



# **SQ7191/SQ7193**

## **Brief Datasheet V1.0**

**SQ7191/SQ7193****PUF-Based Low Power Secure ASIC, ECC-256, ECDSA, ECDH, AES-128/AES-256, SHA-256, TRNG**◆ **Basic Information**

- Operating Voltage : 2.5V ~ 5.5V
- Operating Temperature : -40°C ~ 105°C

◆ **Low Power Platform**

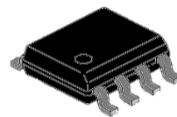
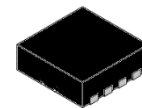
- Low Power Operation and Deep Sleep Mode

◆ **Security Features**

- PUF protected Keys, Data
- 128-bit Unique ID (UID) +256-bit PUF Unique ID (PUID)
- Asymmetric H/W Accelerator
  - NIST Standard P-256 Elliptic Curve
  - ECDSA: FIPS186-4 Curve Digital Signature
  - ECDH: FIPS SP800-56A Key Agreement
- Symmetric H/W Accelerator
  - FIPS 180-4 SHA-256 & FIPS 198-1 HMAC Hash Algorithm
- Networking Key Management
  - PRF/HKDF Calculation for TLS 1.2/1.3
  - ECDHE : Ephemeral key generation and key agreement
- True Random Number Generator(TRNG)
- Active Tamper Detection and Reacts to Perturbation Attacks
- Simple/Differential Power Analysis Attack Countermeasure (SPA/DPA)
- Independent Internal Clock to Prevent Glitch Attack

◆ **Certification**

- NIST CAVP : DRBG, AES, SHA2, ECDSA and HMAC
- NIST ESV Certified and CMVP FIPS 140-3 Complied
- STOC Level 2 ready
- SESIP & PSA Level 3 certification ready

◆ **Package****SOP8****8-Lead DFN  
(4mm x 4mm)**◆ **Secure Storage**

- Chip-Dependent Encryption Technology
- Secure Storage for Key, Certificate , Data
- Large User Data Storage: 5.6KB

◆ **Communication**

- SQ7191 supports standard I2C (Max: 1MHz)
- SQ7193 supports standard SPI (Max: 10MHz@MODE3)

◆ **Applications**

- Accessory/Disposable Authentication
- System Anti-Cloning
- Secure TLS 1.2 and 1.3 Communication
- Security Smart Lock, E-Lock
- AIoT Device Security
- End-to-End Encryption
- Secure Boot/ Secure OTA

## Content

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## 1. Preface

SQ719x supports many hardware cryptographic accelerators: embedded high-quality TRNG (True Random Number Generator), SHA-256, asymmetric encryption ECC-256, and symmetric encryption AES-128/AES-256. It also has secure storage for ECC and AES keys storage. The PUF technology is embedded to provide highest keys and the sensitivity data protection.

The device is suitable for building high-security applications, such as IoT symmetric/asymmetric authentication, attestation, TLS1.2/1.3 secure connections, secure boot, secure OTA, and F/W protection, etc.

Secure storage for ECC and AES keys .:

| Key Type              | SQ719x | Note           |
|-----------------------|--------|----------------|
| AES Key (AES-128/256) | 12     | Slot 8~19      |
| ECC Private Key – 256 | 7      | Slot 1~7       |
| ECC Public Key – 256  | 4      | Slot 24, 26~28 |

