



MG216, BLE Transmitter

Data Sheet

Revision History:

Rev. No.	History	Issue Date	Remark
0.1	Draft	Dec 17, 2021	
0.2	Update reference schematic	Jan 27, 2022	
0.3	Add ESD info	Feb 16, 2022	

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1. Overview

MG216 is a single mode Bluetooth 5.1 BLE transmitter with software configurable registers, embedded packet handling engine, and designed for ultra low power Bluetooth Smart Devices.

The chip is configured and operated via the SPI(Serial Peripheral Interface) or I2C interface.

Internal voltage regulators ensure a high Power Supply Rejection Ratio (PSRR) and a wide power supply range(2.0~3.6V).

1.1 Features

- Radio

Worldwide 2.4GHz ISM band operation with 2MHz channel spacing

GFSK modulation

Support 1Mbps and 2Mbps air data rate

- Transmitter

Programmable output power: -20 ~ +3.5 dBm, without an external RF PA

8.5 mA at 0dBm output power with DCDC on

14.5mA at 0dBm output power with DCDC bypass

- Baseband

Dedicated logic performs:

Cyclic redundancy check

Data whitening

Access code correlation

- Host Interface



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

Support low cost crystal(16MHz)

1.2 Typical Application

- AoA transmitter
- Beacon transmitter



1.3 Block Diagram

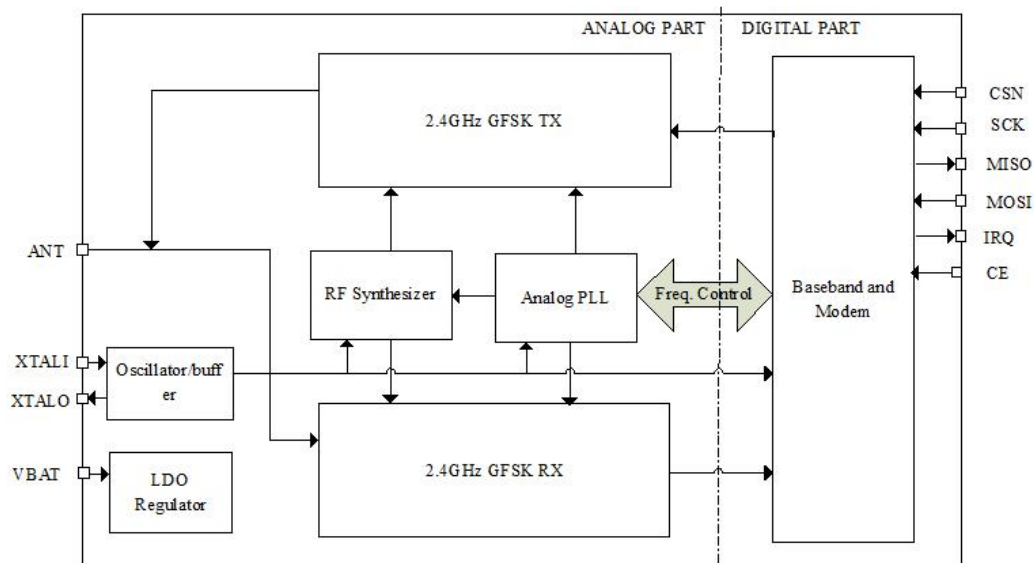


Figure1.1 Block Diagram

2. Pin Description

Pin No.	Symbol	I/O	Function Description
1	CSN	DI	SPI Chip Select
2	MOSI	DI	SPI Slave Data Input / I2C_SDA
3	SCK	DI	SPI Clock / I2C_SCL
4	MISO	DO	SPI master input slave output
5	DVDD	AO	Digital VDD 1.2v Output
6	VFB	A	DCDC voltage feedback
7	VSW	A	DCDC voltage output
8	VBAT	Power	Power Supply
9	XTALI	AI	Crystal 16MHz
10	XTALO	AO	Crystal 16MHz
11	X32K_O	AO	Crystal 32.768KHz
12	X32K_I	AI	Crystal 32.768KHz
13	ANT	RF	Antenna interface
14	GND	Power	Ground(0V)



15	nRST	AI	Chip reset pin, active low
16	IRQ	DO	Interrupt indication

Table2.1 Pin Description

3. Example Application Schematic

MG216 with single ended RF output, crystal and decoupling capacitors.

