

## Features

- Fully integrated, PLL-stabilized VCO
- Frequency range from 850 MHz to 920 MHz
- ASK achieved by on/off keying of internal power amplifier
- FM possible with external varactor
- Wide power supply range from 2.2 V to 5.5 V
- High over-all frequency accuracy
- Very low standby current
- Adjustable output power range from -15 dBm to +1 dBm
- Adjustable current consumption from 6.2 mA to 12.5 mA
- Differential output well-suited for loop antenna
- Conforms to EN 300 220 and similar standards
- 8-pin Small Outline Integrated Circuit (SOIC)

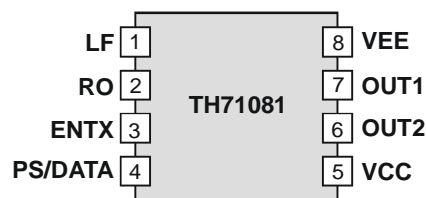
## Ordering Information

Part No.	Temperature Code	Package Code
TH71081	E (-30 C° to 85 °C)	DC (SOIC8)

## Application Examples

- Keyless car and central locking
- Low-power telemetry
- Alarm and security systems
- General digital data transmission
- General analog audio signal transmission
- Local oscillator signal generation

## Pin Description



## General Description

The TH71081 ASK transmitter IC is designed for applications in the European 868MHz industrial-scientific-medical (ISM) band, according to the EN 300 220 telecommunications standard. It can also be used for any other system with carrier frequencies ranging from 850 MHz to 920 MHz (e.g. for applications in the US 915MHz ISM band).

The transmitter's carrier frequency  $f_c$  is determined by the frequency of the reference crystal  $f_{ref}$  that is used. The integrated PLL synthesizer ensures that each RF value, ranging from 850 MHz to 920 MHz, can be achieved by using a crystal with reference frequency according to:  $f_{ref} = f_c/N$ , where  $N = 32$  is the PLL feedback divider ratio.

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## 1 Theory of Operation

### 1.1 General

As depicted in Fig.1, the TH71081 transmitter consists of a fully integrated voltage-controlled oscillator (VCO), a divide-by-32 divider (div32), a phase-frequency detector (PFD) and a charge pump. An external loop filter at pin LF determines the dynamic behaviour of the PLL and suppresses reference spurious signals. The VCO's output signal feeds the power amplifier (PA). RF signal power  $P_o$  can be adjusted in six steps from  $P_o = -15$  dBm to +1 dBm either by changing the value of resistor R1 or by varying the voltage  $V_{PS}$  at pin PS/DATA. The open-collector differential output (OUT1, OUT2) can be used to either directly drive a loop antenna or to be converted to a single-ended impedance by means of a balanced-to-unbalanced (balun) transformer. For maximum available output power, the differential output should be matched to a load of about 1 k $\Omega$ .

Bandgap biasing ensures stable operation of the IC at a power supply range of 2.2 V to 5.5 V.

