

## 256K-Bit, IIC, Serial EEPROM, BL24C256F

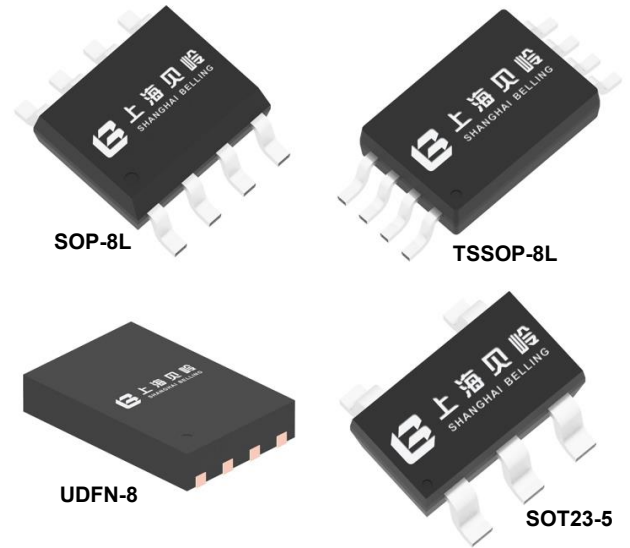
### 1. Product Features

- Compatible with all I2C bidirectional data transfer protocol
- Memory array:  
256 Kbits (32 Kbytes) of EEPROM  
Page size: 64 bytes
- Single supply voltage and high speed:  
1 MHz
- Random and sequential Read modes
- Write:  
Byte Write within 3 ms  
Page Write within 3 ms
- Write Protect Pin for Hardware Data Protection
- Schmitt Trigger, Filtered Inputs for Noise Suppression
- High-reliability  
Endurance: 1 Million Write Cycles  
Data Retention: 100 Years
- Enhanced ESD/Latch-up protection

- 8-lead SOP/TSSOP/UDFN/SOT23-5 packages

### 2. Product Applications

- TV & Display
- Electricity metering
- Industrial motor control
- IoT Applications



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## 3. Product Overview

The BL24C256F provides 262,144 bits of serial electrically erasable and programmable read-only memory (EEPROM), organized as 32768 words of 8 bits each.

The device is optimized for use in many industrial and commercial applications where low-power and low-voltage operation are essential.

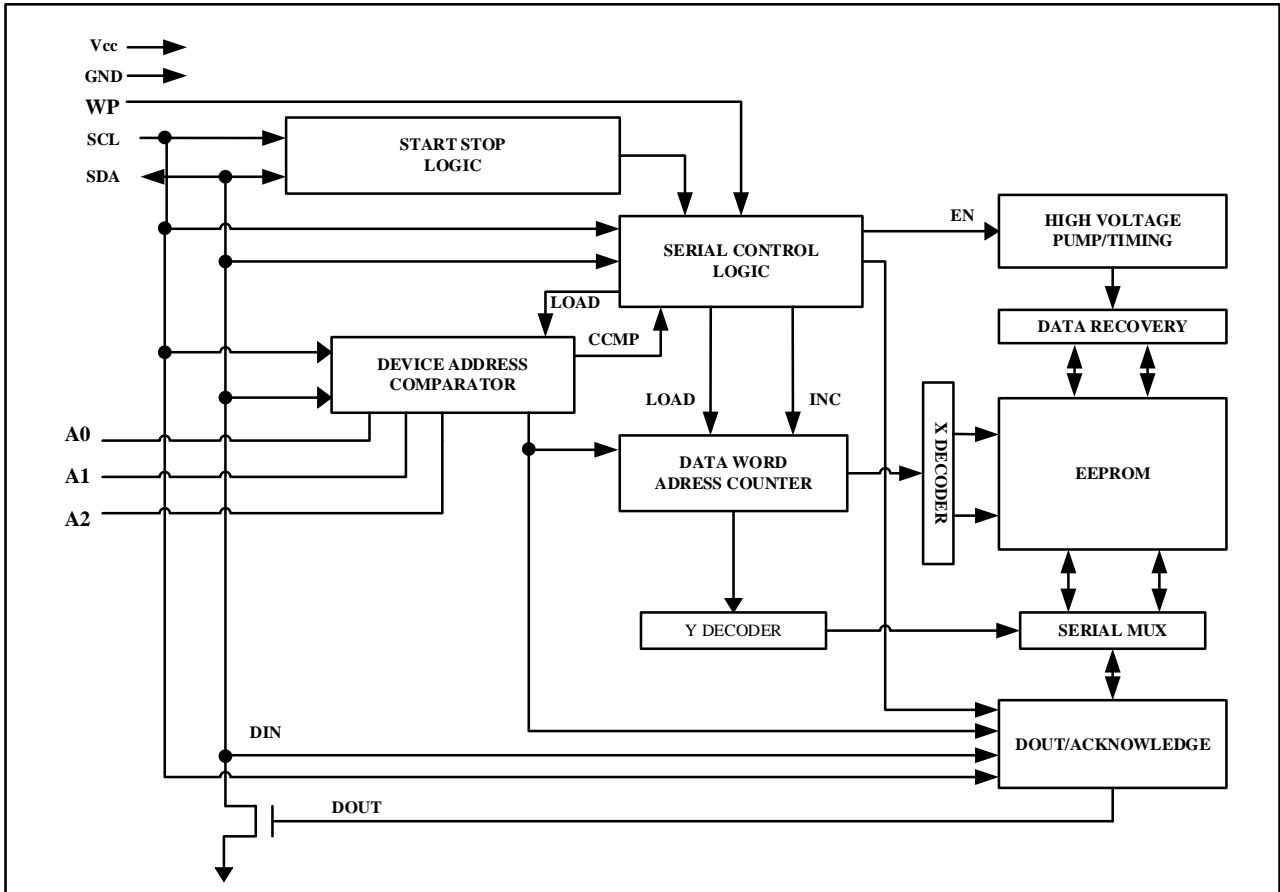


Figure 1 Functional Block Diagram

DEVICE/PAGE ADDRESSES (A2, A1 and A0): The A2, A1 and A0 pins are device address inputs that are hard wire for the BL24C256F. Eight 256K devices may be addressed on a single bus system (device addressing is discussed in detail under the Device Addressing section).

SERIAL DATA (SDA): The SDA pin is bi-directional for serial data transfer. This pin is open-drain driven and may be wire-ORed with any number of other open-drain or open-collector devices.

SERIAL CLOCK (SCL): The SCL input is used to positive edge clock data into each EEPROM device and negative edge clock data out of each device.

WRITE PROTECT (WP): The BL24C256F has a Write Protect pin that provides hardware data protection. The Write Protect pin allows normal read/write operations when connected to ground (GND). When the Write Protection pin is connected to Vcc, the write protection feature is enabled and operates as shown in the following **Table 1**.

Table 1. Write Protect

WP Pin Status	BL24C256F
At VCC	Full(256K)Array
At GND	Normal Read/Write Operations

## 4. Pin Function Description

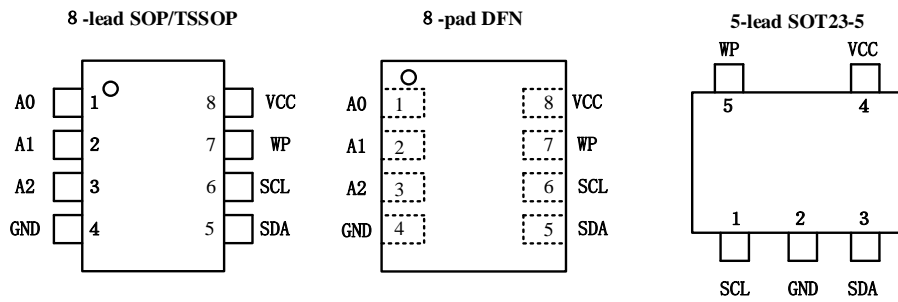


Figure 2 Pin Configuration

Table 2 Serial Port Interface Pins

Pin	Type	Function
A0-A2	I	Address Inputs
SDA	I/O	Serial Data
SCL	I	Serial Clock Input
WP	I	Write Protect
GND	P	Ground
Vcc	P	Power Supply

## 5. Functional Description

### 5.1 Memory Organization

BL24C256F, 256K SERIAL EEPROM: Internally organized with 512 pages of 64 bytes each, the 256K requires a 15-bit data word address for random word addressing.

### 5.2 Device Operation

CLOCK and DATA TRANSITIONS: The SDA pin is normally pulled high with an external device. Data on the SDA pin may change only during SCL low time periods (see **Figure 3**). Data changes during SCL high periods will indicate a start or stop condition as defined below.

