



## Security & Chip Card ICs

### SLE 66CX160S

16-bit Security Controller  
in 0.6  $\mu\text{m}$  CMOS Technology  
32-Kbyte ROM, 1980 Byte RAM  
16-Kbyte EEPROM and  
1100-bit Advanced Crypto Engine

|                                                                                                                                         |                                        |                              |
|-----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|------------------------------|
| <b>SLE 66CX160S Short Product Information</b>                                                                                           |                                        | Ref.: SPI_SLE 66CX160SU_1001 |
| <b>This document contains preliminary information on a new product under development. Details are subject to change without notice.</b> |                                        |                              |
| <b>Revision History:    Current Version 10.01</b>                                                                                       |                                        |                              |
| Previous Releases:                                                                                                                      |                                        |                              |
| Page                                                                                                                                    | Subjects (changes since last revision) |                              |
|                                                                                                                                         |                                        |                              |

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## 16-bit Security Controller SLE 66CX160S with 32-Kbyte ROM, 1980 Byte RAM, 16-Kbyte EEPROM and 1100-bit Advanced Crypto Engine

### Features

- 16-bit microcomputer in 0.6 µm CMOS technology
- Instruction set opcode compatible with standard SAB 8051 processor
- Enhanced 16-bit arithmetic
- Additional powerful instructions optimized for chip card applications
- Dedicated, non-standard architecture with **execution time six times faster** than standard SAB 8051 processor
- **31.5-Kbytes User ROM** for application programs
- 512-bytes reserved ROM for Resource Management System (RMS) with intelligent write/erase routines
- 16-Kbytes EEPROM as program/data memory
- 256 (+ 700) bytes internal RAM
- **1-Kbyte external RAM (XRAM)**
- **1100-bit Advanced Crypto Engine (ACE)** for fast execution of public key crypto algorithms
- **True random number generator**
- **Interrupt module for I/O interface**
- **CRC Module**
- **16-bit timer with 8-bit prescaler**
- Power saving sleep mode
- Clock freq. = int. freq.: 1 to 7.5 MHz
- Contact configuration and serial interface in accordance with ISO 7816
- Supply voltage range: 2.7 V to 5.5 V
- Current consumption < 10 mA at 5 MHz and 5.5 V
- Temperature range: -25 to +70°C
- ESD protection larger than 4 kV

### EEPROM

- Reading, erasing and writing byte by byte
- Flexible page mode for 1 to 64 bytes write/erase operation
- 32 bytes security area
- Write time 3.6 ms, erase time 1.8 ms
- Programming time adaptable to clock frequency
- **Minimum of 500,000 write/erase cycles**
- Data retention for a minimum of ten years
- EEPROM programming voltage generated on chip

### Security Features

#### Operation state monitoring mechanism

- Low and high voltage sensors
- Frequency sensors and filters

#### Memory Security

- 16 bytes security PROM, hardware protected
- Unique chip identification number for each chip
- MED – memory encryption/decryption device for XRAM, ROM and EEPROM
- True Random Number Generator with Firmware test function
- Security optimised layout and layout scrambling
- user settable additional encryption key for EEPROM
- Move code blocking (from EEPROM)

### Support

- HW-& SW-Tools (Emulator, ROM Monitor, Card Emulator, Simulator, Softmasking)
- Application notes (e.g.: T=0, T=1, DES, RSA, RNG, etc.)

**Testmode**

- Irreversible Lock - Out of testmode

**Anti Snooping**

- HW-countermeasures against SPA/DPA-, Timing- and DFA-attacks (differential fault analysis – DFA)
- CRC - Module
- Non standard dedicated Smart Card CPU – Core

**Development Tools Overview**

- Short Product Information Software Development Kit SDK CC
- Short Product Information Card Emulator SCE66
- Short Product Information ROM Monitor SRM66
- Short Product Information Emulator SET66 Hitex or SET66 KSC
- Short Product Information Smart Mask Package

**Supported Standards**

- ISO/IEC 7816
- EMV 2000
- GSM 11.1x
- ETS I TS 102 221

**Document References**

- Confidential Data Book SLE 66CxxS
- Confidential Instruction SLE 66CxxS
- Confidential Quick Reference SLE 66CxxS
- Qualification report
- Chip delivery specification for wafer with chip-layout (die size, orientation,...)
- Module specification containing description of package, etc.
- Qualification report module

