

# DATASHEET



**巨微** MacroGiga  
*Wirelessing Everyone*

**MG223**

---

BLE 5.1 Beacon Transmitter

*V1.1*

*November 11, 2022*

MACROGIGA reserves the right to make changes to its products or to discontinue any integrated circuit product or service without notice. MACROGIGA integrated circuit products are not designed, intended, authorized, or warranted to be suitable for use in life-support applications, devices or systems or other critical applications. Use in such applications is done at the sole discretion of the customer. MACROGIGA will not warrant the use of its devices in such applications.

**Revision History:**

Revision	Date	Descriptions
0.1	2020/11/15	Initial version
0.2	2020/12/25	Amend: Update Electrical Characteristics
1.1	2022/11/11	Amend: Document style Add: MG223-S08 SOP8 package description

## Overviews

MG223 is a BLE 5.1 beacon transmitter which supports advertising communication. It integrates all necessary components such as Balun, GFSK, modem, baseband and packet handling engine, with software configurable registers for providing a simplest approach for BLE transmission through advertising channels by a single-ended RF port pin with no external matching components needed. It's specially designed ultra-low power consumption ( $< 0.2\mu\text{A}$ ) standby mode makes MG223 an outstanding RF transmitter for ultra low power Bluetooth Smart Devices application.

MG223 can be configured and operated through a 3-wire SPI(Serial Peripheral Interface) or an I2C interface.

The on-chip built-in voltage regulators ensure a high Power Supply Rejection Ratio (PSRR) and a wide power supply range(2.0~3.6V).

### RF transceiver

- BLE 5.1 beacon transmitter
- GFSK modulation
- Supports 1Mbps and 2Mbps air data rate
- Provides a single-ended RF port pin; Matching components is not necessary
- Programmable -20dBm to +3.5dBm TX power
- 14.5mA TX current @0dBm, 3.3V

### Baseband

- Cyclic redundancy check
- Data whitening
- Access code correlation

### Host Interface

- 3-wire hardware SPI, Max 10Mbps
- I2C interface

### Power Management

- Integrated voltage regulator
- 2.0 to 3.6V supply range
- Idle modes with fast start-up times for advanced power management
- 4uA in sleep mode
- 0.2uA in standby mode

### Low cost BOM

- Provides a single-ended RF port pin, no matching components needed
- Built-in 32KHz oscillator
- Supports low cost crystal(16MHz)

## Typical Applications

- Beacon transmitter
- Remote Controller

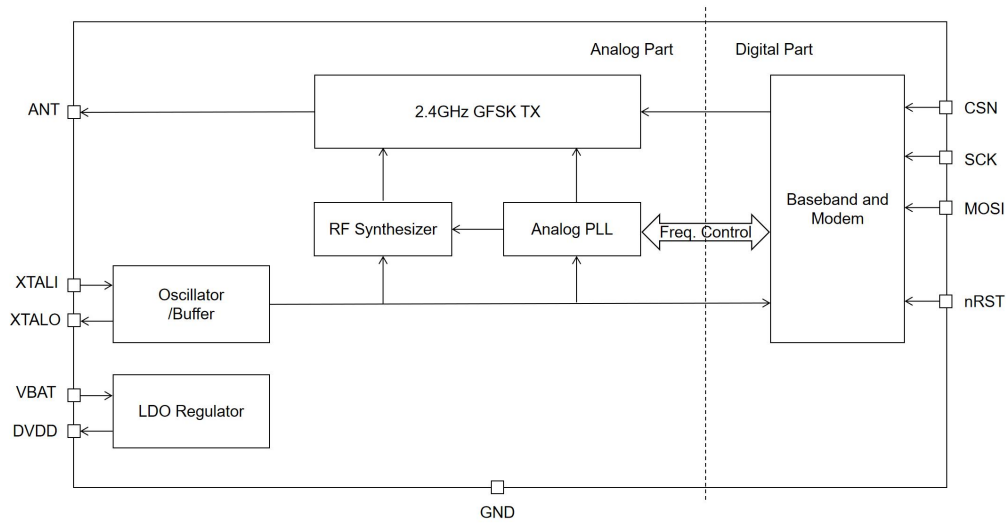
## Ordering Information

- Part number for ordering depends on the package type:
  - MG223 : MSOP10 (3.0mm body width, 0.5mm pitch)
  - MG223-S08 : SOP8 (150mil body width, 1.27mm pitch)