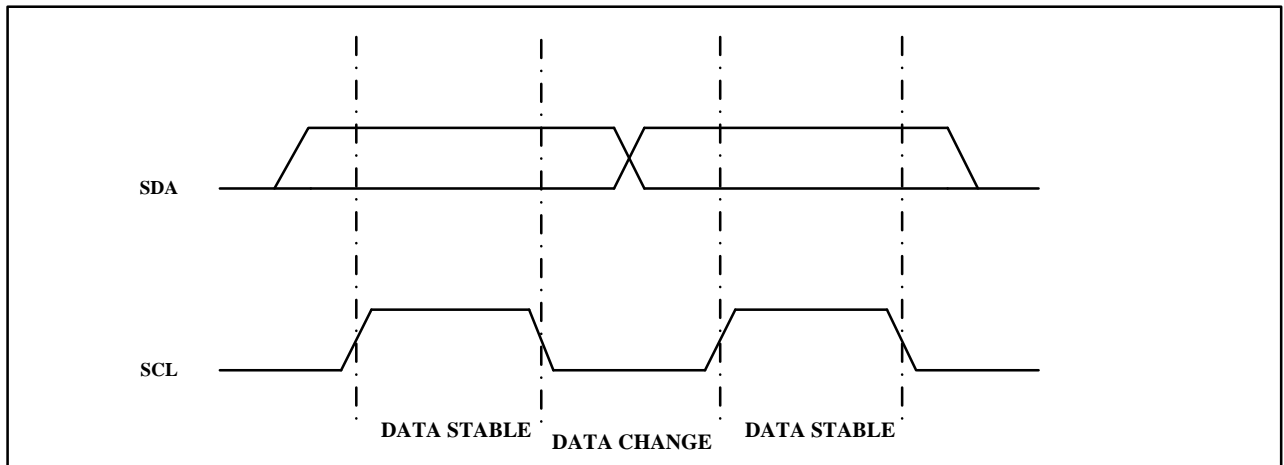


Figure 3. Data Validity

START CONDITION: A high-to-low transition of SDA with SCL high is a start condition which must precede any other command (see **Figure 4**).

STOP CONDITION: A low-to-high transition of SDA with SCL high is a stop condition. After a read sequence, the stop command will place the EEPROM in a standby power mode (see **Figure 4**).

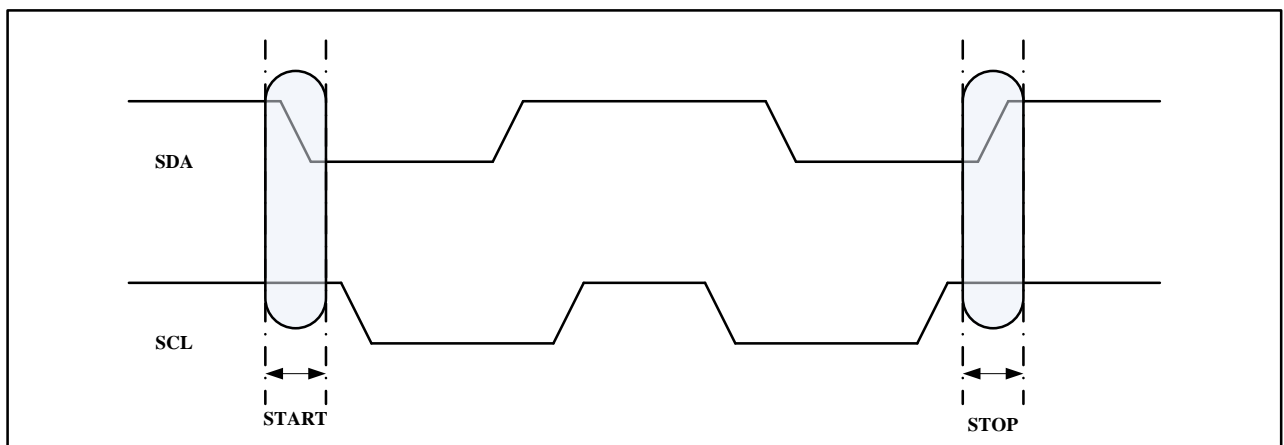


Figure 4. Start and Stop Definition

ACKNOWLEDGE: All addresses and data words are serially transmitted to and from the EEPROM in 8-bit words. The EEPROM sends a "0" to acknowledge that it has received each word. This happens during the ninth clock cycle.

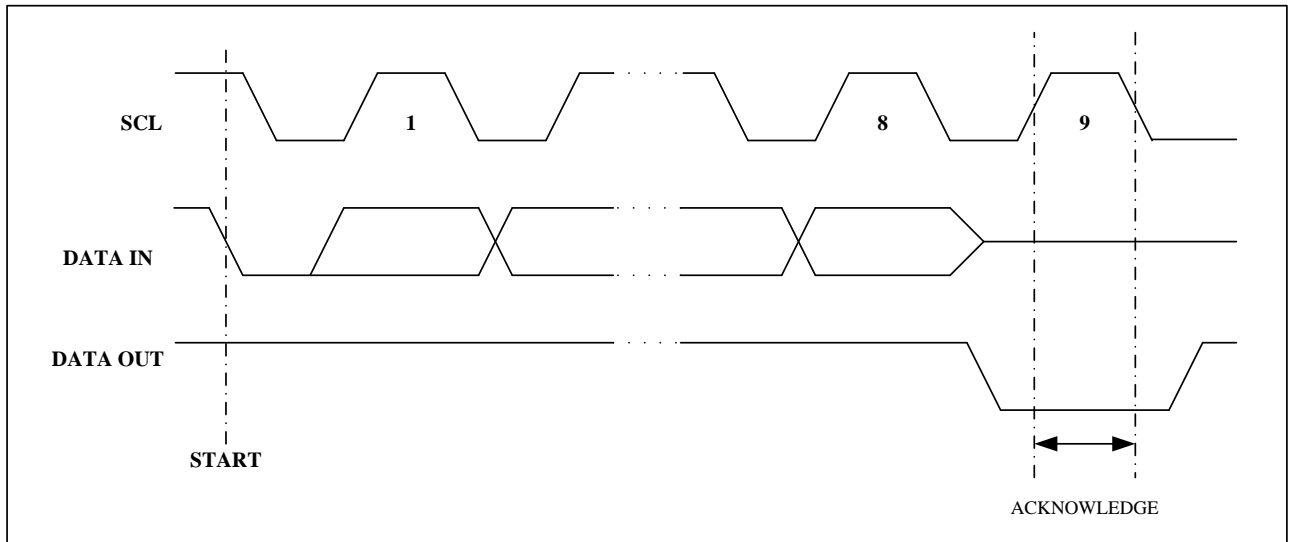


Figure 5. Output Acknowledge

**STANDBY MODE:** The BL24C256F features a low-power standby mode which is enabled: (a) upon power-up and (b) after the receipt of the STOP bit and the completion of any internal operations.

**MEMORY RESET:** After an interruption in protocol, power loss or system reset, any two-wire part can be reset by following these steps:

1. Clock up to 9 cycles.
2. Lock SDA high in each cycle while SCL is high.
3. Create a start condition and a stop condition.

## 5.3 Device Addressing

The 256K EEPROM devices all require an 8-bit device address word following a start condition to enable the chip for a read or write operation (see **Figure 6**)

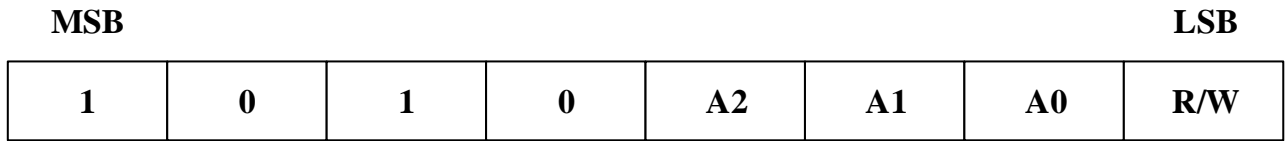


Figure 6. Device Address

The device address word consists of a mandatory "1", "0" sequence for the first four most significant bits as shown. This is common to all the Serial EEPROM devices.

The 256K EEPROM uses A2, A1 and A0 device address bits to allow as much as eight devices on the same bus. These 3 bits must be compared to their corresponding hardwired input pins. The A2, A1 and A0 pins use an internal proprietary circuit that biases them to a logic low condition if the pins are allowed to float.

The eighth bit of the device address is the read/write operation select bit. A read operation is initiated if this bit is high and a write operation is initiated if this bit is low.

Upon a compare of the device address, the EEPROM will output a "0". If a compare is not made, the chip will return to a standby state.

**DATA SECURITY:** The BL24C256F has a hardware data protection scheme that allows the user to write protect the entire memory when the WP pin is at VCC.

## 5.4 Write Operations

**BYTE WRITE:** A write operation requires two 8-bit data words address following the device address word and acknowledgment. Upon receipt of this address, the EEPROM will again respond with a "0" and then clock in the first 8-bit data word. Following receipt of the 8-bit data word, the EEPROM will output a "0" and the addressing device, such as a microcontroller, must terminate the write sequence with a stop condition. At this time the EEPROM enters an internally timed write cycle,  $t_{WR}$ , to the nonvolatile memory. All inputs are disabled during this write cycle and the EEPROM will not respond until the write is complete (see **Figure 7**).