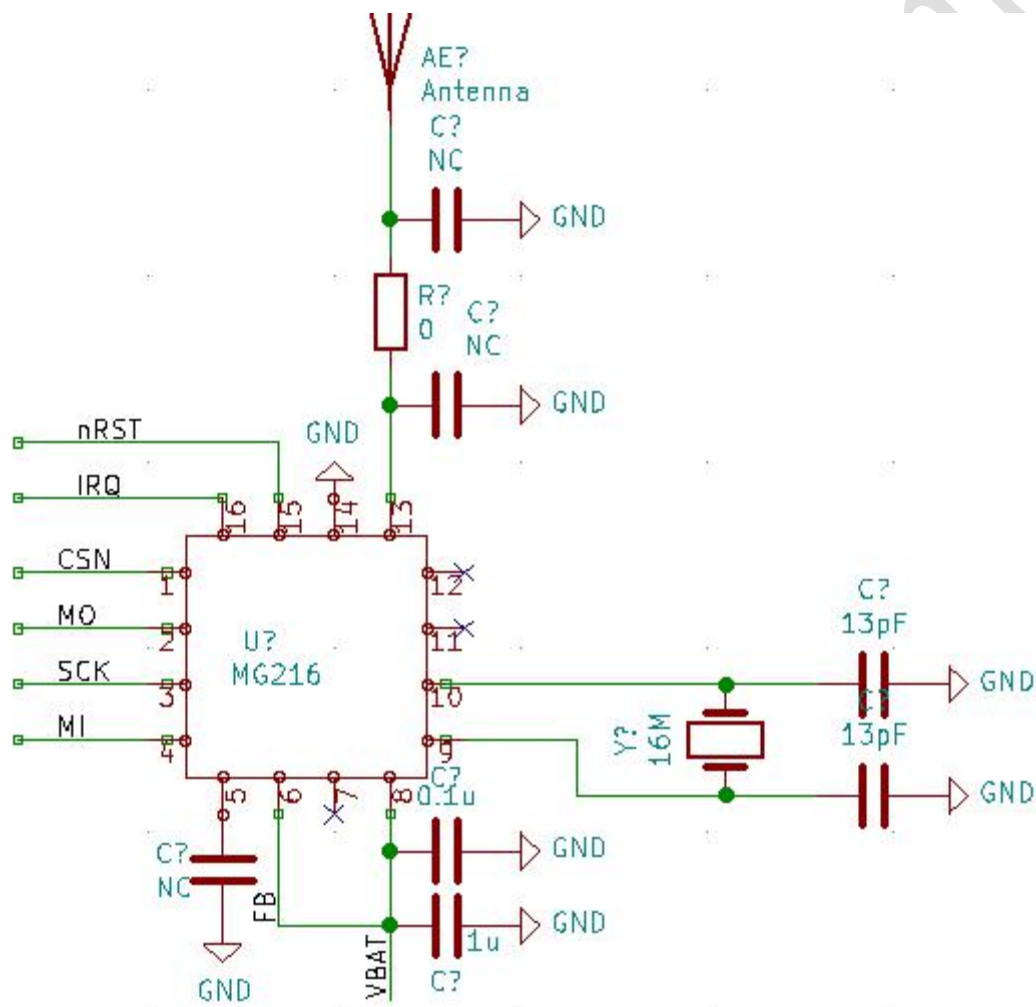


Figure 3.1 Example Application Schematic(DCDC bypass)