### 1.2 Block Diagram

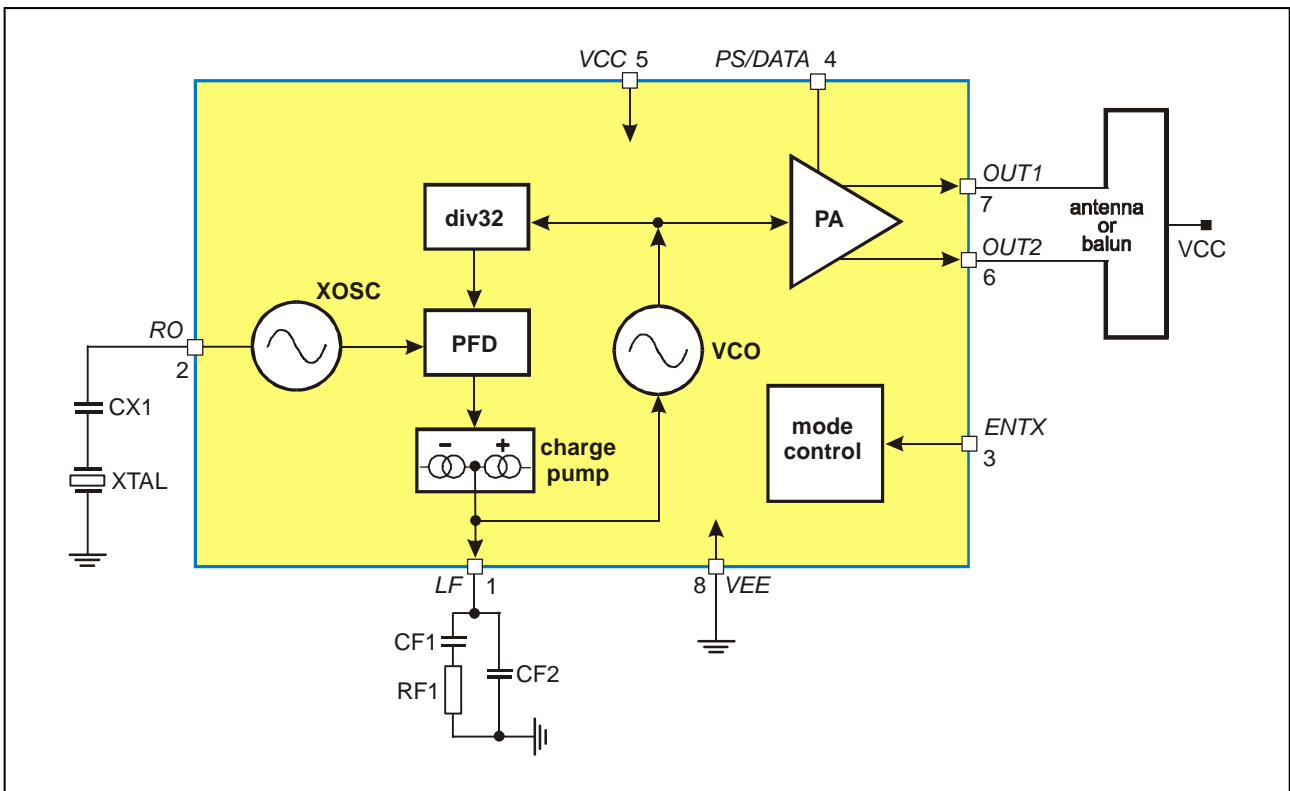


Fig. 1: Block diagram with external components

## 2 Functional Description

### 2.1 ASK Modulation

The TH71081 can be ASK-modulated by applying data directly at pin PS/DATA. This turns the PA on and off and therefore leads to an ASK signal at the output.

### 2.2 Frequency Modulation

For FM operation an external varactor is required. It simply acts as a pulling capacitor connected in series to the crystal. Then the analog modulation signal, applied through a series resistor, directly modulates the XOSC.

### 2.3 LO Source

Many applications require a stable RF source. For this purpose, the TH71081 can be used without modulation as an easy-to-use, PLL-stabilized, continuous wave (CW) generator.

### 2.4 Mode Control Logic

The mode control logic allows two different modes of operation as listed in the following table. The mode control pin ENTX is pulled-down internally. This guarantees that the whole circuit is shut down if this pin is left floating.

ENTX	Mode	Description
0	TX standby	TX disable
1	TX active	TX enable

### 3 Pin Definition and Description

Pin No.	Name	I/O Type	Functional Schematic	Description
1	LF	analog I/O		connection to loop filter, charge pump output, VCO tuning input
2	RO	analog I/O		XOSC connection to XTAL, Colpitts type crystal oscillator
3	ENTX	input		mode control input, CMOS-compatible with internal pull-down
4	PS/DATA	analog I/O		power-select and ASK input, high-impedance comparator logic  TX standby: $I_{PS} = 0$ TX active: $I_{PS} = 20\mu A$
5	VCC	supply		positive power supply
6	OUT2	output		differential power amplifier output, open collector
7	OUT1	output		differential power amplifier output, open collector
8	VEE	ground		negative power supply

## 4 Electrical Characteristics

### 4.1 Absolute Maximum Ratings

Parameter	Symbol	Condition	Min	Max	Unit
Supply voltage	$V_{CC}$		0	7.0	V
Input voltage	$V_{IN}$		-0.3	$V_{CC}+0.3$	V
Storage temperature	$T_{STG}$		-65	150	°C
Junction temperature	$T_J$			150	°C
Thermal Resistance	$R_{thJA}$			163	K/W
Power dissipation	$P_{diss}$			0.12	W
Electrostatic discharge	$V_{ESD1}$	human body model, 1)	-1.0	+1.0	kV
	$V_{ESD2}$	human body model, 2)	-0.75	+0.75	