Table 1-1 AES and ECC Key Slots

## 2. Pin Assignment/Description

### 2.1 SQ7191 Pin Assignment/Description

PRODUCT : SQ7191SP008C00X

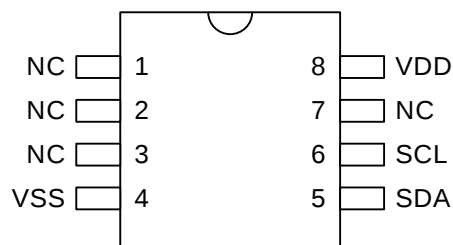


Figure 2-1 Pin Assignment of SQ7191 SOP8

PRODUCT : SQ7191D4008C00X

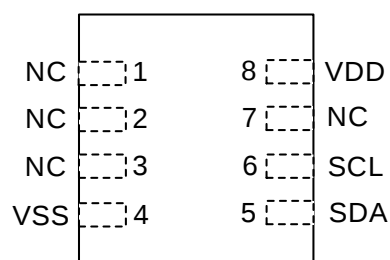


Figure 2-2 Pin Assignment of SQ7191 8-Lead DFN

| Pin No. | Pin Name | I/O Type | Description            |
|---------|----------|----------|------------------------|
| 1       | NC       | -        | No Connect             |
| 2       | NC       | -        | No Connect             |
| 3       | NC       | -        | No Connect             |
| 4       | VSS      | GND      | Ground                 |
| 5       | SDA      | I/O      | I2C Serial Data        |
| 6       | SCL      | I        | I2C Serial Clock Input |
| 7       | NC       | -        | No Connect             |
| 8       | VDD      | Power    | VDD power Supply       |

## 2.2 SQ7193 Pin Assignment/ Description

PRODUCT : SQ7193SP008S00X

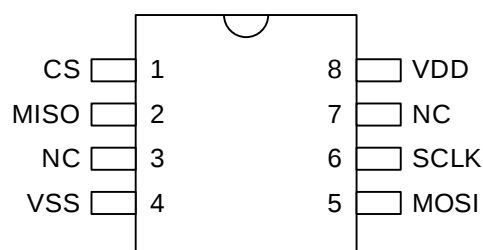


Figure 2-3 Pin Assignment of SQ7193 SOP8

PRODUCT : SQ7193D4008S00X

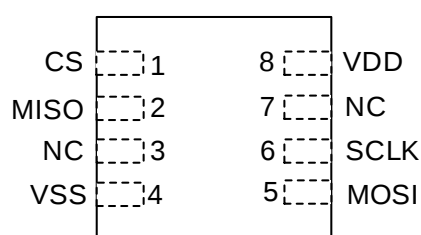


Figure 2-4 Pin Assignment of SQ7193 8-Lead DFN

| Pin No. | Pin Name | I/O Type | Description               |
|---------|----------|----------|---------------------------|
| 1       | CS       | I        | SPI, Chip Select          |
| 2       | MISO     | O        | SPI, Master In Slave Out  |
| 3       | NC       | -        | No Connect                |
| 4       | VSS      | GND      | Ground                    |
| 5       | MOSI     | I        | SPI, Master Out, Slave In |
| 6       | SCLK     | I        | SPI, Clock Input          |
| 7       | NC       | -        | No Connect                |
| 8       | VDD      | Power    | VDD power Supply          |

### 3. Electrical Characteristics

#### 3.1 Absolute Maximum Rating

The absolute maximum ratings are rated values which must not be exceeded during operation, even for an instant. Any one of the ratings must not be exceeded. If any absolute maximum rating is exceeded, a device may break down or its performance may be degraded, causing it to catch fire or explode resulting in injury to the user. Thus, when designing products which include this device, ensure that no absolute maximum rating value will ever be exceeded.

(V<sub>SS</sub>=0V)

| Parameter             | Symbol           | Pins         | Ratings                      | Unit |
|-----------------------|------------------|--------------|------------------------------|------|
| Supply Voltage        | V <sub>DD</sub>  | -            | -0.3 to 5.5                  | V    |
| Input Voltage         | V <sub>IN</sub>  | All I/O pins | -0.3 to V <sub>DD</sub> +0.3 | V    |
| Output Current(Total) | I <sub>OL</sub>  | All I/O pins | 100                          | mA   |
| Storage Temperature   | T <sub>STG</sub> | -            | -50 to 125                   | °C   |

## 3.2 Operation Conditions

The following defines the electrical characteristics of the device when it is operated at voltage and temperature maximum/minimum values. Unless otherwise stated, the standard conditions were determined at "operating temperature 25°C and operating voltage VDD = 3.3 V."