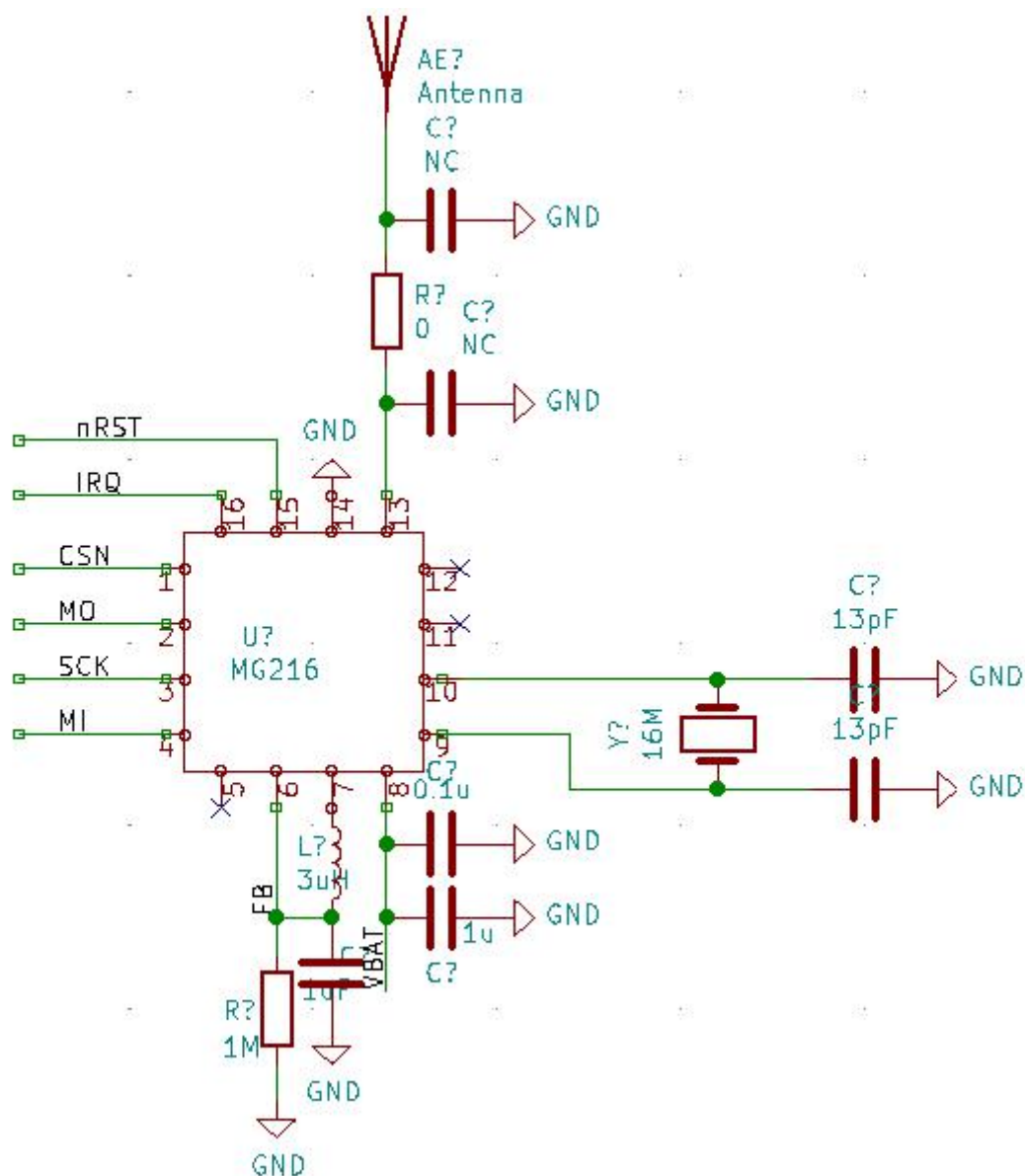


Figure 3.2 Example Application Schematic(DCDC active)

4. Operating modes

The chip has 3 operating modes:

- Standby
- Sleep
- TX active



5. Data and Control Interface

The data and control interface gives you access to all the features in the chip. The data and control interface consists of the following digital signals:

- CSN (SPI_CS signal)
- SCK (SPI_SCK or I2C_SCL)
- MOSI (SPI master output slave input or I2C_SDA)
- MISO (SPI master input slave output)

5.1 Features

- 3-wire or 4-wire SPI serial interface, as slave, up to 10Mbps data rate
- I2C interface
- Easily configurable register map

5.2 I2C

When working in I2C, CSN pin should be floating (Not Connected)。

5.3 SPI Timing

SPI operation and timing is given in Figure 5.3.1, 5.3.2 and 5.3.3. The device must be in one of the standby modes or sleep mode before writing to the configuration registers.