1) all pins except OUT1, OUT2      2) pins OUT1, OUT2

### 4.2 Normal Operating Conditions

Parameter	Symbol	Condition	Min	Max	Unit
Supply voltage	$V_{CC}$		2.2	5.5	V
Operating temperature	$T_A$		-30	85	°C
Input low voltage CMOS	$V_{IL}$	ENTX pin		$0.3 \cdot V_{CC}$	V
Input high voltage CMOS	$V_{IH}$	ENTX pin	$0.7 \cdot V_{CC}$		V
XOSC frequency	$f_{ref}$	set by the crystal	26.5	28.75	MHz
VCO frequency	$f_c$	$f_c = 32 \cdot f_{ref}$	850	890	MHz
				$T_A < 70^\circ\text{C}$ , $V_{CC} \geq 2.5\text{V}$	
Data rate ASK	$R_{ASK}$	NRZ		40	kbit/s
FM deviation	$\Delta f_{FM}$			$\pm 6$	kHz
Modulation frequency FM	$f_{mod}$			5	kHz

### 4.3 Crystal Parameters

Parameter	Symbol	Condition	Min	Max	Unit
Crystal frequency	$f_0$	fundamental mode, AT	26.5	28.75	MHz
Load capacitance	$C_L$		10	15	pF
Static capacitance	$C_0$			7	pF
Resonance resistance	$R_1$			40	$\Omega$

#### 4.4 DC Characteristics

all parameters under normal operating conditions, unless otherwise stated;  
 typical values at  $T_A = 23\text{ °C}$  and  $V_{CC} = 3\text{ V}$

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Standby current	$I_{SBY}$	ENTX=0		0.05	0.1	$\mu\text{A}$
Operating current	$I_{CC}$	ENTX=1, $V_{PS}=1.1\text{V}$	7	9.5	14	mA
Input current	$I_{IN}$	ENTX=0	-1		1	$\mu\text{A}$
Pull down current	$I_{PD}$	ENTX=1	3	8	30	$\mu\text{A}$
Pull up current	$I_{PS}$	ENTX=1	14	20	24	$\mu\text{A}$

#### 4.5 AC Characteristics

all parameters under normal operating conditions, unless otherwise stated;  
 typical values at  $T_A = 23\text{ °C}$  and  $V_{CC} = 3\text{ V}$ ;  
 ENTX = 1,  $V_{PS}=1.1\text{V}$ ,  $f_c = 868.3\text{ MHz}$ , test circuit shown in Fig. 2

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Output power	$P_o$			-2		dBm
Reference spurs	$P_{ref}$	@ $f_c \pm f_{ref}$		-44		dBm
Harmonic content	$P_{harm}$	@ $2f_c, 3f_c, 4f_c$		-40		dBm
Spurious output signal	$P_{off}$	$V_{PS} \leq 0.1\text{V}$		-60		dBm
VCO gain	$K_{VCO}$			300		MHz/V
Charge pump current	$I_{CP}$			$\pm 260$		$\mu\text{A}$
Start-up time	$t_{on}$	from "TX standby" to "TX active" mode		1.0	1.2	ms

#### 4.6 Output Power Selection

typical values at  $T_A = 23\text{ °C}$  and  $V_{CC} = 3\text{ V}$ ;  
 ENTX = 1,  $f_c = 868.3\text{ MHz}$ , test circuit shown in Fig. 2

R1 / k $\Omega$	0	7.5	11	15	24	43
R2 / k $\Omega$	$\infty$	4.7	4.7	4.7	4.7	4.7
$V_{PS}$ / V	$\geq 2$	1.1	0.9	0.7	0.5	0.3
$I_{CC}$ / mA	12.5	9.5	8.5	7.8	7.0	6.2
$P_o$ / dBm	1	-2	-5	-8	-10	-15
$P_{harm}$ / dBm	$\leq -40$	$\leq -40$	$\leq -40$	$\leq -45$	$\leq -45$	$\leq -50$

