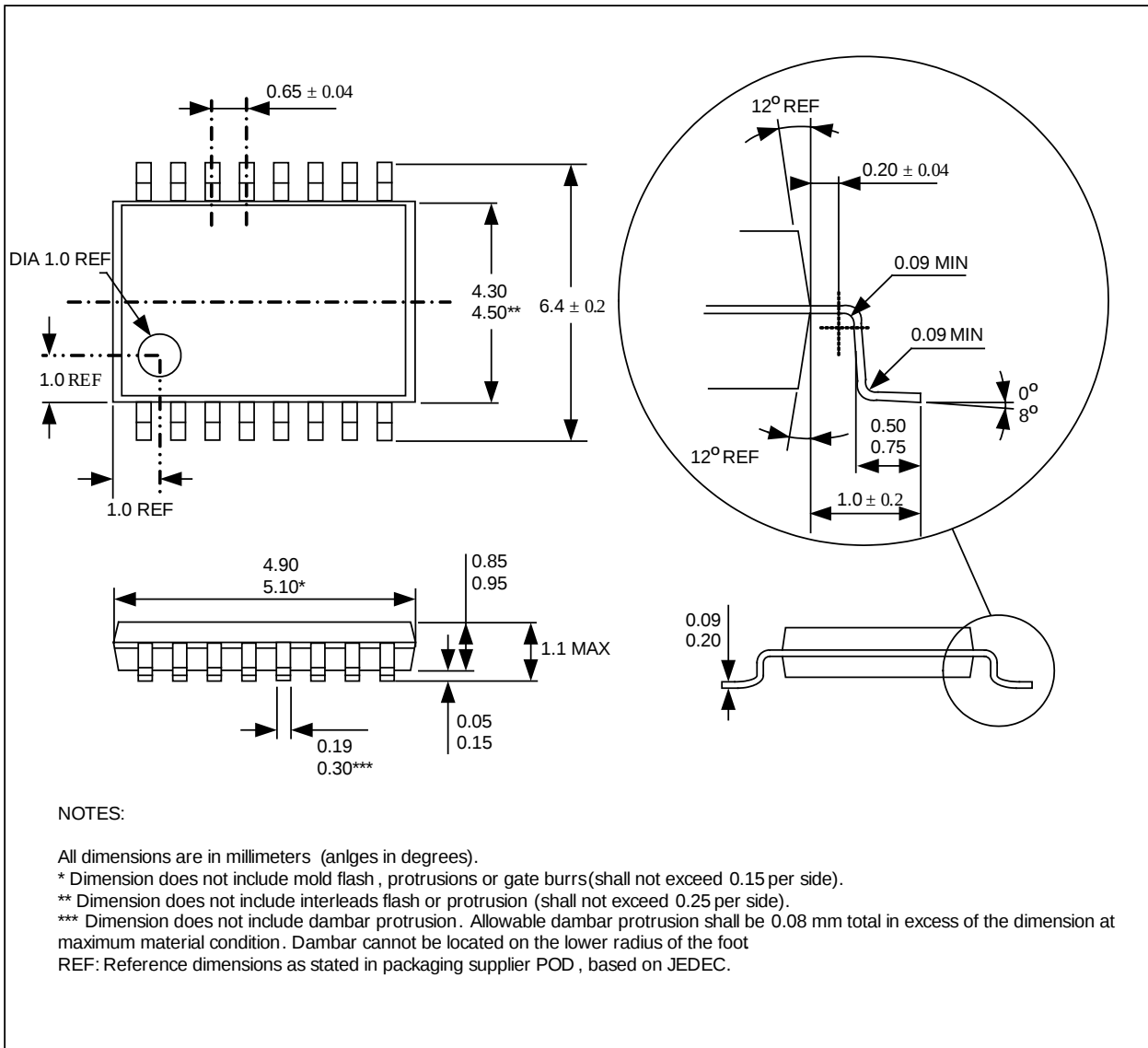
Angle detection MLX90365 SOIC8



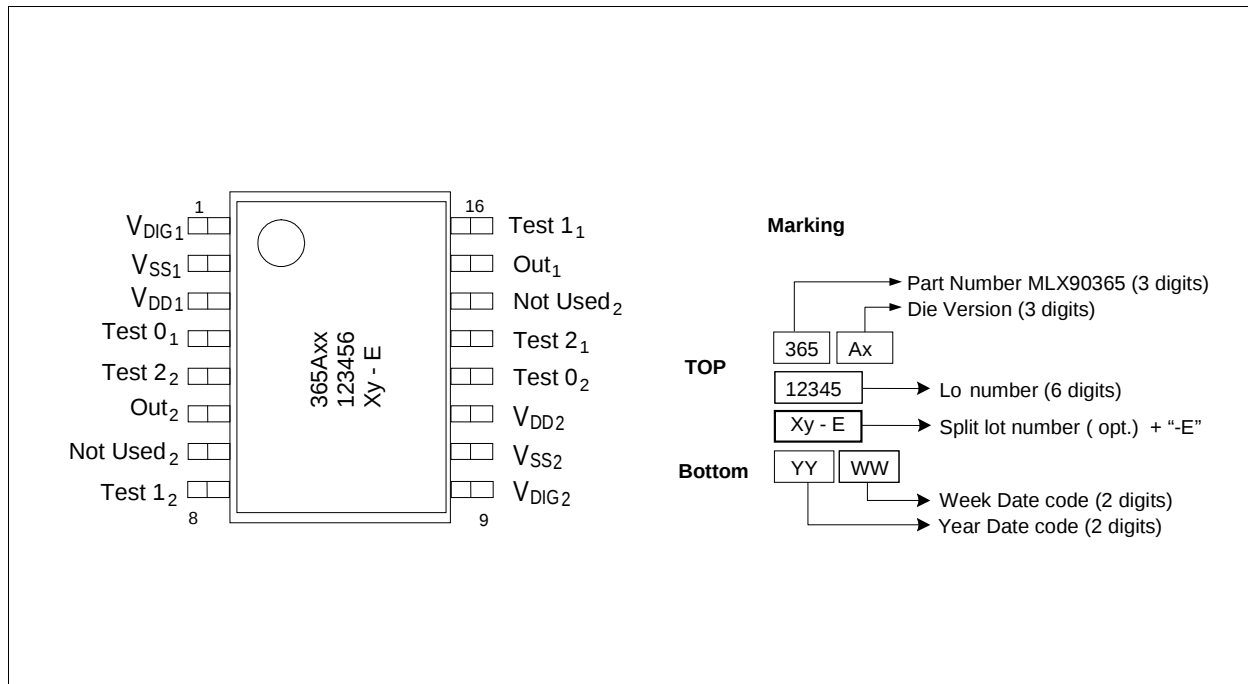
* No absolute reference for the angular information.

The MLX90365 is an absolute angular position sensor but the linearity error (See section 10) does not include the error linked to the absolute reference 0 Deg (which can be fixed in the application through the discontinuity point).