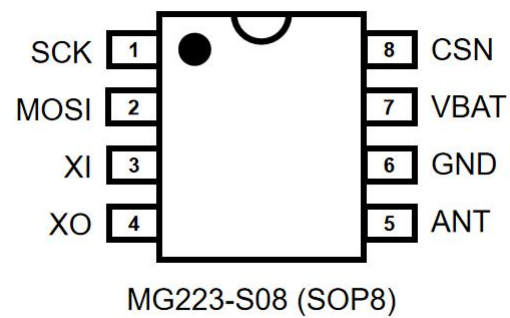
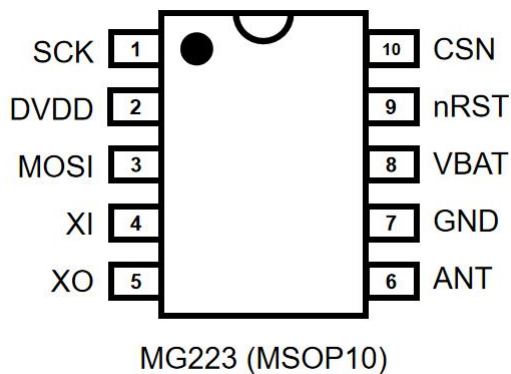
## Table of Contents

<b>1. Block Diagram .....</b>	<b>5</b>
<b>2. Pin Description / Pinout Information .....</b>	<b>5</b>
<b>3. Functional Description .....</b>	<b>6</b>
3.1. Operating modes .....	6
3.2. Data and Control Interface .....	6
3.3. SPI Timing .....	7
3.4. Power management .....	8
3.5. Oscillators .....	8
3.6. nRST pin .....	8
3.7. DVDD pin .....	8
3.8. Antenna matching circuit .....	8
<b>4. Electrical Characteristics .....</b>	<b>9</b>
<b>5. Current Consumption .....</b>	<b>9</b>
<b>6. Typical Application Circuit .....</b>	<b>10</b>
<b>7. Ordering Information .....</b>	<b>12</b>
<b>8. Contact Us .....</b>	<b>12</b>
<b>9. Package Information .....</b>	<b>13</b>
<b>10. Soldering Reflow Profile .....</b>	<b>15</b>

### 1. Block Diagram



### 2. Pin Description / Pinout Information



MG223 (MSOP10)	MG223-S08 (SOP8)	Pin Name	Type	Function Description
1	1	SCK	DIO	SPI Clock / I2C_SCL
2		DVDD	AIO	Digital VDD 1.2v Output
3	2	MOSI	DIO	SPI Slave Data Input / I2C_SDA
4	3	XI	AIO	Connect to external 16MHz Crystal
5	4	XO	AIO	Connect to external 16MHz Crystal
6	5	ANT	RF	Connect to RF antenna
7	6	GND	PWR	Ground
8	7	VBAT	PWR	Power Supply
9		nRST	DIO	Chip reset. Used to wake up from standby mode
10	8	CSN	DIO	SPI Chip Select

Note: DIO=Digital IO, AIO=Analog IO, PWR=Power, RF=Radio Frequency

### 3. Functional Description

#### 3.1. Operating modes

The MG223 supports 3 operating modes for saving power:

Mode	Description
Standby	In Deep Sleep status. All circuit stops, wake up through nRST (not for MG223-S08)
Sleep	In Idle status, no TX
Tx Active	In transmitting status