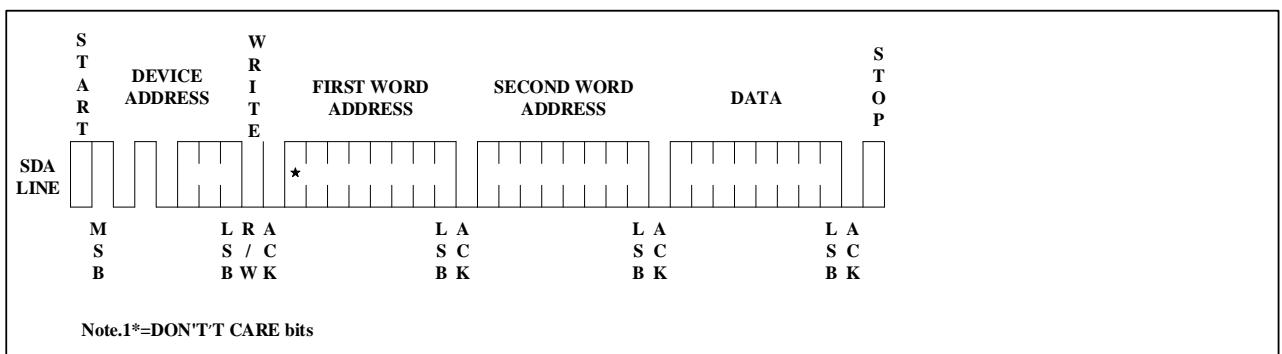


Figure 7. Byte Write

**PAGE WRITE:** The 256K EEPROM is capable of a 64-byte page writes. A page write is initiated the same as a byte write, but the microcontroller does not send a stop condition after the first data word is clocked in. Instead, after the EEPROM acknowledges receipt of the first data word, the microcontroller can transmit up to 63 more data words. The EEPROM will respond with a “0” after each data word received. The microcontroller must terminate the page write sequence with a stop condition (see **Figure 8**).

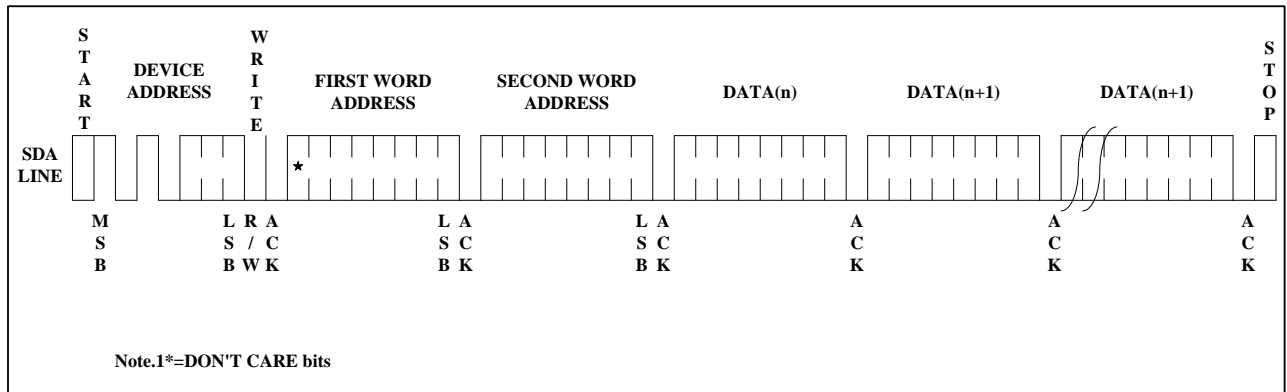


Figure 8. Page Write

The data word address lower six bits are internally incremented following the receipt of each data word. The higher data word address bits are not incremented, retaining the memory page row location. When the word address, internally generated, reaches the page boundary, the following byte is placed at the beginning of the same page. If more than 64 data words are transmitted to the EEPROM, the data word address will "roll over" and previous data will be overwritten.

### 5.5 Read Operations

Read operations are initiated the same way as write operations with the exception that the read/write select bit in the device address word is set to "1". There are three read operations: current address read, random address read and sequential read.

**CURRENT ADDRESS READ:** The internal data word address counter maintains the last address accessed during the last read or write operation, incremented by one. This address stays valid between operations as long as the chip power is maintained. The address "roll over" during read is from the last byte of the last memory page to the first byte of the first page. The address "roll over" during write is from the last byte of the current page to the first byte of the same page. Once the device address with the read/write select bit set to "1" is clocked in and acknowledged by the EEPROM, the current address data word is serially clocked out. The microcontroller does not respond with an input "0" but does generate a following stop condition (see Figure 9).

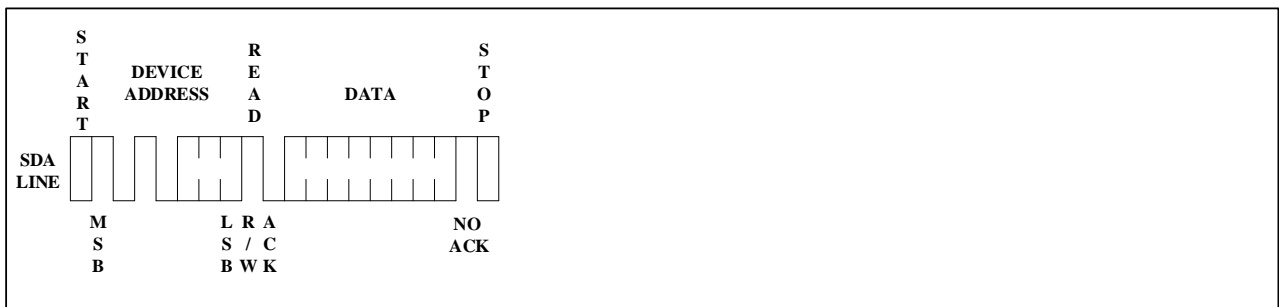


Figure 9. Current Address Read

**RANDOM READ:** A random read requires a "dummy" byte write sequence to load in the data word address. Once the device address word and data word address are clocked in and acknowledged by the EEPROM, the microcontroller must generate another start condition. The microcontroller now initiates a current address read by sending a device address with the read/write select bit high. The EEPROM acknowledges the device address and serially clocks out the data word. The microcontroller does not respond with a "0" but does generate a following stop condition (see **Figure 10**)

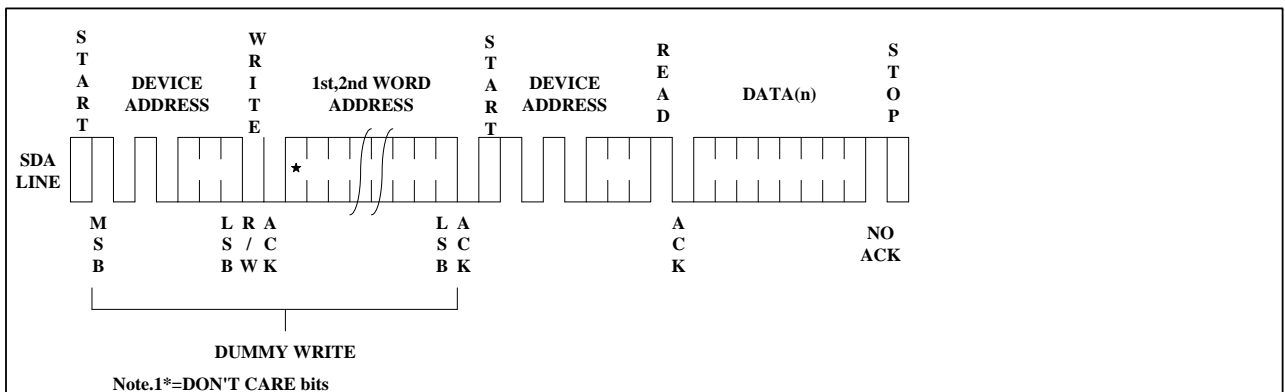


Figure 10. Random Read

SEQUENTIAL READ: Sequential reads are initiated by either a current address read or a random address read. After the microcontroller receives a data word, it responds with an acknowledge. As long as the EEPROM receives an acknowledge, it will continue to increment the data word address and serially clock out sequential data words. When the memory address limit is reached, the data word address will "roll over" and the sequential read will continue. The sequential read operation is terminated when the microcontroller does not respond with a "0" but does generate a following stop condition (see **Figure 11**).