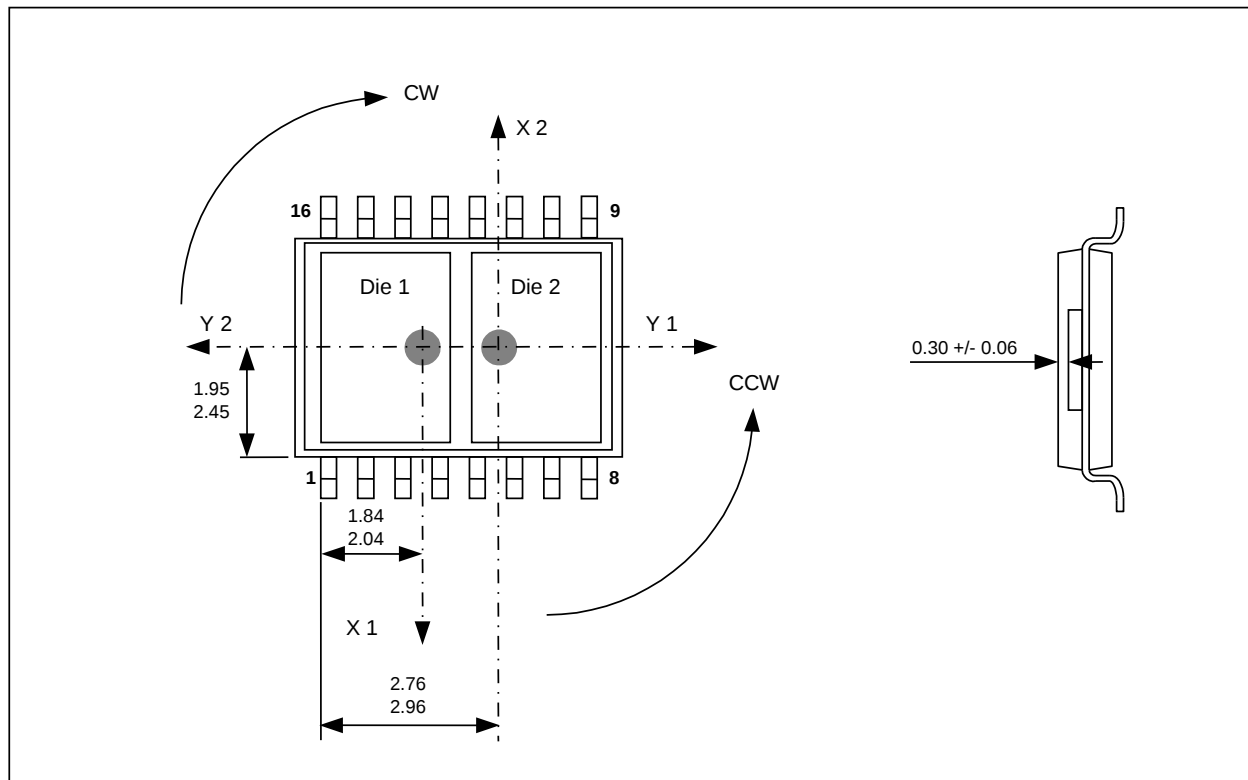
19.4. TSSOP16 - Package Dimensions



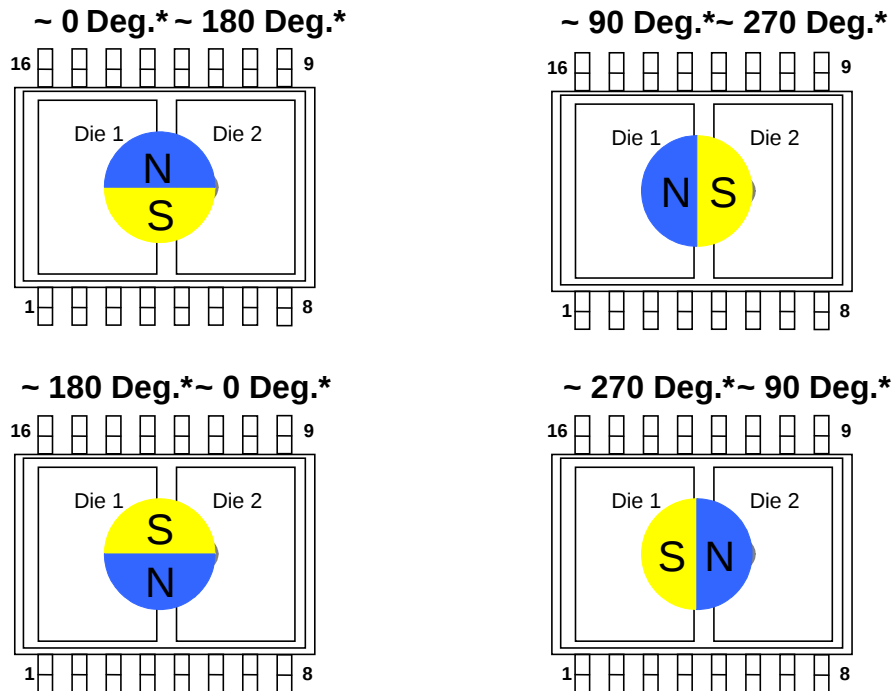
19.5. TSSOP16 - Pinout and Marking



19.6. TSSOP16 - Sensitive spot Positioning



Angle detection MLX90365 TSSOP16



* No absolute reference for the angular information.

The MLX90365 is an absolute angular position sensor but the linearity error (See section 10) does not include the error linked to the absolute reference 0Deg (which can be fixed in the application through the discontinuity point).

20. Disclaimer

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.

The information furnished by Melexis is believed to be correct and accurate. However, Melexis shall not be liable to recipient or any third party for any damages, including but not limited to personal injury, property damage, loss of profits, loss of use, interrupt of business or indirect, special incidental or consequential damages, of any kind, in connection with or arising out of the furnishing, performance or use of the technical data herein. No obligation or liability to recipient or any third party shall arise or flow out of Melexis' rendering of technical or other services.

© 2012 Melexis NV. All rights reserved.

For the latest version of this document, go to our website at
www.melexis.com