#### 3.2. Data and Control Interface

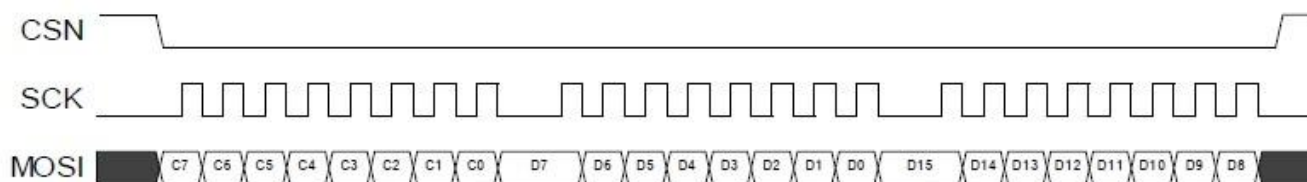
The data and control interface allows accessing to all functions and registers in MG223 through SPI or I2C interface. it consists of the following digital signals:

Signal	Description	I2C mode
MOSI	SPI data signal	SDA
SCK	SPI clock signal	SCL
CSN	SPI chip select signal (low active)	Floating

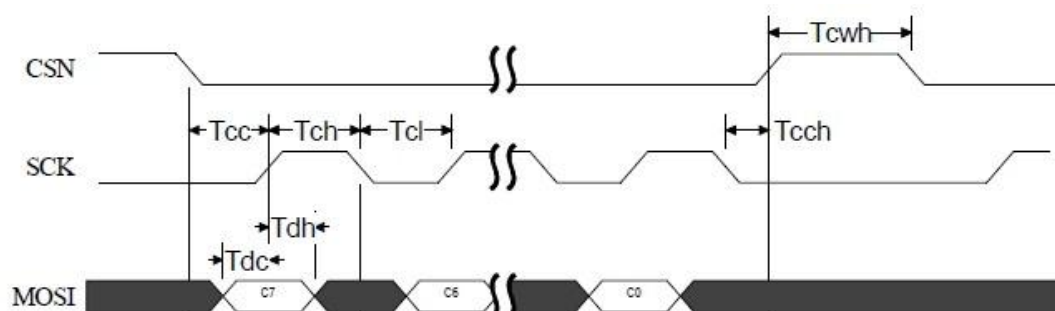
The 3-wire SPI serial interface works in slave mode and supports up to 10Mbps data rate. The I2C mode will be selected when CSN pin leaves floating (Not connected). User can configure and control the MG223 by using read and write commands.

### 3.3. SPI Timing

The SPI operation and timing is given in the following diagrams and table. The device must be in either t standby modes or sleep mode before writing to the configuration registers.



*SPI Read/Write Operation diagram*



*SPI Timing diagram*

Symbol	Parameters	Min.	Max.	Unit
Tcc	CSN to SCK setup	2	-	ns
Tch	SCK high time	40	-	ns
Tcl	SCK low time	40	-	ns
Tcwh	CSN inactive time	50	-	ns
Tcch	SCK to CSN hold	2	-	ns
Tdc	Data to SCK setup	2	-	ns
Tdh	SCK to Data hold	2	-	ns

### 3.4. Power management

The VBAT pin is actually the power supply pin of MG223. It should be connected to the battery or LDO directly with decoupling capacitances. The voltage of VBAT never exceed the maximum rated voltage 3.6V, otherwise permanent damage may cause.

### 3.5. Oscillators

A 16MHz crystal must be connected to XO and XI pin for providing the reference clock for the internal PLLs of the MG223. The precision requirement of the crystal is better than 20ppm.

### 3.6. nRST pin

The nRST pin is the only way for waking up MG223 from Standby mode unless power-off, but it is not available in MG223-S08 (SOP8 package). Thus, please don't try to enter into standby mode in MG223-S08 if there is no power control function.