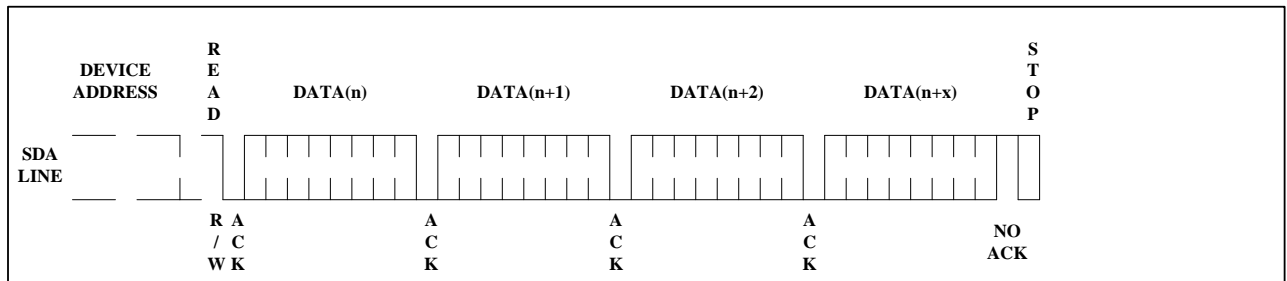


Figure 11. Sequential Read

## 6. Product Specifications

Absolute Maximum Stress Ratings:

Table 3 Absolute Maximum Stress Ratings

Parameters	Ratings	Units
DC Supply Voltage	-0.3 to +6.5	V
Input / Output Voltage	GND-0.3 to VCC+0.3	V
Operating Ambient Temperature	-40 to +85	mA
Storage Temperature	-65 to +150	°C
Junction Temperature (Tjmax)	150	°C

Comments: Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to this device. These are stress ratings only. Functional operation of this device at these or any other conditions above those indicated in the operational sections of this specification is not implied or intended. Exposure to the absolute maximum rating conditions for extended periods may affect device reliability.

### 6.1 DC Specifications

Applicable over recommended operating range from (unless otherwise noted):

Table 4 Operating conditions

BL24C256F	TA = -40°C to +85°C	V <sub>CC</sub> = +1.7V to +5.5V@400kHz V <sub>CC</sub> = +2.5V to +5.5V@1MHz CL=100 pF
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Table 5 DC characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Condition
Supply Current VCC=5.0V	ICC1	-	0.14	0.3	mA	READ at 400KHZ
Supply Current VCC=5.0V	ICC2	-	0.28	0.5	mA	WRITE at 400KHZ
Supply Current VCC=5.0V	ISB1	-	0.03	0.5	μA	VIN=VCC or VSS
Input Leakage Current	IL1	-	0.10	1.0	μA	VIN=VCC or VSS
Output Leakage Current	ILO	-	0.05	1.0	μA	VOUT=VCC or VSS
Input Low Level	VIL1	-0.3	-	VCC×0.3	V	VCC=1.7V to 5.5V
Input High Level	VIH1	VCC×0.7	-	VCC+0.3	V	VCC=1.7V to 5.5V
Output Low Level VCC=1.7V	VOL1	-	-	0.2	V	IOL=0.15mA
Output Low Level VCC=5.0V	VOL2	-	-	0.4	V	IOL=3.0mA

## Pin Capacitance

Applicable over recommended operating range from TA = 25°C, f = 1.0 MHz, VCC = +1.7V

Table 6 Pin Capacitance

Parameter	Symbol	Min	Typ	Max	Unit	Condition
Input/Output Capacitance(SDA)	C <sub>I/O</sub>	-	-	8	pF	V <sub>IO</sub> =0V
Input Capacitance(A0,A1,A2,SCL)	C <sub>IN</sub>	-	-	6	pF	V <sub>IN</sub> =0V

## 6.2 AC Specifications

Applicable over recommended operating range from (unless otherwise noted):

Table 7 Operating conditions

BL24C256F	TA = -40°C to +85°C	V <sub>CC</sub> = +1.7V to +5.5V@400kHz V <sub>CC</sub> = +2.5V to +5.5V@1MHz CL=100 pF
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Table 8 AC characteristics

Parameter	Symbol	1.7V ≤ V <sub>CC</sub> < 2.5V			2.5V ≤ V <sub>CC</sub> < 5.5V			Units
		Min	Typ	Max	Min	Typ	Max	
Clock Frequency,SCL	fSCL	-	-	400	-	-	1000	kHz
Clock Pulse Width Low	tLOW	1.3	-	-	0.5	-	-	μs
Clock Pulse Width High	tHIGH	0.6	-	-	0.26	-	-	μs
Noise Suppression Time	tI	-	-	50	-	-	50	ns
Clock Low to Data Out Valid	tAA	-	-	0.9	-	-	0.45	μs
Time the bus must be free before a new transmission can start	tBUF	1.3	-	-	0.5	-	-	μs
Start Hold Time	tHD:STA	0.6	-	-	0.25	-	-	μs
Start Setup Time	tSU:STA	0.6	-	-	0.25	-	-	μs
Data In Hold Time	tHD:DAT	0	-	-	0	-	-	μs
Data in Setup Time	tSU:DAT	100	-	-	100	-	-	ns
Input Rise Time(1)	tR	-	-	0.3	-	-	0.12	μs
Input Fall Time(1)	tF	-	-	0.3	-	-	0.12	μs
Stop Setup Time	tSu:STO	0.6	-	-	0.25	-	-	μs
Data Out Hold Time	tDH	50	-	-	50	-	-	ns
Write Cycle Time	twR	-	1.9	3	-	1.9	3	ms
5.0V,25°C,Byte Mode(1)	Endurance	1M	-	-	1M	-	-	Write Cycle

### Notes:

1. This parameter is characterized and is not 100% tested.

2. AC measurement conditions:

RL (connects to V<sub>CC</sub>): 1.3 k

Input pulse voltages: 0.3 V<sub>CC</sub> to 0.7 V<sub>CC</sub>

Input rise and fall time: 50 ns

Input and output timing reference voltages: 0.5 V<sub>CC</sub>

The value of RL should be concerned according to the actual loading on the user's system.

### 6.3 Bus Timing

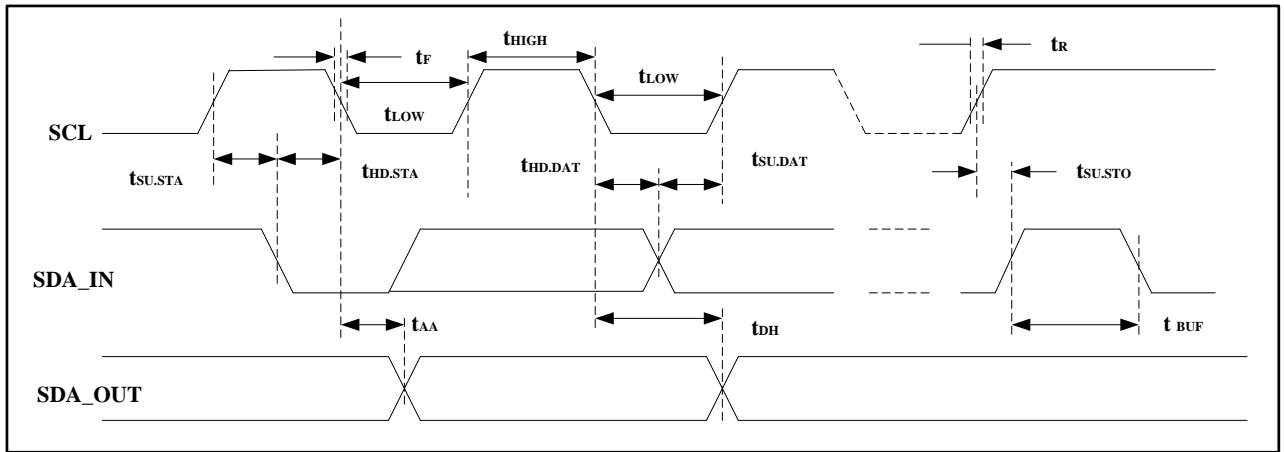


Figure 12. Bus Timing

### 6.4 Write Cycle Timing

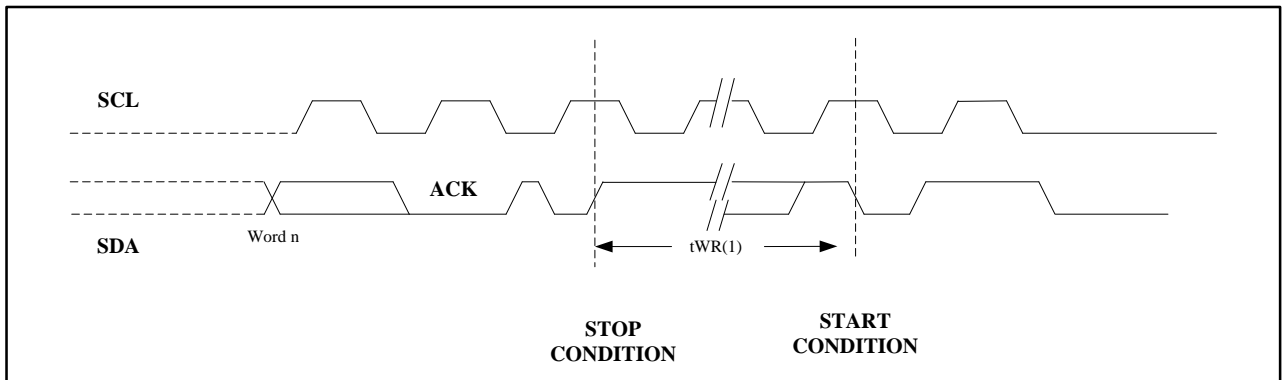


Figure 13. SCL: Serial Clock, SDA: Serial Data I/O

Notes:

The write cycle time  $t_{WR}$  is the time from a valid stop condition of a write sequence to the end of the internal clear/write cycle.