If the transmitter is operated at any supply voltage  $V_{CC}$ ,  
 the values for  $R_1$  and  $R_2$  can be calculated as follows:

$$R_1 = R_2 \cdot \left( \frac{V_{CC}}{V_{PS}} - 1 \right)$$

## 5 Test Circuit

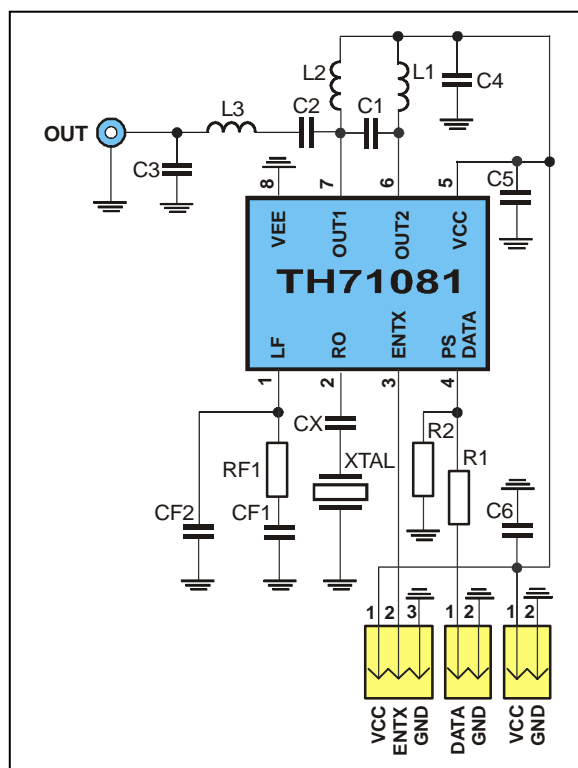


Fig. 2: Test circuit for ASK with 50Ω matching network

### 5.1 Test circuit component list to Fig. 2

Part	Size	Value	Tolerance	Description
CF1	0603	4.7 nF	±10%	loop filter capacitor
CF2	0603	56 pF	±10%	loop filter capacitor
CX	0603	18 pF	±5%	XOSC capacitor, <b>note 1</b>
C1	0603	0.68 pF	±5%	impedance matching capacitor
C2	0805	33 pF	±5%	impedance matching capacitor
C3	0805	2.2 pF	±5%	impedance matching capacitor
C4	0603	330 pF	±5%	blocking capacitor
C5	0603	330 pF	±10%	blocking capacitor
C6	0805	33 nF	±10%	blocking capacitor
L1	0603	8.2 nH	±5%	impedance matching inductor
L2	0603	15 nH	±5%	impedance matching inductor
L3	0603	22 nH	±5%	impedance matching inductor
RF1	0603	1.0 kΩ	±10%	loop filter resistor
R1	0603	see para. 4.6	±10%	ASK power-select resistor, not requirement at CW mode
R2	0603	see para. 4.6	±10%	ASK or CW mode power-select resistor
XTAL	HC49/S	27.1344 MHz	±30ppm calibr. ±30ppm temp.	fundamental wave crystal, $C_L = 12 \text{ pF}$ , $C_{0, \text{max}} = 7 \text{ pF}$ , $R_1 = 40 \text{ } \Omega$

**Note 1:** value depending on crystal parameters



## 6 Spectrum Plots

All plots depict TH71071's typical performance at  $V_{CC} = 3.0\text{ V}$  and  $T_A = 23\text{ }^\circ\text{C}$ , derived with the test circuit shown in Fig. 2.