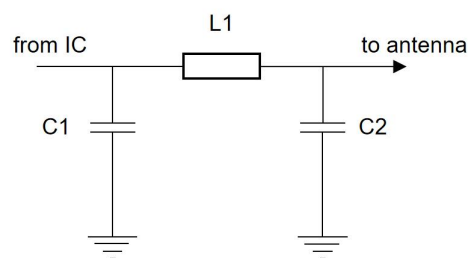
### 3.7. DVDD pin

DVDD pin is the regulated power of 1.2V from the on-chip voltage regulator, which supplies the radio circuit of the chip. It is only available in MG223 MSOP10 but not for SOP8 package. A 0.01uF to 1uF capacitor connected to this pin would be helpful for more RF stability in the case that the lithium battery (like CR2025) is used.

**WARNING:** Never try to connect any power to DVDD pin, otherwise damage may cause.

### 3.8. Antenna matching circuit

An antenna matching circuit may be needed to fulfill some safety regulations. A  $\pi$ -type filter circuit foot-print should be reserved on the PCB in case of necessary. The value of the components should be confirmed in accordance with the actual tuning results.





## 4. Electrical Characteristics

All data are acquired under the conditions of  $V_{DD}=3.0V$ ,  $T_a = 25^{\circ}C$  unless noted.

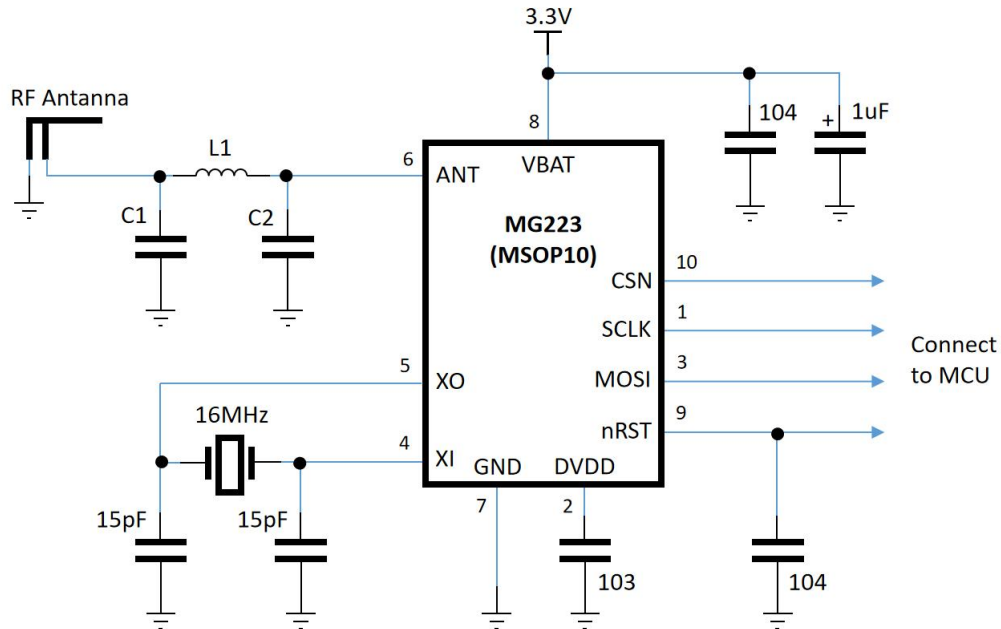
Symbol	Parameter	Notes	Min.	Typ.	Max.	Unit
Operating Conditions						
V <sub>BAT</sub>	Supply voltage		2.0	3.0	3.6	V
TEMP	Operating temperature		-40	+27	+85	°C
General RF condition						
f <sub>OP</sub>	Operating frequency		2402		2480	MHz
R <sub>GFSK</sub>	Air data rate			1, 2		Mbps
F <sub>channel</sub>	Non-overlapping channel spacing			2		MHz
Transmitter Operation condition						
P <sub>RF</sub>	Maximum output power				+3.5	dBm
Power on Reset						
T <sub>POR</sub>	Power on reset time		1.5	5.3	10.3	ms