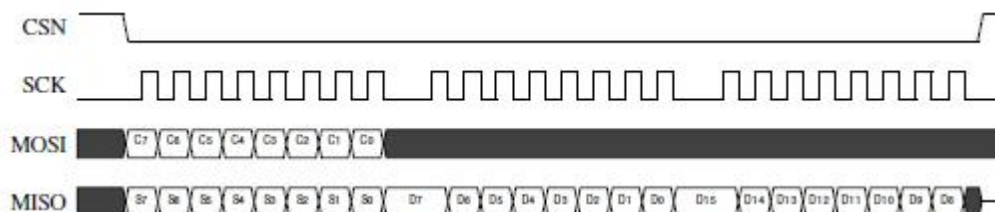


Figure 5.3.1 SPI read operation

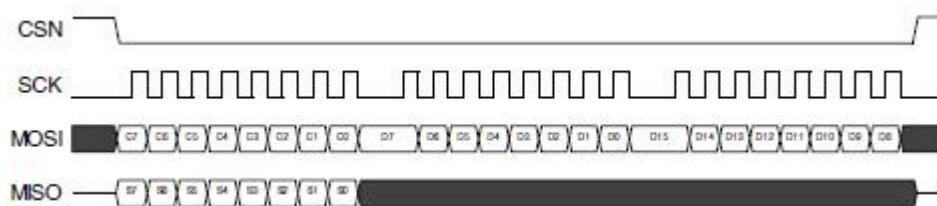


Figure 5.3.2 SPI write operation

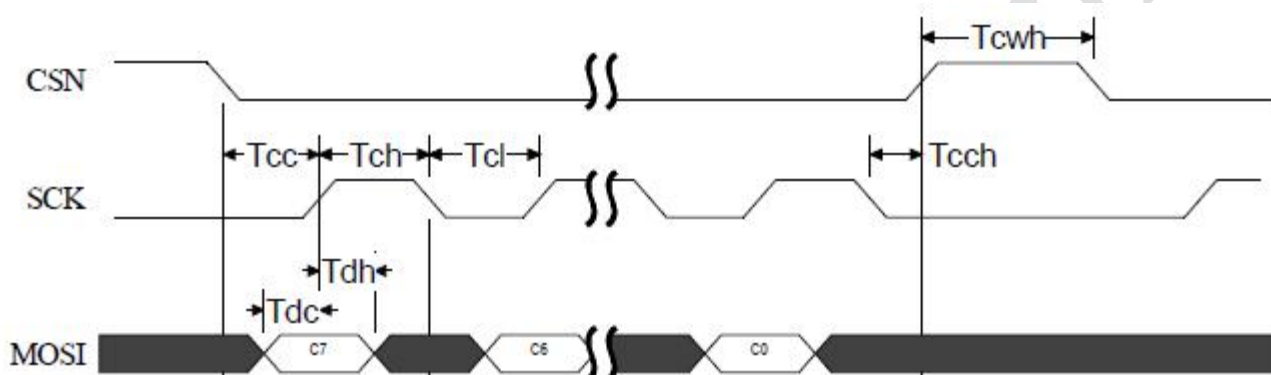


Figure 5.3.3 SPI timing diagram

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

6. Register Map

You can configure and control the radio chip by accessing the register map through SPI or I2C by using



read and write commands.

Address (Hex)	Mnemonic	Bit	Reset Value	Description
00	CONFIG			BLE 配置
		7:1	1000011	Reserved
		0	0	Pwr_up, 芯片开工
01	CONT_TEST			测试配置
		23	1	Adv_no_gap, 三个通道之间无间隔发射
		22	0	Cont_test_2m, 2M 模式发送
		21:16	000000	test_chnl, 测试广播通道设置, 37/38/39
		15:13	110	Xo_wait, 晶体打开后等待 RC 时钟数
		12:8	00000	Reserved
		7:4	0000	Reserved
		3	0	SPI 三线模式使能
		2:0	000	Reserved
02	WAKEUP_NO W			
		7:1	0000000	Reserved
		0	0	开始发送广播
03	PACKET1_CFG			
		23:16	0	Pdu length
		15	0	Rx_add
		14	0	Tx_add
		13:12	00	Reserved
		11:8	0000	Pdu_type
		7:4	0000	Reserved