**Features (cont'd)**
**Enhanced Crypto Performance**

| <b>Operation</b>                                                         | <b>Modulus</b> | <b>Exponent</b> | <b>Calculation Time at 5 MHz</b> |
|--------------------------------------------------------------------------|----------------|-----------------|----------------------------------|
| Modular Exponentiation                                                   | 160 bit        | 160 bit         | 20 ms                            |
| Modular Exponentiation                                                   | 256 bit        | 256 bit         | 35 ms                            |
| Modular Exponentiation                                                   | 512 bit        | 512 bit         | 110 ms                           |
| Modular Exponentiation<br>RSA Encrypt / RSA Signature Verify             | 1024 bit       | 16 bit          | 20 ms                            |
| Modular Exponentiation<br>RSA Decrypt / RSA Signature Generate           | 1024 bit       | 1024 bit        | 820 ms                           |
| Modular Exponentiation using CRT<br>RSA Decrypt / RSA Signature Generate | eq.1024 bit    | eq.1024 bit     | 250 ms                           |
| DSA Signature Generate                                                   | 512 bit        | 160 bit         | 145 ms                           |
| DSA Signature Verify                                                     | 512 bit        | 160 bit         | 130 ms                           |
| DSA Signature Generate                                                   | 1024 bit       | 160 bit         | 290 ms                           |
| DSA Signature Verify                                                     | 1024 bit       | 160 bit         | 360 ms                           |
| Elliptic Curves EC-GDSA Sign. Generate                                   | 160 bit        | 160 bit         | 260 ms                           |
| Elliptic Curves EC-GDSA Sign. Verify.                                    | 160 bit        | 160 bit         | 550 ms                           |

**Ordering Information**

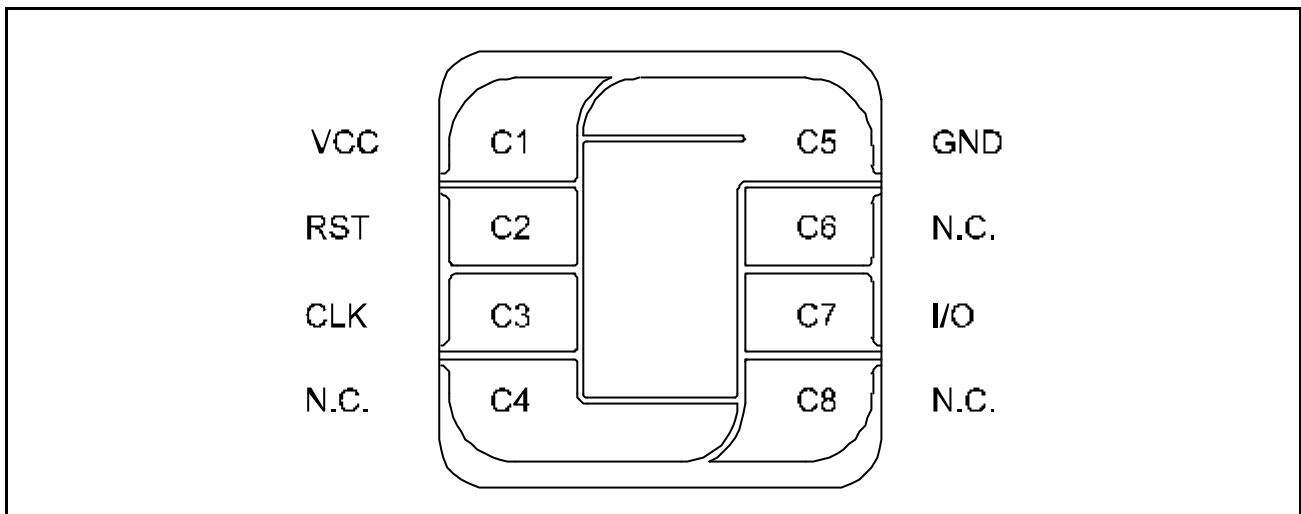
| Type                   | Package <sup>1</sup> | Voltage Range | Temperature Range | Frequency Range                          |
|------------------------|----------------------|---------------|-------------------|------------------------------------------|
| SLE 66CX160S-M6        | M6                   | 2.7 V - 5.5 V | – 25°C to + 70°C  | 1 MHz - 5 MHz @ 5V<br>1 MHz - 4 MHz @ 3V |
| SLE 66CX160S-C         | C                    |               |                   |                                          |
| SLE 66CX160S-T85-M6    | M6                   | 2.7 V - 5.5 V | – 25°C to + 85°C  | 1 MHz - 5 MHz @ 5V<br>1 MHz - 4 MHz @ 3V |
| SLE 66CX160S-T85-C     | C                    |               |                   |                                          |
| SLE 66CX160S-V5-M6     | M6                   | 4.5 V - 5.5 V | – 25°C to + 70°C  | 1 MHz - 5 MHz                            |
| SLE 66CX160S-V5-C      | C                    |               |                   |                                          |
| SLE 66CX160S-V5-T85-M6 | M6                   | 4.5 V - 5.5 V | – 25°C to + 85°C  | 1 MHz - 5 MHz                            |
| SLE 66CX160S-V5-T85-C  | C                    |               |                   |                                          |
| SLE 66CX160S-V5-F7-M6  | M6                   | 4.5 V - 5.5 V | – 25°C to + 70°C  | 1 MHz - 7.5 MHz                          |
| SLE 66CX160S-V5-F7-C   | C                    |               |                   |                                          |