## 5. Current Consumption

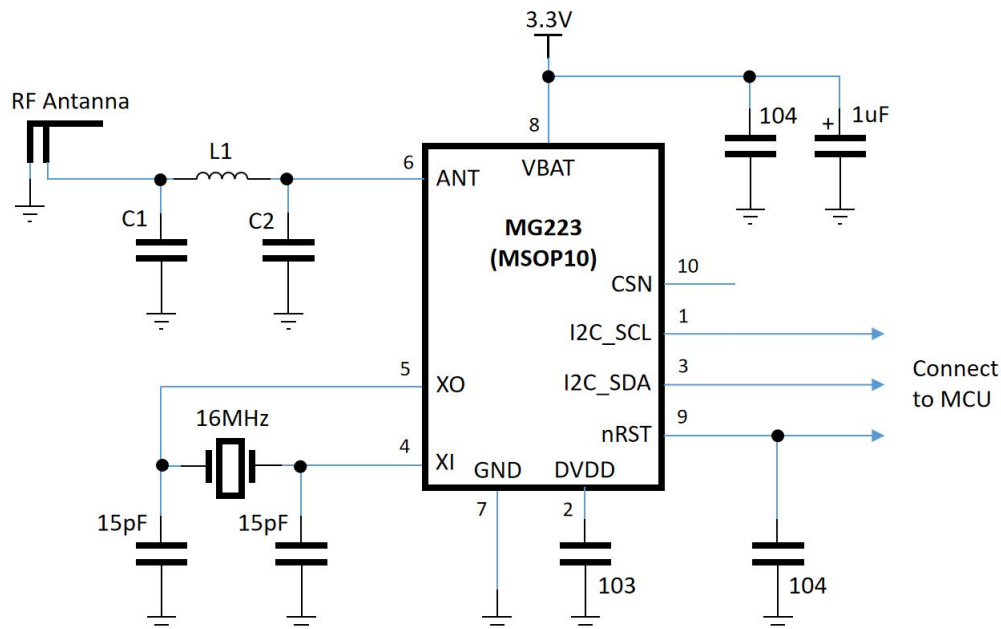
All data are acquired under the conditions of  $V_{DD}=3.0V$ ,  $T_a = 25^{\circ}C$  unless noted.

Mode	Description	Total Typical Current at 3.3V
Standby	Deep-sleep mode. Wake-up through nRST	0.2 $\mu$ A
Sleep	Idle state, no TX, no RX	4 $\mu$ A
TX active	In transmitting	14.5 mA @ 0dBm output power