### 3.2.1 Operation Conditions

| Parameter             | Symbol          | Condition | Min. | Typ. | Max. | Unit |
|-----------------------|-----------------|-----------|------|------|------|------|
| Supply Voltage        | V <sub>DD</sub> |           | 2.5  | 3.3  | 5.5  | V    |
| Operating Temperature | T <sub>a</sub>  |           | -40  | 25   | 105  | °C   |

### 3.2.2 I/O Characteristics

| Parameter           | Symbol          | Condition                                            | Min.    | Typ. | Max.    | Unit |
|---------------------|-----------------|------------------------------------------------------|---------|------|---------|------|
| Input Low Voltage   | V <sub>IL</sub> | VDD=5V, temperature=25 °C                            | 0       |      | 0.3 VDD | V    |
| Input High Voltage  | V <sub>IH</sub> | VDD=5V, temperature=25 °C                            | 0.7 VDD |      | VDD     | V    |
| Output Low Voltage  | V <sub>OL</sub> | VDD=5V, temperature=25 °C<br>I <sub>OL</sub> = 3 mA  | 0       |      | 0.1 VDD | V    |
| Output High Voltage | V <sub>OH</sub> | VDD=5V, temperature=25 °C<br>I <sub>OH</sub> = -3 mA | 0.9VDD  |      | VDD     | V    |

### 3.3 DC Characteristics

| Parameter                                          | Symbol             | Min. | Typ. | Max. | Unit |
|----------------------------------------------------|--------------------|------|------|------|------|
| Supply Current in Operation Mode <sup>(Note)</sup> | I <sub>DD_N1</sub> | -    | 4.2  | -    | mA   |
| Supply Current in Deep Sleep Mode                  | I <sub>DD_DS</sub> | -    | 0.35 | -    | uA   |

Note : The condition is waiting for Commands.

### 3.4 Power-on Reset Characteristics

$T_a = -40 \sim 105^{\circ}\text{C}$

| Symbol | Description                                             | Min. | Typ. | Max. | Unit |
|--------|---------------------------------------------------------|------|------|------|------|
| tPPW   | Power-on reset minimum pulse width                      | 1    | -    | -    | ms   |
| tPWUP  | Warming-up time after a reset is clear and device ready | -    | 4    | -    | ms   |
| tVDD   | Power supply rise time                                  | 0.5  | -    | 5    | ms   |

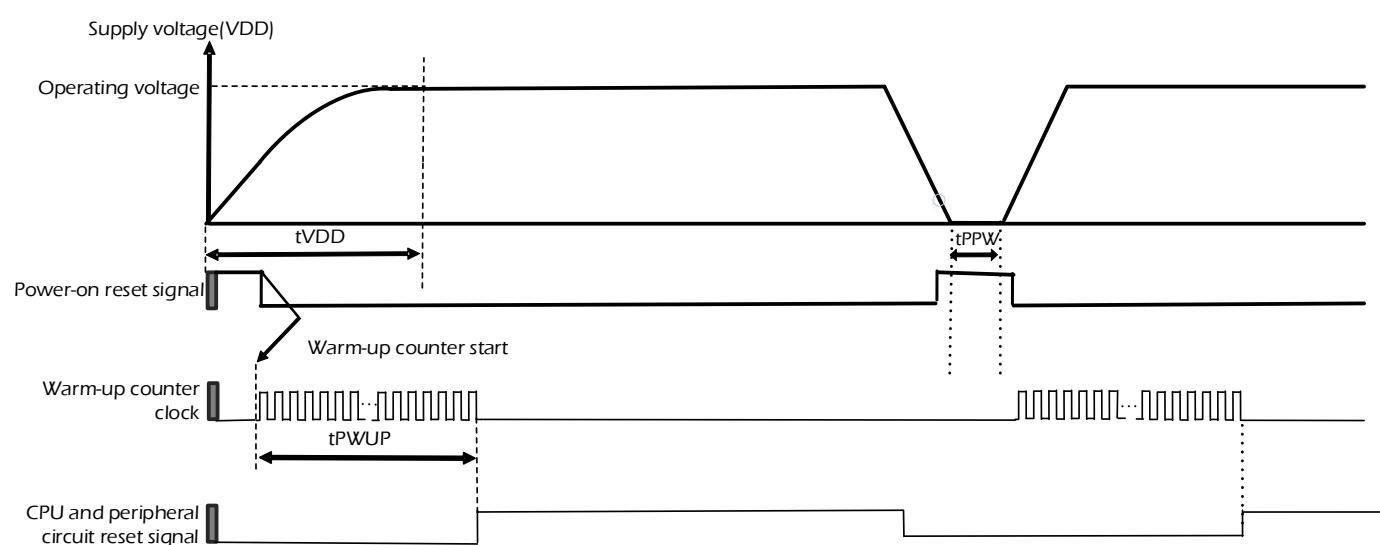


Figure 3- 1 Operation Timing of Power-on Reset

Note : In power-down process, the VDD must be 0V, then re-power-on to ensure the IC operating normal.