		3	1	Update fifo enable
		2:0	000	Reserved
04	ADVA			BLE 蓝牙地址
		47:40	0	Ble_advA[47:40]
		39:32	0	Ble_advA[39:32]
		31:24	0	Ble_advA[31:24]
		23:16	0	Ble_advA[23:16]
		15:8	0	Ble_advA[15:8]
		7:0	0	Ble_advA[7:0]
13	ADV_INTERV			Adv interval (1/32 ms)
		31	0	Channel 37 mask
		30	0	Channel 38 mask
		29	0	Channel 39 mask
		28:25	0000	Reserve
		24	0	Adv_interv_rc reload
		23:16	0	Adv_interv_rc[23:16], 周期性广播包的发包间隔高 8 位
		15:8	1	Adv_interv_rc[15:8], 周期性广播包的发包间隔中 8 位
		7:0	0	Adv_interv_rc[7:0], 周期性广播包的发包间隔低 8 位
14	BB_STOP			
		7:6	00	Reserved
		5	0	Phy_coded_en, 物理层 coded 使能
		4:3	00	物理层 Coded 设置 00: s=8



				01: s=2
		2	1	Bb_sleep_xo, 基带 sleep 的时候关闭晶体
		1	0	Bb_stop_now, 广播停止发送
		0	1	Wakeup_interval_en, 周期性广播发送使能
18	XO_PWR_CARR			晶体/载波设置
		7:5	000	Reserved
		4	0	Cont_wave, 连续发送
		3	0	Carrier_wave_en, 载波模式
		2	1	上电结束标志
		1	0	Reserved
		0	1	XO_PD_EN, 从 0 到 1 关闭 XO
1C	IRQ_MASK			IRQ mask 设置
		7:6	01	Reserved
		5	0	Wakeup irq mask
		4	0	Sleep irq mask
		3:0	0000	Reserved
1D	IRQ_STATE			IRQ 状态
		7:6	01	Reserved
		5	0	Wakeup irq status
		4	0	Sleep irq status
		3:0	0000	Reserved
1E	IC_VER			Chip version info
		7:0		Chip version, read only
2F	PA_CFG			Chip version info



		15:13	000	Reserved
		12:8	00000	pa_gain[4:0], range 00~1F
		7:4	0000	Reserved
		3	1	Buck_pd
		2	1	Pa_pd
		1:0	00	Reserved
E1	TX_PLD			TX Data Payload, MaxLen is 31 Bytes

7. Electrical Characteristics

Conditions: VDD = +3V, VSS = 0V, TA = - 40°C to + 85°C

Symbol	Parameter	Notes	Min.	Typ.	Max.	Unit
Operating Conditions						
VDD	Supply voltage		2.0	3.0	3.6	V
TEMP	Operating Temperature		-40	+25	+85	°C
General RF condition						
f _{OP}	Operating frequency		2402		2480	MHz
R _{GFSK}	Air data rate			1, 2		Mbps
F _{channel}	Non-overlapping channel spacing			2		MHz
Transmitter Operation condition						
P _{RF}	Maximum output power				+3.5	dBm
Power on Reset						
T _{POR}	Power on reset time		1.5	5.3	10.3	ms

Table 7.1 Electrical Specification

Symbol	Parameter	Min.	Typ.	Max.	Unit
T _{STG}	Storage temperature	-40	25	150	°C
Top	Working temperature	-40	25	85	°C

Table 7.2 Absolute maximum rating

Symbol	Parameter	Conditions	Max	Unit
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$V_{ESD(HBM)}$	Electrostatic discharge voltage (Human body model)	$T_A=+25^{\circ}\text{C}$, conforming to JS-001-2017	± 8000	V
$V_{ESD(CDM)}$	Electrostatic discharge voltage (Charging device model)	$T_A=+25^{\circ}\text{C}$, conforming to JS-002-2018	± 750	
I_{LU}	Latch-up current	$T_A=+25^{\circ}\text{C}$, conforming to JESD78E	± 200	mA

Table 7.3 ESD characteristics

8. Current Consumption

Table 8.1 shows total typical current consumption measured at the battery.

Mode	Description	Total Typical Current at 3.3v
Sleep	Idle state, no TX	4 uA
standby	Deepsleep mode. Wakeup through nRST	0.2 uA
TX active	In transmitting	14.5 mA @ 0dBm output power, DCDC bypass
TX active	In transmitting	8.5 mA @ 0dBm output power, DCDC active