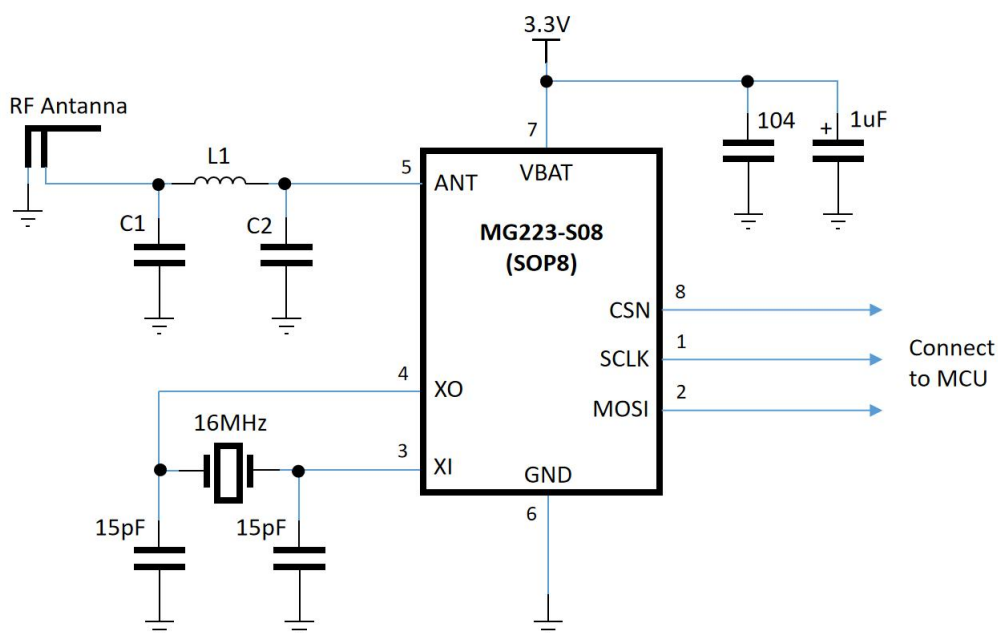
### 6. Typical Application Circuit



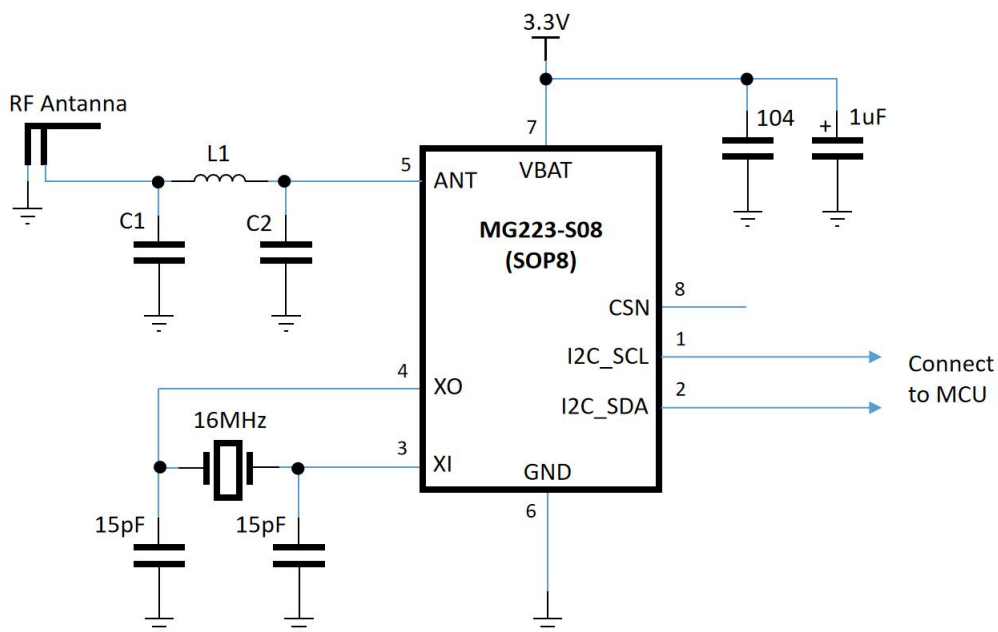
Application circuit example (MG223, SPI mode)



Application circuit example (MG223, I2C mode)



Application circuit example (MG223-S08, SPI mode)



Application circuit example (MG223-S08, I2C mode)

## 7. Ordering Information

Part Number	Package	Marking	Packing form	Packing standard	Min. Order Qty
MG223	MSOP10	Top	Tape and Reel	MSL3 Dry Pack	3000
MG223-S08	SOP8 (150mil)	Top	Tube	MSL3 Dry Pack	10000
MG223-S08-R	SOP8 (150mil)	Top	Tape and Reel	MSL3 Dry Pack	3000

z

## 8. Contact Us

### MacroGiga Electronics Co., Ltd.

Address: Room 1105, No. 257, Xiangke Road, Pudong New Area, Shanghai, P.R.China

Phone: 021-68905736      Zip Code: 201203

Mobile: 15986700805

Email: support@macrogiga.com

### Shenzhen Sales Office

Address: Room 2908, Block 9A1, Shenzhen Bay Eco-Technology Park, No.3609, Baishi Road, Nanshan District, Shenzhen, Guangdong, P.R.China.