**Production sites:**

- Regensburg SLE 66CxxS
- UMC Taiwan SLE 66CxxU

<sup>1</sup> available as wire-bonded module (M6) for embedding in plastic cards or as die (C) for customer packaging

## Pin Configuration



**Figure 1 Pin Configuration (top view)**

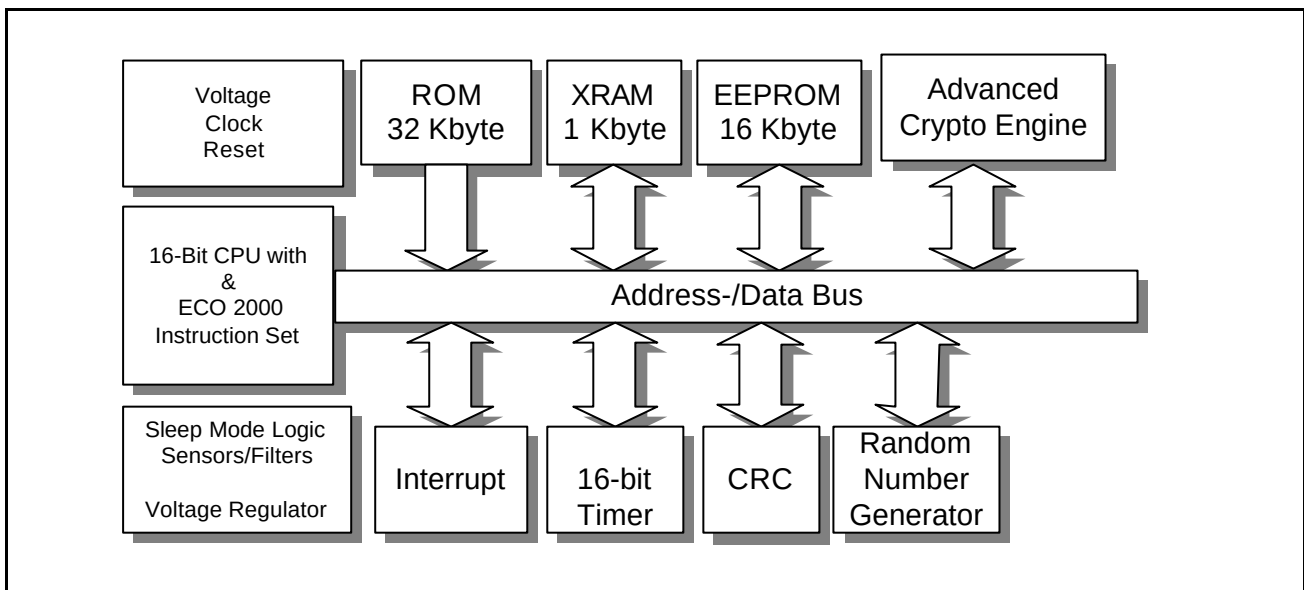
## Pin Definitions and Functions

| Card Contact | Symbol | Function                 |
|--------------|--------|--------------------------|
| C1           | VCC    | Operating voltage        |
| C2           | RST    | Reset input              |
| C3           | CLK    | Processor clock input    |
| C5           | GND    | Ground                   |
| C4; C6; C8   | N.C.   | Not connected            |
| C7           | I/O    | Bi-directional data port |

## General Description

SLE 66CX160S is a member of the Infineon Technologies high end security controller family in 0.6  $\mu\text{m}$  CMOS technology. The CPU provides the high efficiency of the SAB 8051 instruction set extended by additional powerful instructions together with enhanced performance, memory sizes and security features.

The cryptocontroller IC offers 31.5 Kbytes of User-ROM, 256 bytes internal RAM, 1 Kbyte XRAM and 16 Kbytes EEPROM. It suits the requirements of the new generation of operating systems.



**Figure 2: Block Diagram SLE 66CX160S**

The Advanced Crypto Engine is equipped with its own RAM of 700 bytes and supports all of today known public-key algorithms based on large integer modular arithmetic. It allows fast and efficient calculation of e.g. RSA operations with key lengths up to 2048 bit.

The Random Number Generator (RNG) is able to supply the CPU with true random numbers on all conditions. The CRC module allows the easy generation of checksums according to ISO 3309 (16-Bit-CRC). An additional interrupt capability of the I/O module allows parallel operation of chip card and terminal. To minimize the overall power consumption, the chip card controller IC offers a sleep mode.

As an important measure, the chip provides a new and enhanced level of on-chip security features.

In conclusion, the SLE 66CX160S fulfills the requirements of all chip card applications, as especially information security, access control, payment and health care. The SLE 66CX160S is a powerful chip card cryptocontroller IC integrating outstanding memory sizes, an extended crypto-coprocessor, additional peripherals in combination with enhanced performance and optimized power consumption on an minimized die size. Therefore, the SLE 66CX160S offers the basis for new chip card applications.