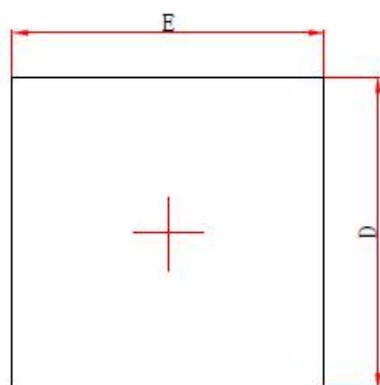
Table 8.1 Current Consumption

Txpwr(dBm)	Current with DCDC(mA)	Current w/o DCDC(mA)	Note
-3	6.8	11.50	In transmitting, VBAT=3.3v
0	8.5	14.50	In transmitting, VBAT=3.3v
1	9.1	15.85	In transmitting, VBAT=3.3v
2	9.9	17.35	In transmitting, VBAT=3.3v
3	10.9	19.20	In transmitting, VBAT=3.3v

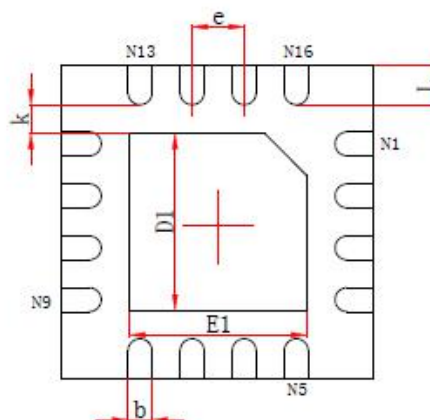
Table 8.2 Typical current vs Tx power

9. Package Information

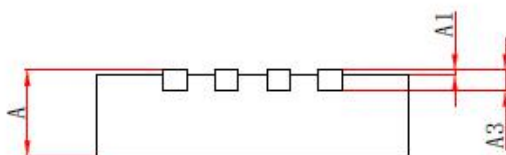
QFN16(3.0 x 3.0 x 0.75mm, pitch 0.5 mm)



Top View



Bottom View



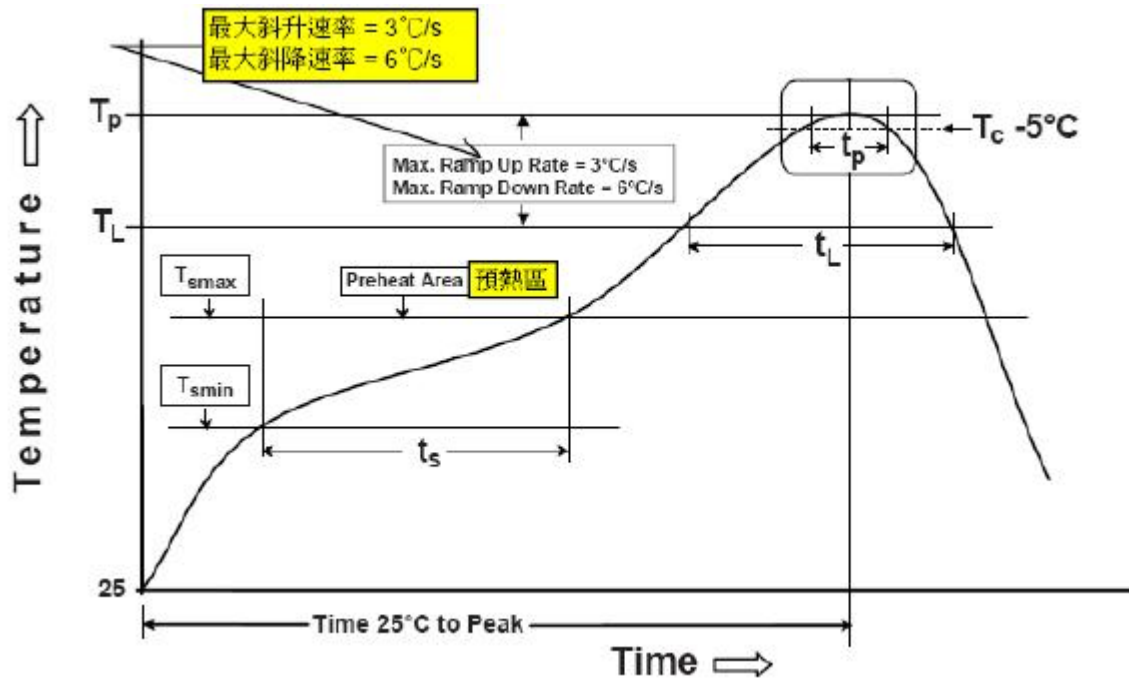
Side View

Table 9.1 Package outline

Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min.	Max.	Min.	Max.
D/E	2.900	3.100	0.114	0.122
D1/E1	1.600	1.800	0.063	0.071
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A3	0.203 REF		0.008 REF	
k	0.200 MIN.		0.008 MIN.	
b	0.180	0.300	0.007	0.012
e	0.500 TYP.		0.020 TYP.	
L	0.300	0.500	0.012	0.020