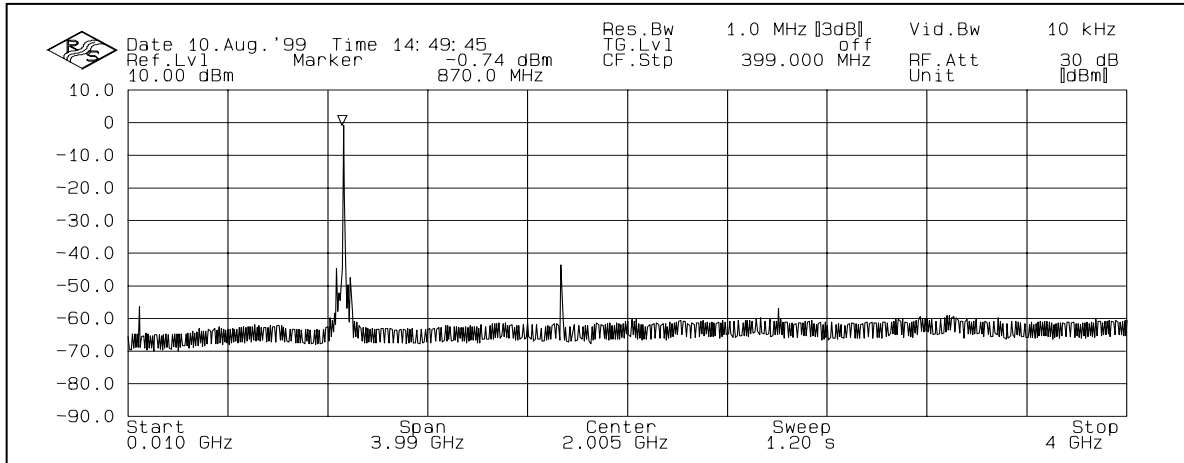


Fig. 3: RF output signal and spurious emissions, CW mode

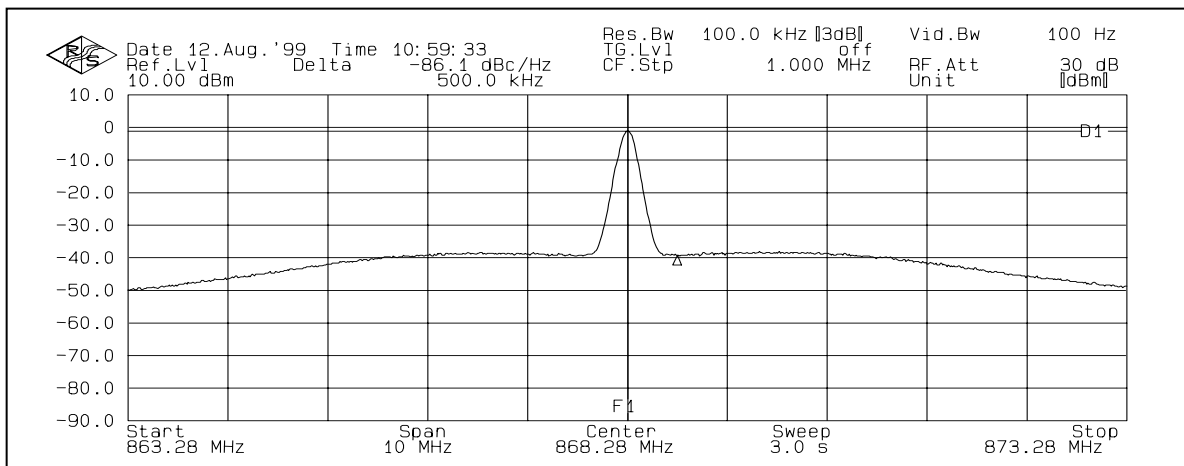


Fig. 4: Single-sideband phase noise at 500 kHz offset, CW mode

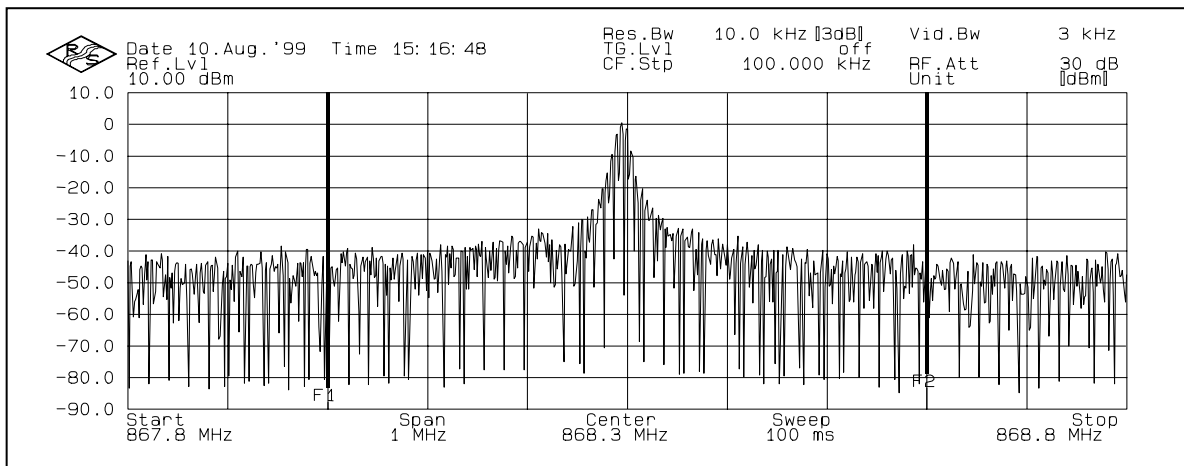


Fig. 5: ASK modulation with  $R_{ASK} = 4\text{ kbit/s NRZ}$

## 7 Package Information

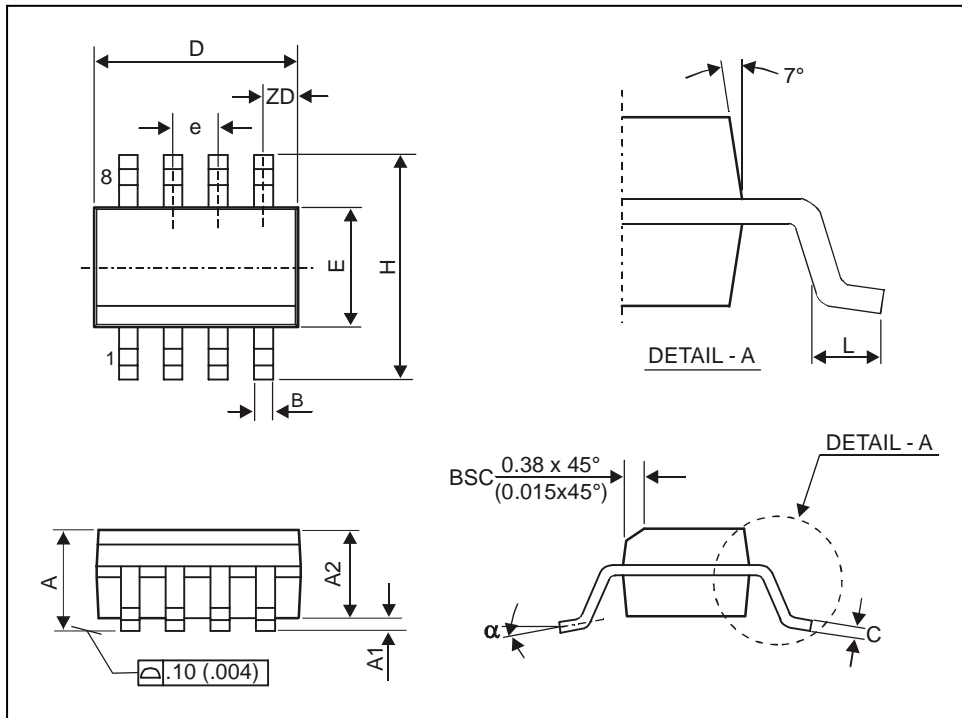


Fig. 6: SOIC8 (Small Outline Integrated Circuit)

all Dimension in mm, coplanarity < 0.1mm												
	D	E	H	A	A1	A2	e	B	ZD	C	L	α
min	4.80	3.81	5.80	1.52	0.10	1.37	1.27	0.36	0.53	0.19	0.41	0°
max	4.98	3.99	6.20	1.72	0.25	1.57	1.27	0.46	0.53	0.25	1.27	8°
all Dimension in inch, coplanarity < 0.004"												
min	0.189	0.150	0.2284	0.060	0.0040	0.054	0.050	0.014	0.021	0.075	0.016	0°
max	0.196	0.157	0.2440	0.068	0.0098	0.062	0.050	0.018	0.021	0.098	0.050	8°

## 8 Reliability Information

This Melexis device is classified and qualified regarding soldering technology, solderability and moisture sensitivity level, as defined in this specification, according to following test methods:

- 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)
- CECC00802  
Standard Method For The Specification of Surface Mounting Components (SMDs) of Assessed Quality
- EIA/JEDEC JESD22-B106  
Resistance to soldering temperature for through-hole mounted devices
- EN60749-15  
Resistance to soldering temperature for through-hole mounted devices
- MIL 883 Method 2003 / EIA/JEDEC JESD22-B102  
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.

Based on Melexis commitment to environmental responsibility, European legislation (Directive on the Restriction of the Use of Certain Hazardous substances, RoHS) and customer requests, Melexis has installed a Roadmap to qualify their package families for lead free processes also.

Various lead free generic qualifications are running, current results on request.

For more information on manufacturability/solderability see quality page at our website:

<http://www.melexis.com/html/pdf/MLXleadfree-statement.pdf>

## 9 ESD Precautions

Electronic semiconductor products are sensitive to Electro Static Discharge (ESD).

Always observe Electro Static Discharge control procedures whenever handling semiconductor products.

## 10 Disclaimer

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