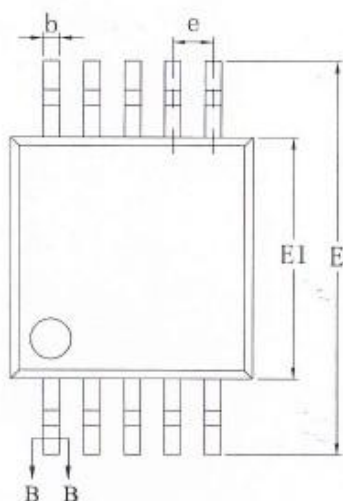
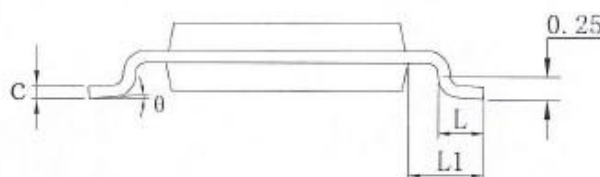
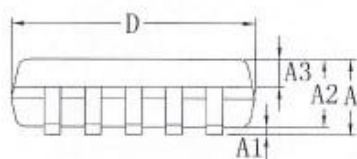
Phone: 021-68905736      Zip Code: 518063

Mobile: 15986700805

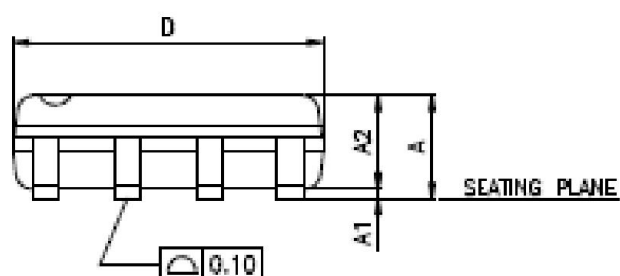
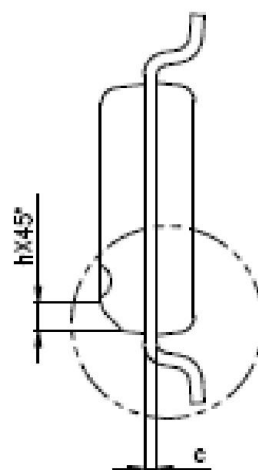
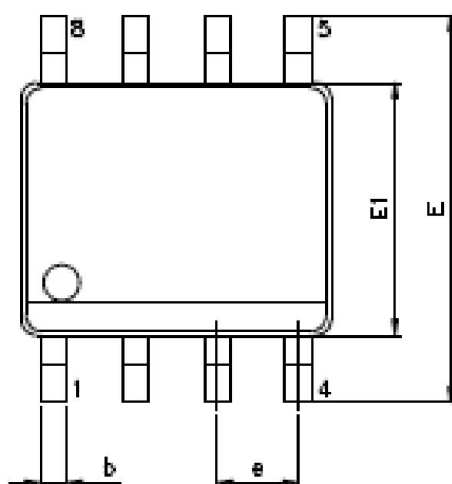
Email: support@macrogiga.com

### 9. Package Information

<b>MG223</b>	<b>MSOP10</b>	<b>Pitch = 0.5mm</b> <b>Body width = 3.00mm = 118mil</b>
--------------	---------------	---