Or for additional information contact Melexis Direct:

Europe, Africa, Asia:	America:
Phone: +32 1367 0495	Phone: +1 248 306 5400
E-mail: sales_europe@melexis.com	E-mail: sales_usa@melexis.com

ISO/TS 16949 and ISO14001 Certified

Revisions

Revision Number	Date	Name	Comment
AA		vsa	Initial release
AB	04/08/11		Timing specification updated, STD EEP map defined
BA	15/02/12	vsa	Revision
01	25/05/12	klw	First release
02	01/07/12	vhi	Released datasheet for launch Official template Benefit & Features Ordering Information Block Diagram Section 14.4.2 – Introduction of SEL_k Section 16 – New application diagrams
03	04/09/13	vsa	Correction of old errors like fig. 8 In section 1 (Diagram), regulator voltage corrected to 2.5V In section 5, max ratings: precise time specification In section 14.1.2 Polarity is inverted In section 15 (Diag. Table) Broken VDD/VSS output level corrected Implementation of new ordering codes for MFI and ABD version (memlock version) Embedding of the PWM specification
04	02/04/13	vsa	Correction of Rising Time in mode 5, on page 33 tssop 16 pinout and marking the marking letters are at the wrong angle.



Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

Телефон: 8 (812) 309 58 32 (многоканальный)

Факс: 8 (812) 320-02-42

Электронная почта: org@eplast1.ru

Адрес: 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.