### 3.5 BROR Characteristics

**Ta=-40~105°C**

| Parameter             | Symbol        | Condition                                                                                    | Min. | Typ. | Max. | Unit |
|-----------------------|---------------|----------------------------------------------------------------------------------------------|------|------|------|------|
| BROR detected voltage | VBROR_Falling | VDD fall time > tVDD( for tVDD please refer to <u>CH3.4 Power-on Reset Characteristics</u> ) | 2.35 | 2.4  | 2.45 | V    |

## 3.6 AC Characteristics

### 3.6.1 AC Parameters

| Parameter                                     | Symbol         | Min. | Typ. | Max. | Unit |
|-----------------------------------------------|----------------|------|------|------|------|
| Power-Up HW Ready Time                        | $T_{PU\_RDY}$  | -    | 11   | -    | ms   |
| Power-Up Ready Time –<br>Ready for Command    | $T_{CMD\_RDY}$ | -    | 14   | -    | ms   |
| Standby Time, Entering the<br>deep sleep mode | $T_{STB}$      | -    | 20   | -    | us   |
| Wake-Up Ready Time, deep<br>sleep mode        | $T_{WDS\_RDY}$ | -    | 2.4  | -    | ms   |

Note: The “Typ.” value is based on 25°C room temperature, and the Sleep command will change this value.

### 3.6.2 I2C Characteristics

| Parameter                                        | Symbol       | Min. | Max. | Unit    |
|--------------------------------------------------|--------------|------|------|---------|
| Clock Frequency                                  | $f_{SCL}$    | -    | 1    | MHz     |
| Hold Time Repeated START Condition               | $t_{HD;STA}$ | 0.45 | -    | $\mu s$ |
| Low Period of SCL Clock                          | $t_{LOW}$    | 0.65 | -    | $\mu s$ |
| High Period of SCL Clock                         | $t_{HIGH}$   | 0.35 | -    | $\mu s$ |
| Setup Time for a Repeated START Condition        | $t_{SU;STA}$ | 0.35 | -    | $\mu s$ |
| Data Hold Time                                   | $t_{HD;DAT}$ | -    | 0.5  | $\mu s$ |
| Data Setup Time                                  | $t_{SU;DAT}$ | 0.1  | -    | $\mu s$ |
| Rise Time of Both SDA and SCL                    | $t_r$        | 20   | 300  | ns      |
| Fall Time of both SDA and SCL                    | $t_f$        | 20   | 300  | ns      |
| Setup Time of STOP Condition                     | $t_{SU;STO}$ | 0.6  | -    | $\mu s$ |
| Bus Free Time Between a STOP and START Condition | $t_{BUF}$    | 1.3  | -    | $\mu s$ |
| Capacitive Load for Each Bus Line                | $C_b$        | -    | 400  | pF      |