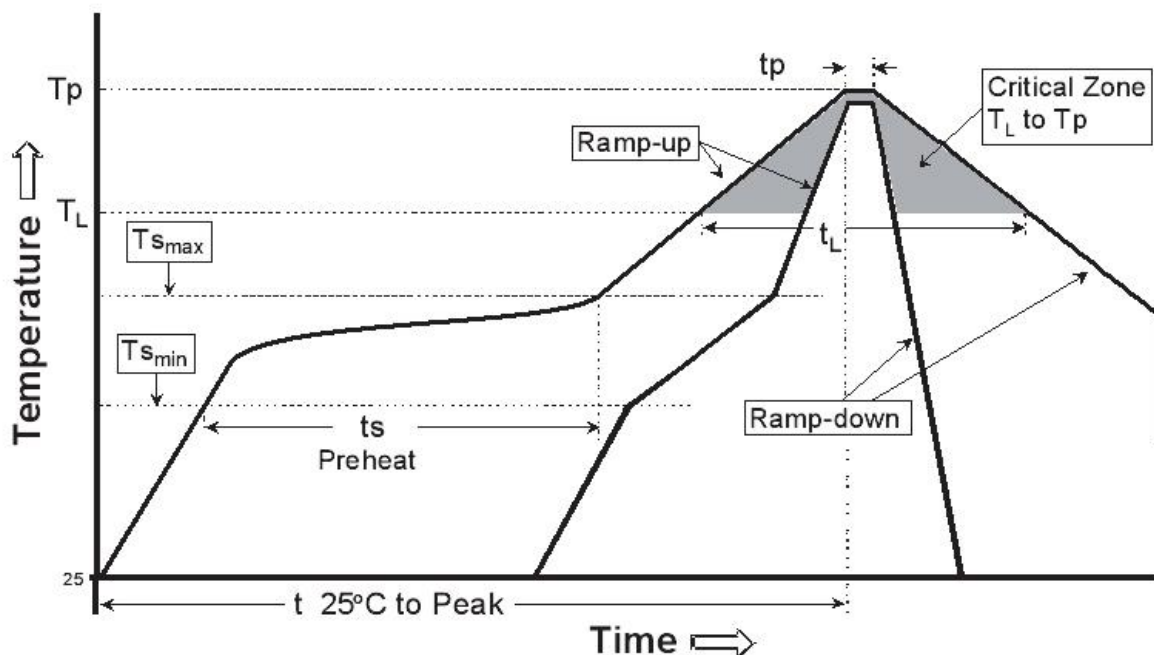
Symbol	Dimensions in Millimeters		
	Min.	Nom.	Max.
A	-	-	1.10
A1	0.05	-	0.15
A2	0.75	-	0.95
A3	0.30	0.35	0.40
D	2.90	3.00	3.10
E	4.70	4.90	5.10
E1	2.90	3.00	3.10
e	0.50 BSC		
L	0.40	-	0.70
L1	0.95 REF		

**MG223-S08**
**SOP8 (150mil)**
**Pitch = 1.27mm = 50mil**
**Body width = 3.95mm = 150mil**


	MILLIMETERS	
SYMBOLS	MIN	MAX
A	-	1.75
A1	0.10	0.25
A2	1.25	-
b	0.31	0.51
c	0.10	0.25
D	4.90 BSC	
E	6.00 BSC	
E1	3.90 BSC	
e	1.27 BSC	
L	0.40	1.27
h	0.25	0.50
$\theta^\circ$	0	8

## 10. Soldering Reflow Profile

Compliance IPC/JEDEC J-STD-020E



Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average Ramp-Up Rate( $T_L$ to $T_P$ )	3 °C/second max.	3 °C/second max
Preheat		
- Temperature Min ( $T_{Smin}$ )	100 °C	150 °C
- Temperature Max ( $T_{Smax}$ )	150 °C	200 °C
- Time ( $t_{Smin}$ to $t_{Smax}$ )	60 - 120 seconds	60 - 120 seconds
Time maintained above:		
- Temperature ( $T_L$ )	183 °C	217 °C
- Time ( $t_L$ )	60 - 150 seconds	60 - 150 seconds
Peak/Classification Temperature ( $T_P$ )	225 °C	260 °C
Time within 5 °C of actual Peak Temperature ( $t_p$ )	10 - 30 seconds	20 - 40 seconds
Ramp-Down Rate	6 °C/second max.	6 °C/second max.
Time 25°C to Peak Temperature	6 minutes max.	8 minutes max.

Note 1: All temperatures refer to topside of the package, measured on the package body surface.