10. Reflow Profile



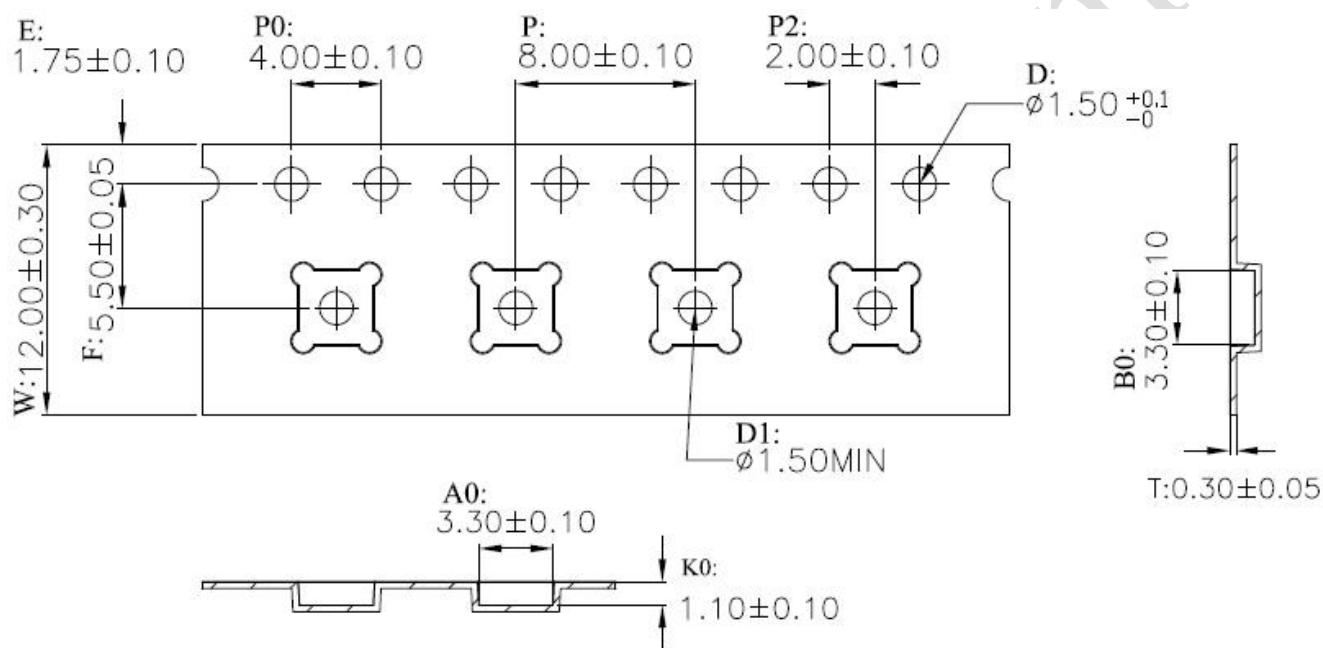
Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Preheat & Soak		
Temperature min (T _{Smin})	100 °C	150 °C
Temperature max (T _{Smax})	150 °C	200 °C
Time (t _{Smin} to t _{Smax}) (ts)	60 - 120 S	60 - 180 S
Average ramp-up rate (T _{Smax} to T _p)	3 °C/S max	3 °C/S max
Liquidous temperature(T _L)	183 °C	217 °C
Time at liquidous (t _L)	60 - 150 S	60 - 150 S
Peak package body temperature(T _p)	235 °C	260 °C
Time(T _c) within 5°C of the specified classification temperature(tp)	20 S	30 S
Average ramp-down rate (T _p to T _L)	6°C/S max	6°C/S max
Time 25°C to peak temperature	6 minutes max	8 minutes max



11. Tape and Reel Information

The following pages include mechanical packaging and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document.

11.1 Tape Information



W	12.00 ±0.30	mm
A0	3.30 ±0.10	mm
B0	3.30 ±0.10	mm
K0	1.10 ±0.10	mm



11.3 Orderable Information

Revision: 0.3