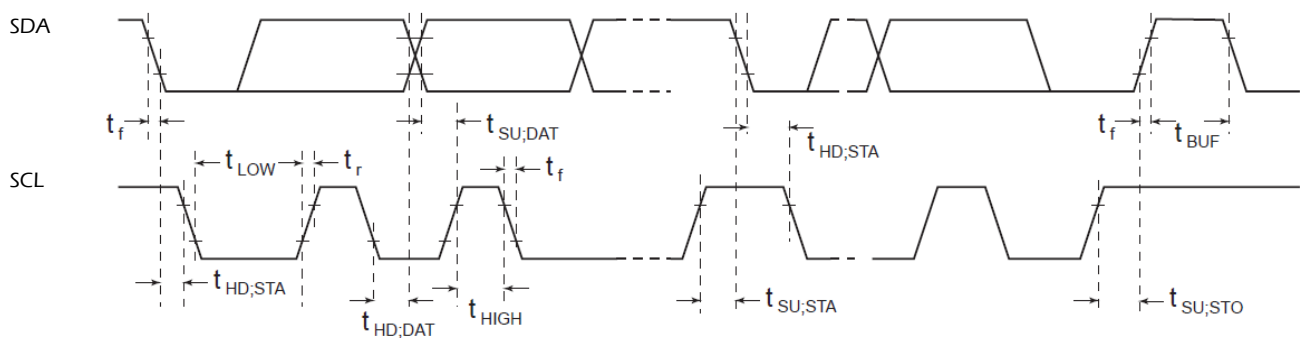


Figure 3-2 I2C Timing Sequence

### 3.6.3 SPI Characteristics

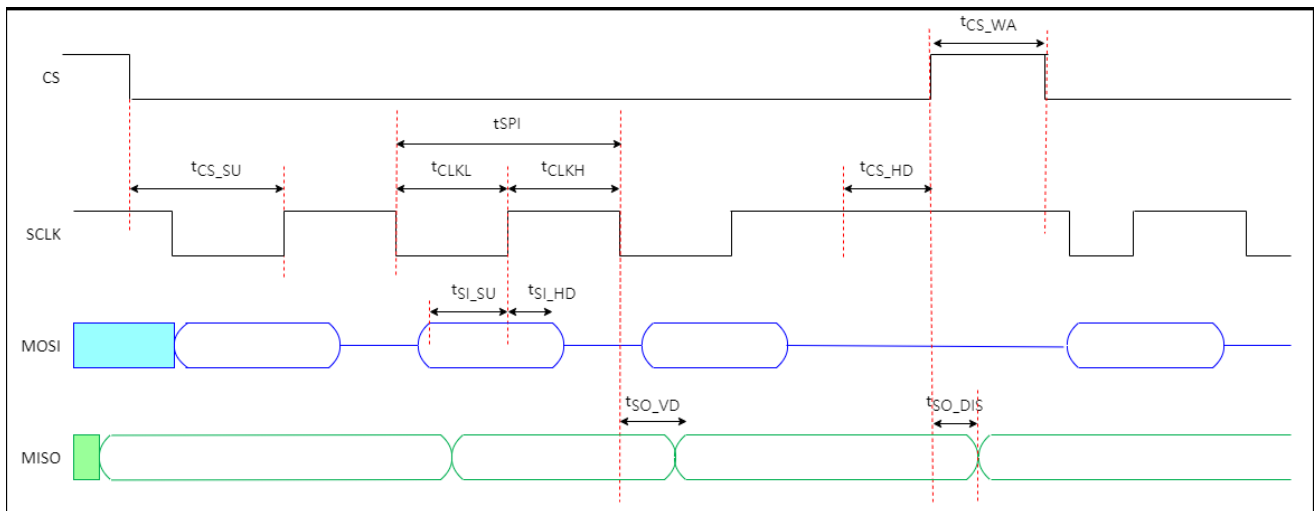


Figure 3-3 SPI Timing Sequence

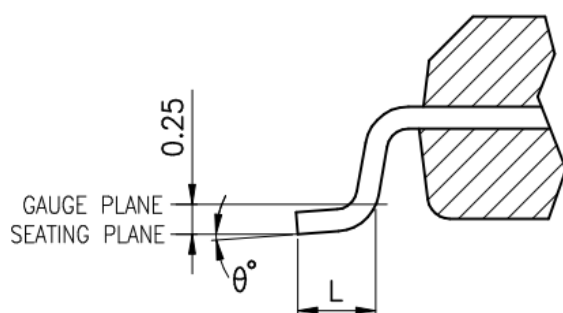
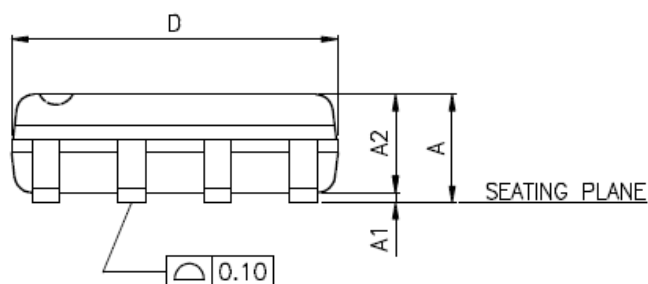
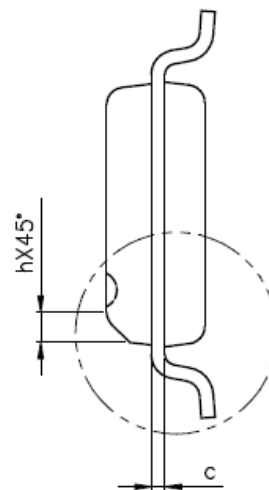
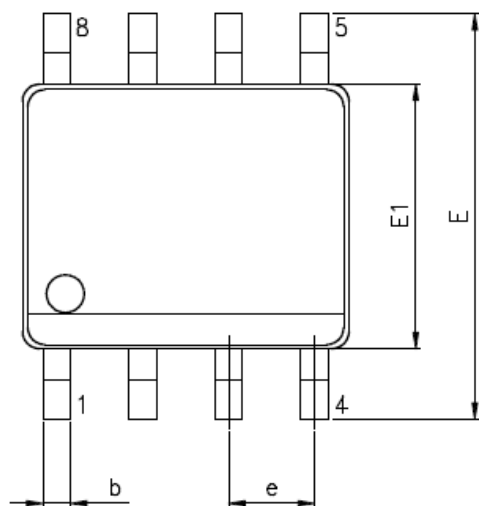
| Parameter                                   | Symbol  | Min.     | Max. | Unit |
|---------------------------------------------|---------|----------|------|------|
| SPI Frequency                               | fSPI    | -        |      |      |
| (VDD=2.7V~5.5V)                             |         |          | 10   | MHz  |
| (VDD=2.5V~2.7V)                             |         |          | 5    | MHz  |
| SPI Period                                  | tSPI    | 1/fSPI   | -    | ns   |
| High period of the SCLK pin                 | tCLKH   | 0.4 tSPI | -    | ns   |
| Low period of the SCLK pin                  | tCLKL   | 0.4 tSPI | -    | ns   |
| From SPICS active to first sample edge      | tCS_SU  | 2.0 tSPI | -    | ns   |