## 7. Ordering Guide

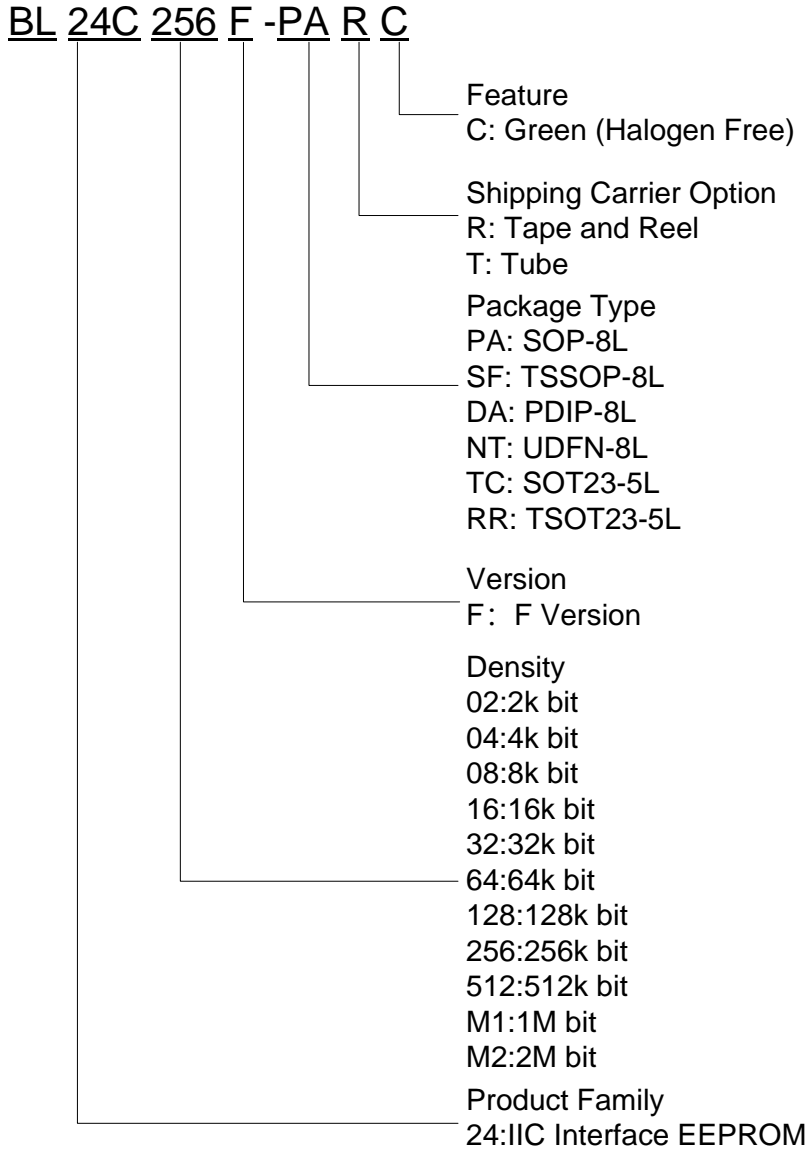


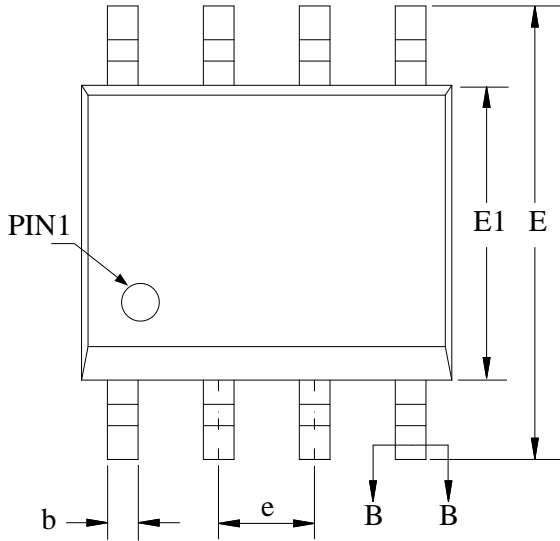
Table 9 Ordering Information

Product Number	Package	Operating Temp.	Eco Status	MSL	Minimum Pack Qty
BL24C256F-PARC	SOP-8L	-40-85°C	Green	3	2500EA
BL24C256F-SFRC	TSSOP-8L	-40-85°C	Green	3	3000EA
BL24C256F-NTRC	UDFN8	-40-85°C	Green	3	3000EA
BL24C256F-TCRC	SOT23-5	-40-85°C	Green	3	3000EA

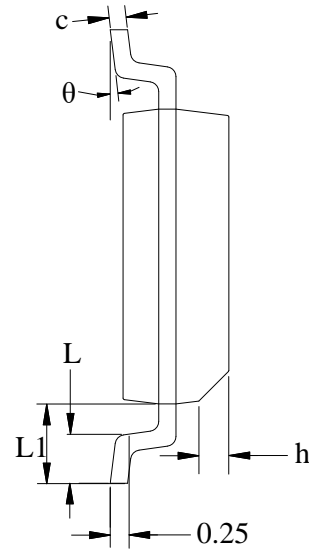
## 8. Package Information

### 8.1 Outline Dimensions

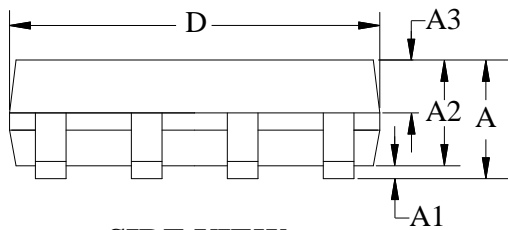
#### 8.1.1 Outline Dimensions SOP-8L



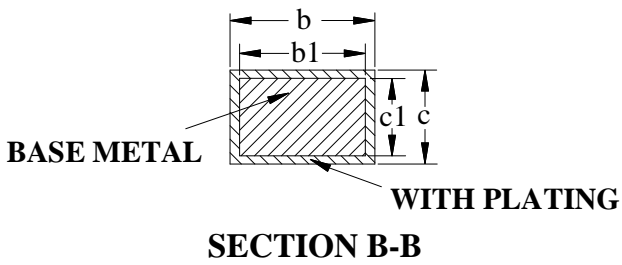
**TOP VIEW**



**SIDE VIEW**



**SIDE VIEW**



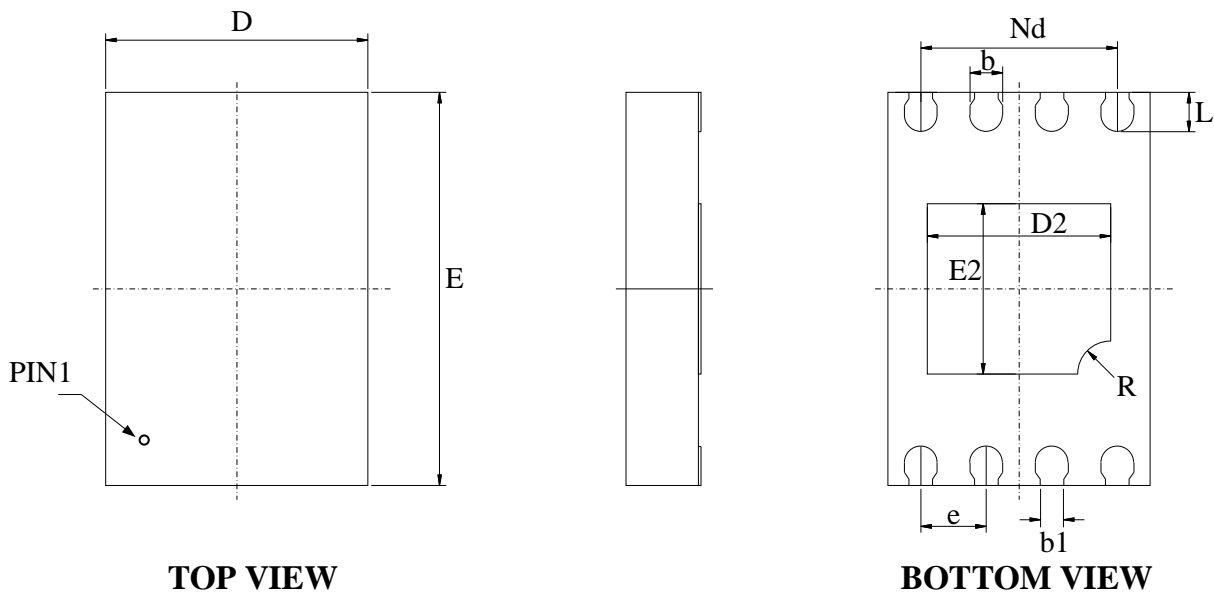
**SECTION B-B**

### COMMON DIMENSIONS

SYMBOL	MIN	NOM	MAX
A	-	-	1.75
A1	0.10	-	0.23
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
b	0.39	-	0.47
b1	0.38	0.41	0.44
c	0.20	-	0.24
c1	0.19	0.20	0.21
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27BSC		
h	0.25	-	0.50
L	0.50	-	0.80
L1	1.05REF		
θ	0°	-	8°