| From last SCLK shift edge to SPICS inactive | tCS_HD  | 2.0 tSPI | -    | ns   |
| Time between SPI transaction                | tCS_WA  | 3.0 tSPI | -    | ns   |
| Data Input Setup Time                       | tSI_SU  | 25       | -    | ns   |
| Data Input Hold time                        | tSI_HD  | 10       | -    | ns   |
| Data Output Valid Time                      | tSO_VD  | -        | 25   | ns   |
| Data Output Disable Time                    | tSO_DIS | -        | 25   | ns   |

### 3.7 EEPROM Characteristics

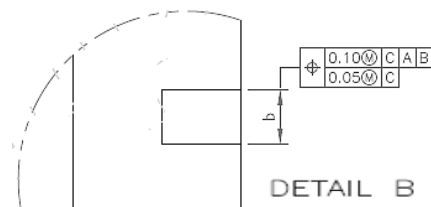
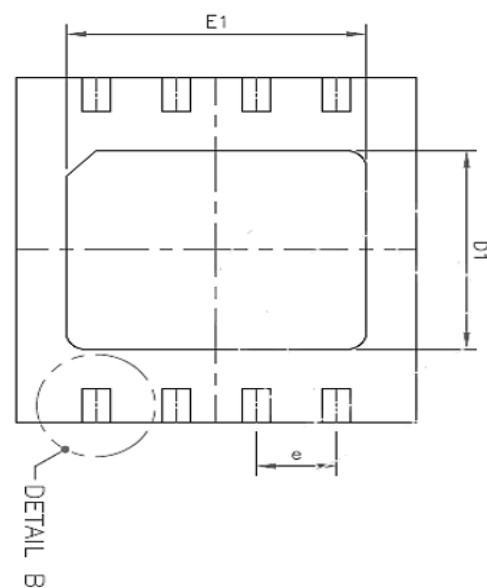
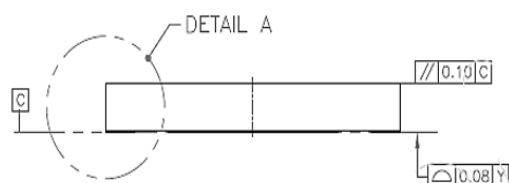
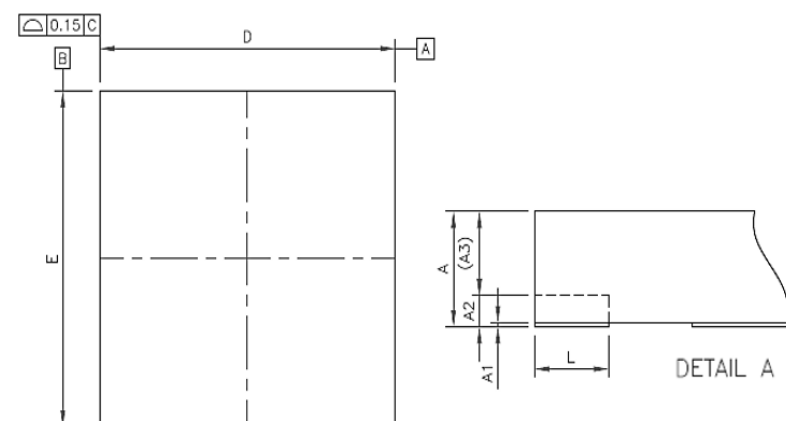
| Parameter                          | Min.    | Typ. | Max. | Unit   |
|------------------------------------|---------|------|------|--------|
| Write Endurance (Sector Endurance) | 100,000 | -    | -    | Cycles |
| Data Retention( at 25°C)           | 100     | -    | -    | Years  |
| Data Retention( at 85°C)           | 20      | -    | -    | Years  |