Unit: mm

## 8.1.2 Outline Dimensions UDFN-8

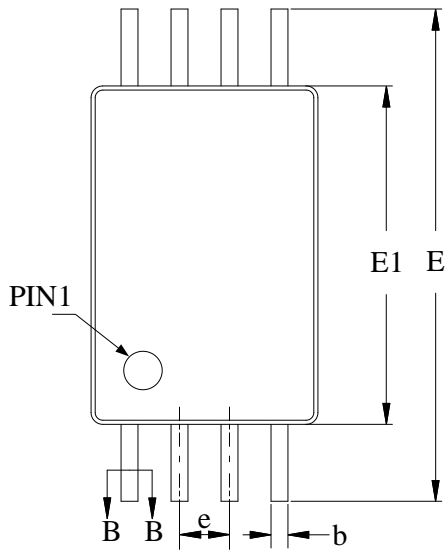


### COMMON DIMENSIONS

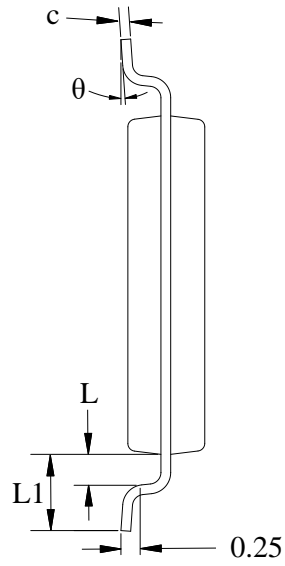
SYMBOL	MIN	NOM	MAX
A	0.50	0.55	0.60
A1	0.00	0.02	0.05
b	0.20	0.25	0.30
b1	0.18REF		
c	0.152REF		
D	1.90	2.00	2.20
D2	1.30	1.40	1.50
e	0.50BSC		
Nd	1.50BSC		
E	2.90	3.00	3.10
E2	1.20	1.30	1.40
L	0.25	0.30	0.35
R	0.20	0.25	0.30
K	0.50	0.55	0.60

Unit: mm

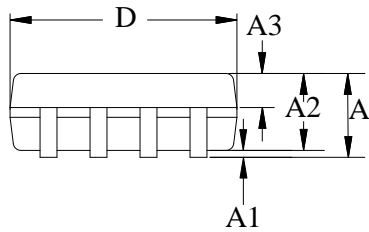
## 8.1.3 Outline Dimensions TSSOP-8L



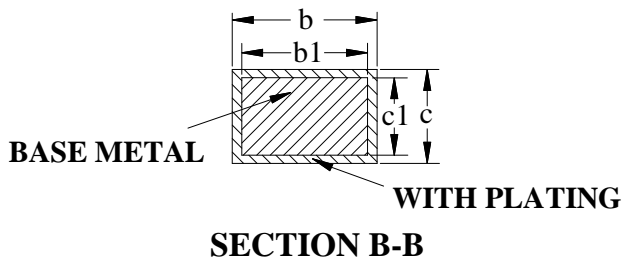
**TOP VIEW**



**SIDE VIEW**



**SIDE VIEW**



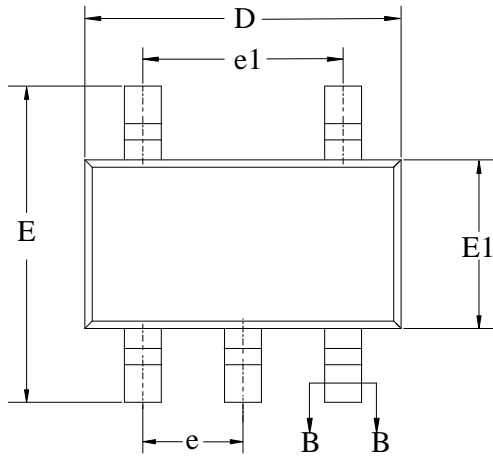
**SECTION B-B**

### COMMON DIMENSIONS

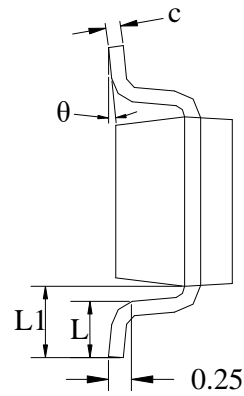
SYMBOL	MIN	NOM	MAX
A	-	-	1.20
A1	0.05	-	0.15
A2	0.90	1.00	1.10
A3	0.39	0.44	0.49
b	0.20	-	0.28
b1	0.19	0.22	0.25
c	0.13	-	0.17
c1	0.12	0.13	0.14
D	2.90	3.00	3.10
E	6.20	6.40	6.60
E1	4.30	4.40	4.50
e	0.65BSC		
L	0.45	-	0.75
L1	1.00REF		
θ	0°	-	8°