## Appendix A. Package Information

### SOP8



| Symbol | mm       |      |      |
|--------|----------|------|------|
|        | Min.     | Typ. | 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 |
| θ      | 0°       | –    | 8°   |

**8-Lead DFN (4mm x 4mm)**

| Symbol | mm       |      |      |
|--------|----------|------|------|
|        | MIN.     | NOM. | MAX. |
| A      | 0.50     | 0.55 | 0.60 |
| A1     | 0.00     | 0.02 | 0.05 |
| A2     | -        | 0.15 | -    |
| A3     | 0.35     | 0.40 | 0.45 |
| 'b     | 0.25     | 0.30 | 0.35 |
| D      | 3.90     | 4.00 | 4.10 |
| D1     | 2.20     | 2.30 | 2.40 |
| E      | 3.90     | 4.00 | 4.10 |
| E1     | 2.90     | 3.00 | 3.10 |
| 'e     | 0.80 BSC |      |      |
| L      | 0.35     | 0.40 | 0.45 |

## Appendix B. Ordering Information

When ordering products, please provide the following details:

| Ordering Information | Product         | Packing | Provisioning Service | Description                                            |
|----------------------|-----------------|---------|----------------------|--------------------------------------------------------|
| Example              | SQ7191SP008C00X | T       | Y                    | I2C, SOP8, Tape & Reel, 105°C, provisioning service    |
|                      | SQ7191D4008C00X | B       | N                    | I2C, DFN 4x4, Tray, 105°C, no provisioning service     |
|                      | SQ7193SP008S00X | B       | N                    | SPI, SOP8, Tube, 105°C, no provisioning service        |
|                      | SQ7193D4008S00X | T       | Y                    | SPI, DFN 4x4, Tape & Reel, 105°C, provisioning service |

Note 1: "Packing"- T: Tape & Reel; B: Tube/Tray

Note 2: "Provisioning service for Customers"- Y: Need provisioning service for customers; N: No need for provisioning service from customers

Note 3: For Packing T, SOP: 4K/Reel, DFN: 5K/Reel

## Appendix C. Product Number Information

Example :

**SQ**   **Z1**   **91**   **SP**   **008**   **C**   **00**   **X**   **I**   **Y**

iMQ SQ product

Product Series

Sub Series

Package Type

| Code | Package Type |
|------|--------------|
| SP   | SOP          |
| D4   | DFN 4x4      |

Pin Count

| Code | Pin |
|------|-----|
| 008  | 8   |

Communication Interface

| Code | Type. |
|------|-------|
| C    | I2C   |
| S    | SPI   |

Designator

Operating Temp.

| Code | Operating Temp. |
|------|-----------------|
| X    | -40~105°C       |

Packing

| Code | Packing |
|------|---------|
| T    | T&R     |
| B    | Tube    |

Provisioning Service

| Code | Provisioning |
|------|--------------|
| Y    | Yes          |
| N    | No           |

## Revision History

| Version | Approved<br>Date | Description                      |
|---------|------------------|----------------------------------|
| V1.0    | 2025/10/17       | 1. Sync with full datasheet V1.0 |
| V0.9    | 2025/08/26       | 1. Sync with full datasheet V0.9 |
| V 0.7   | 2025/04/17       | 1. 1 <sup>st</sup> version issue |