Unit: mm

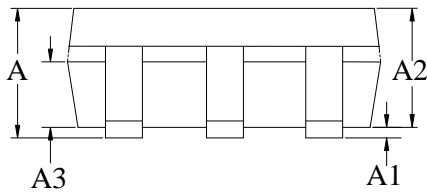
## 8.1.4 Outline Dimensions SOT23-5



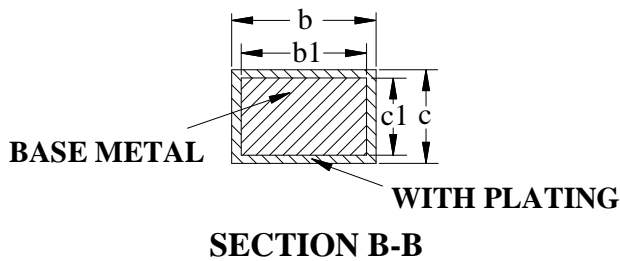
**TOP VIEW**



**SIDE VIEW**



**SIDE VIEW**



**SECTION B-B**

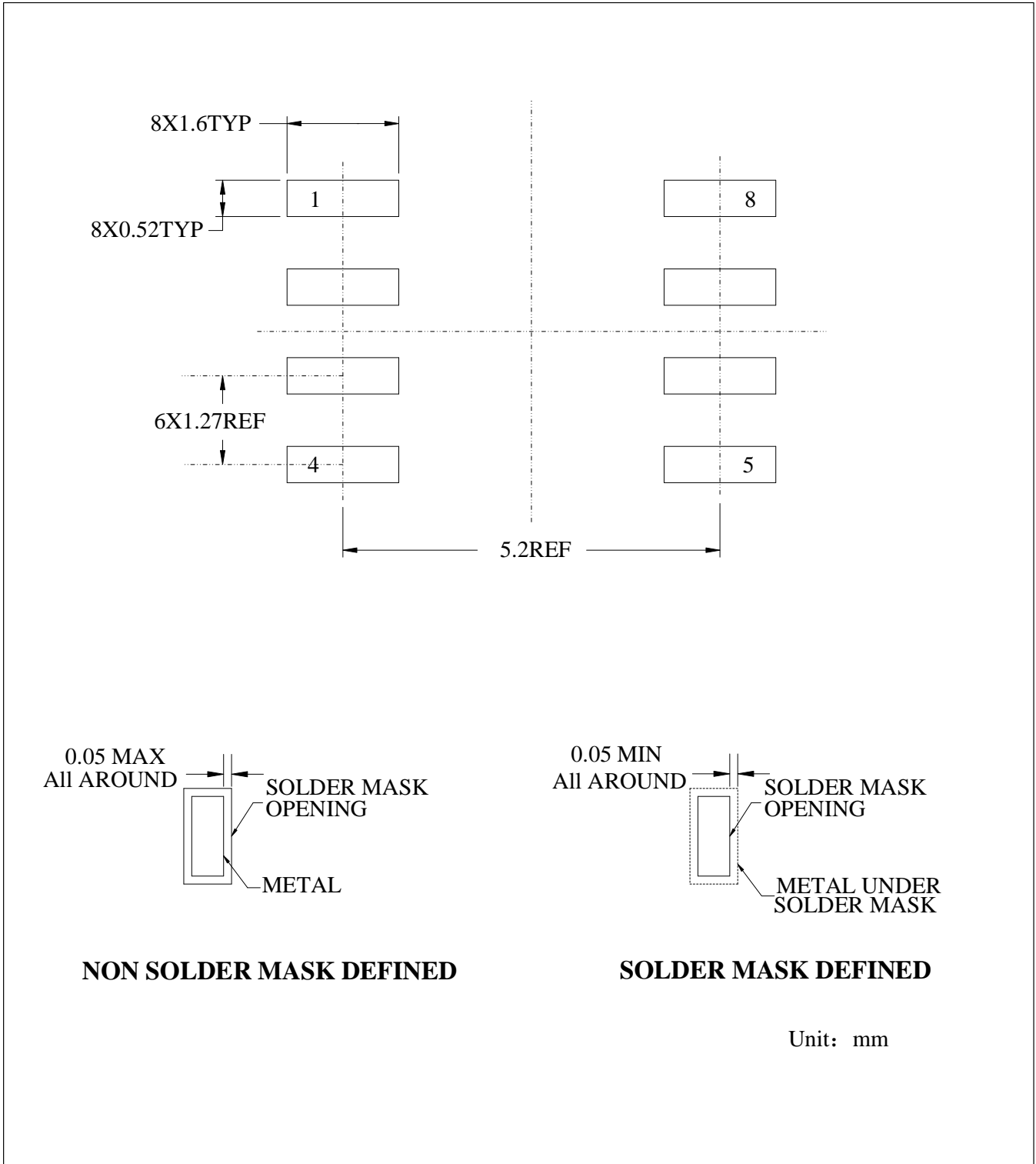
### COMMON DIMENSIONS

SYMBOL	MIN	NOM	MAX
A	-	-	1.25
A1	0.04	-	0.10
A2	1.00	1.10	1.20
A3	0.60	0.65	0.70
b	0.33	-	0.41
b1	0.32	0.35	0.38
c	0.15	-	0.19
c1	0.14	0.15	0.16
D	2.82	2.92	3.02
E	2.60	2.80	3.00
E1	1.50	1.60	1.70
e	0.95BSC		
e	1.90BSC		
L	0.30	-	0.60
L1	0.60REF		
$\theta$	0°	-	8°

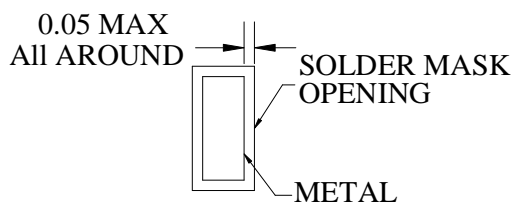
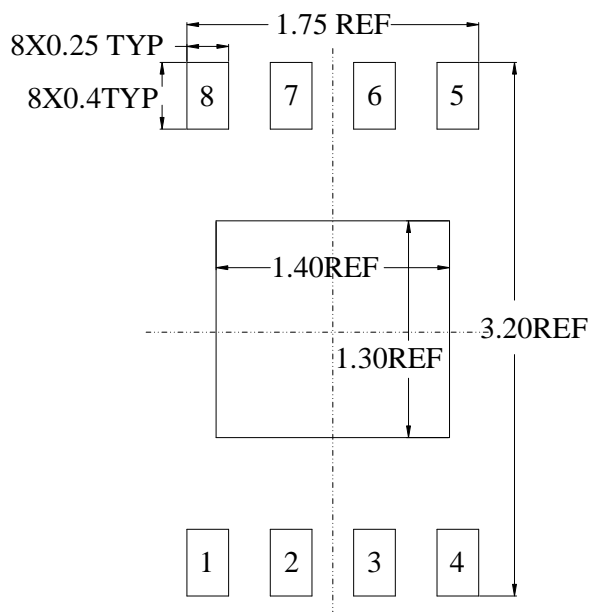
Unit: mm

## 8.2 Recommended Land Pattern

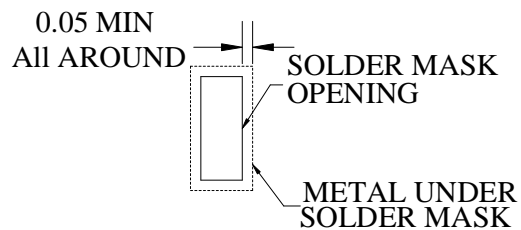
### 8.2.1 Recommended Land Pattern SOP-8L



## 8.2.2 Recommended Land Pattern UDFN-8



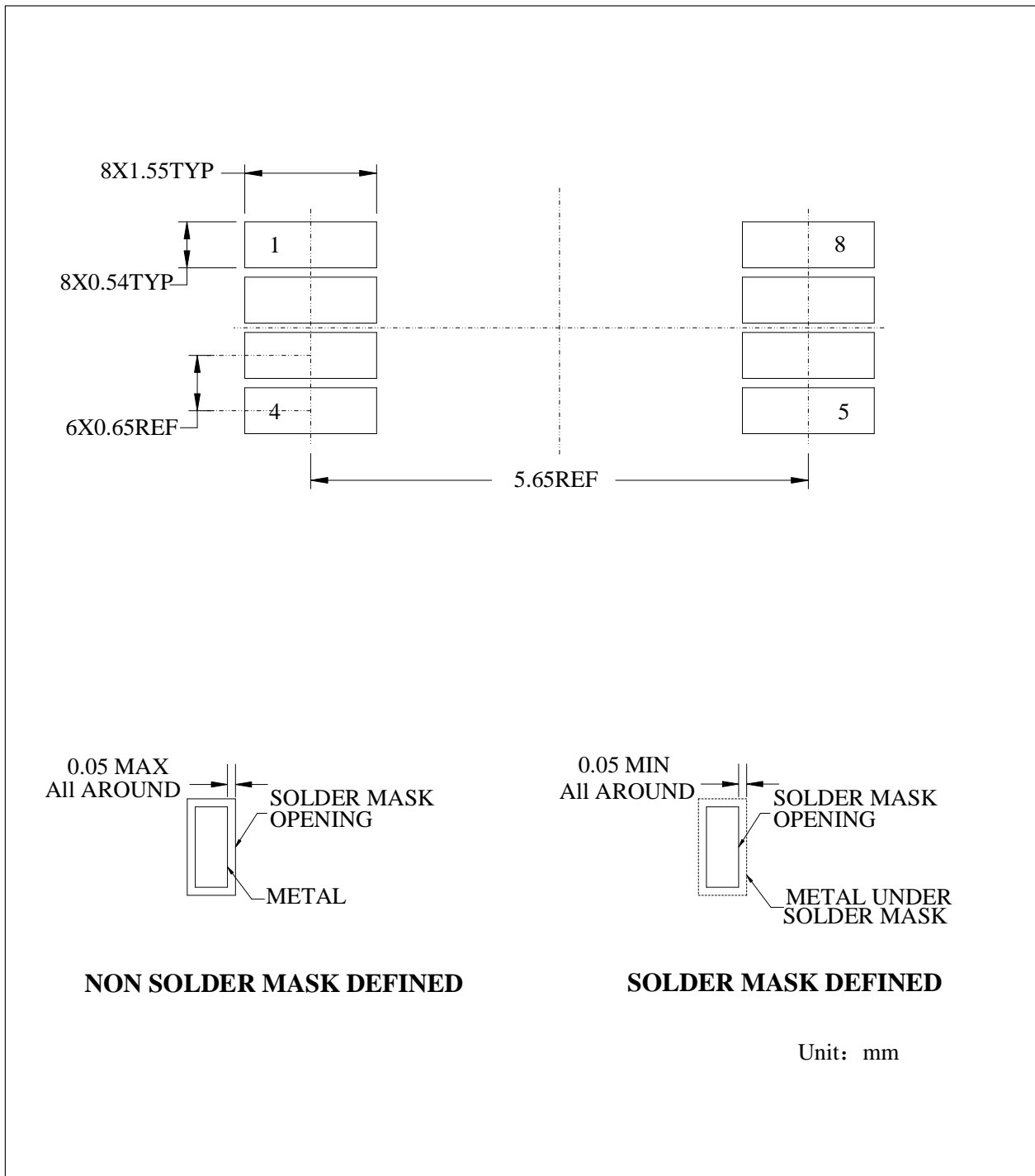
**NON SOLDER MASK DEFINED**



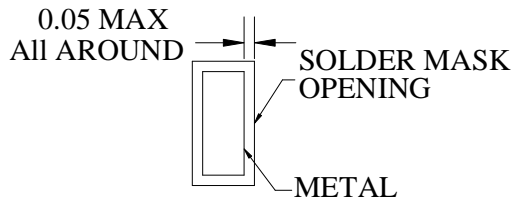
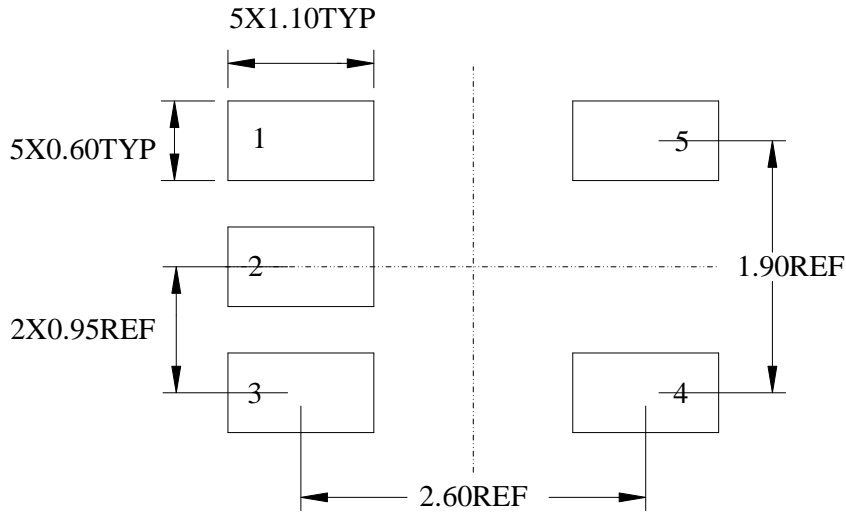
**SOLDER MASK DEFINED**

Unit: mm

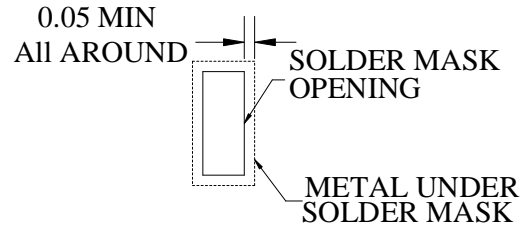
## 8.2.3 Recommended Land Pattern TSSOP-8L



## 8.2.4 Recommended Land Pattern SOT23-5



**NON SOLDER MASK DEFINED**

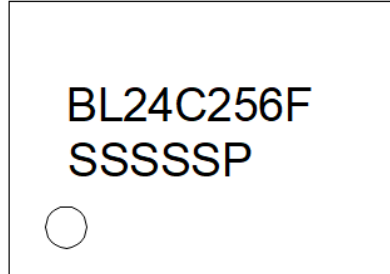


**SOLDER MASK DEFINED**

Unit: mm

## 8.3 Marking

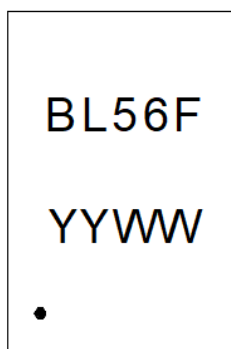
### 8.3.1 SOP-8L



Marking Drawing

Content	Note
BL24C256F	Device
SSSSS	Lot ID
P	Fixed characters

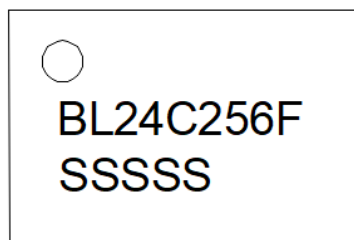
## 8.3.2 UDFN-8



Marking Drawing

Content	Note
BL56F	Device
YY	The last two digits of the production year
WW	Week of production year

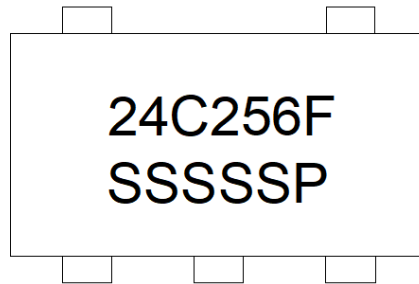
## 8.3.3 TSSOP-8L



Marking Drawing

Content	Note
BL24C256F	Device
SSSSS	Lot ID

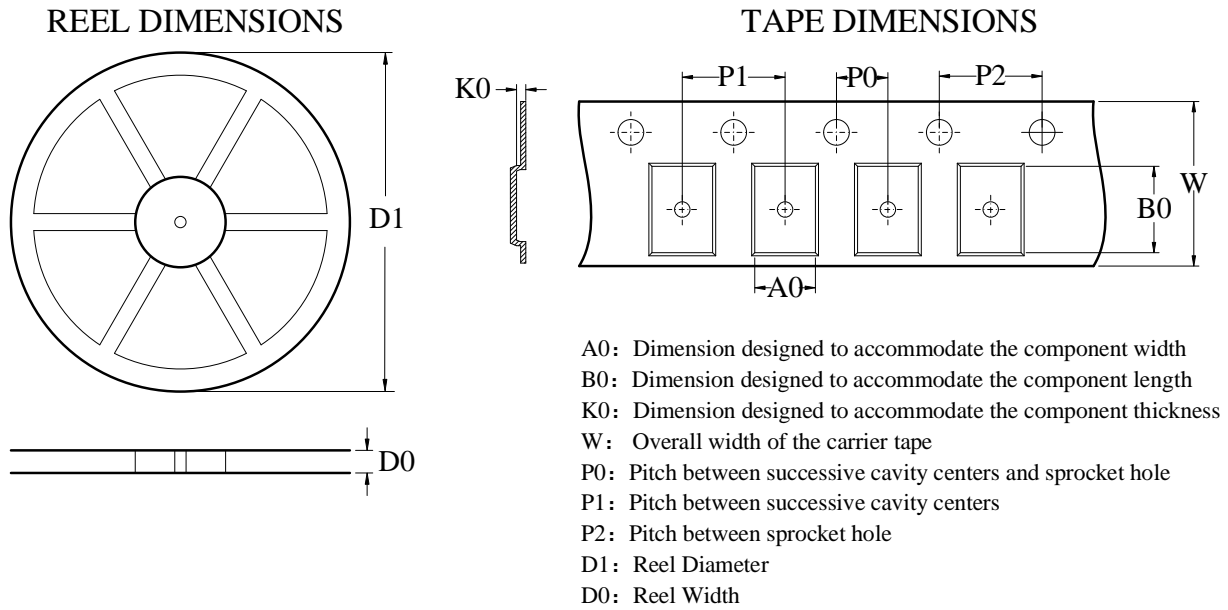
## 8.3.4 STO23-5



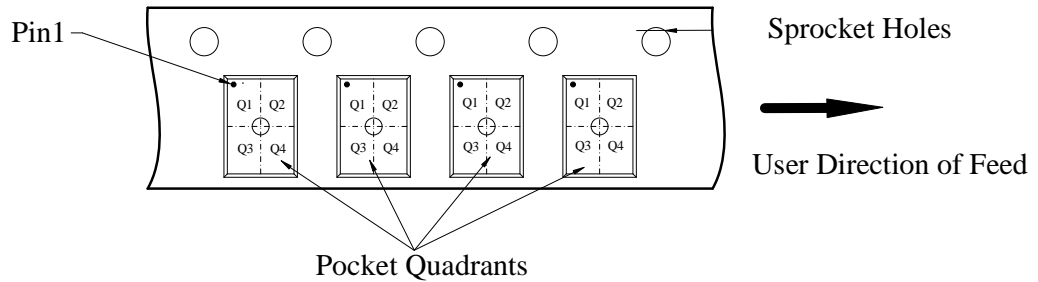
Marking Drawing

Content	Note
24C256F	Device
SSSSS	Lot ID
P	Fixed characters

## 9. Packing Specifications



### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



Note: The above picture is for reference only. Please refer to the value in the table below for the actual size

\*All dimensions are nominal

Device	Package Type	Pins	SPQ	D1 (mm)	D0 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
BL24C256F-PARC	SOP	8	2500	330	12.4	6.6	5.3	1.9	2	8	4	12	Q1
BL24C256F-SFRC	TSSOP	8	3000	330	12.4	6.9	3.4	1.2	2	8	4	12	Q1
BL24C256F-NTRC	DFN	8	3000	180	8.6	2.2	3.15	0.76	2	4	4	8	Q2
BL24C256F-TCRC	SOT23	5	3000	180	8.6	2.26	3.3	1.4	2	4	4	8	Q3

## Revision History

Version	Date	Changes
V02	2025/8/18	Document template updated to align with new corporate branding guidelines.
V01	2025/6/18	Initial version

## Important Notice

- a. Exceeding Maximum Ratings: Operation beyond the device's maximum rated performance may result in damage to the device, including permanent failure, which could affect system reliability. Do not exceed the absolute maximum ratings during circuit design. Belling shall not be liable for any personal injury, property damage, or other adverse consequences arising from user misuse, including but not limited to incorrect operation, negligence, or similar circumstances.
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