AE45X

High Security 16-bit Dual Interface Smart Card Microcontroller

Features
- ISO/IEC 14443 Type B or C contactless interface
- Data transmission up to 212 Kbit/s
- ISO 7816 Interface
- 32.5 KBytes EEPROM
- 128 KBytes ROM
- 5 KBytes RAM
- 1024 Bit Coprocessor
- Integrated Security Concept (ISC)

Dual Interface:

The dual interface chip AE45X belongs to the high security smart card controller family of Hitachi. It combines the security features of the ISO 7816 compliant standard AE4 products, with the advantages of an additional contactless interface according to the ISO 14443 type B or C. The AE45X is manufactured using a highly reliable 0.35 µm shrink CMOS process providing outstanding memory sizes.

In contactless mode the power supply and bi-directional data transmission is done via a coil connected to the AE45X. The coil is tuned to an operating frequency of 13.56 MHz, basis of a proximity card system. It provides a high data transfer rate of 212 Kbit/s (max) at a distance of up to 10 cm, and fulfils the requirements of most of the contactless smart card applications in terms of performance and cost.

Compared to standard contact based smart cards, this system works without any physical contact between the terminal and the smart card, resulting in low maintenance costs and reliable functionality in adverse environmental conditions. The fast and high security data transfer combined with its convenient handling makes it best suited for various applications. Additionally, by using the integrated anti-collision method several cards can be operated on one terminal simultaneously.

Integrated Security Concept:

The AE45X designed under Hitachi's Integrated Security Concept is ideally suited for high security applications. The ISC means that security is not just an add-on feature to standard modules or cores, security has been built-in from the start, forming an integral part of the whole Smart card design concept. The whole ISC process e.g. secure chip design environment, secured production facilities and secure handling during shipment to the customer are constantly reviewed in order to maximise the overall security package. All devices of the AE-series will be evaluated and certified by independent evaluation authorities.

Many security features such as integrated sensors, distributed layout, random number generation, watchdog timer, DES engine, Firewall Management Unit (FMU) and power analysis attack protection are included providing a strong ON-CHIP hardware security structure.

Uniquely, Hitachi smart card devices are fabricated using a MONOS (Metal Oxide Nitride Oxide Silicon) EEPROM structure. MONOS advantages compared to standard EEPROM structures are: high resistance to radiation disturbance, high reliability and endurance.

A high performance Coprocessor is complementary to the design concept ensuring final operation system efficiency, application integrity and performance that meet tomorrow's needs today.
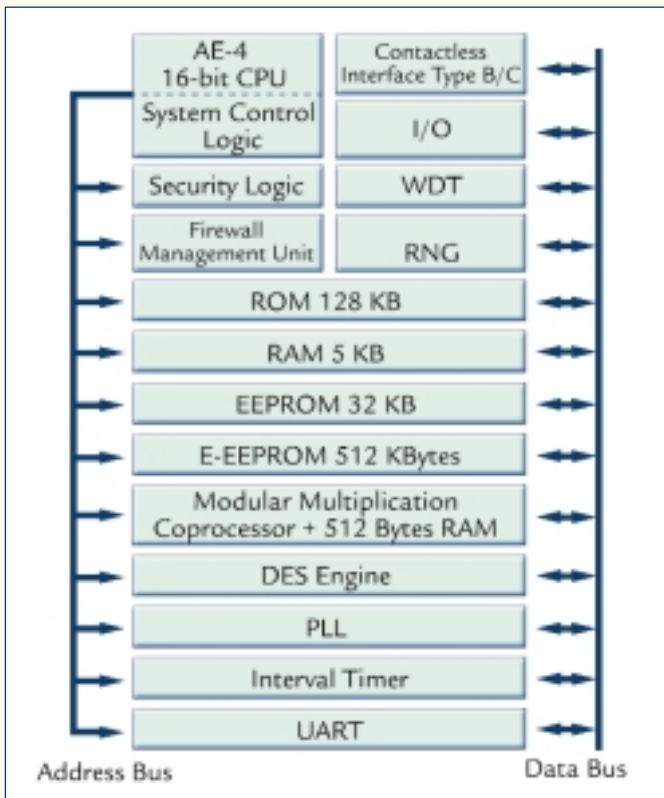
Applications:

The AE45X fulfils the requirement of Smart Card applications for large memories, high security and high-speed secure authentication, data encryption or electronic signature, as well as secure contactless data transmission. This multi-application capability combines the standard

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smart card usage such as bankcards with contactless based applications for vending machines or passenger tickets. The anti-collision method of the contactless interface is particularly suitable for automatic public transport fare collection where one terminal can operate several cards simultaneously, preventing queues at the entrance gates. Other contactless applications include access control to a network or a building, and labelling and logistics involving process tracking and identification.

The move from a single to multi-application on a single chip requires not only additional memory for application data storage but also features such as Firewall management units to provide data integrity between applications. The AE45X includes these features and its high speed Coprocessor ensures the performance needed for processing of arithmetical data required in today's high security applications.

Specification

Item	Specification
Process	0.35 µm Shrink CMOS process
CPU	AE-4 - High performance 16-bit CPU
	16 MBytes Linear Address Space
	minimum instruction timing:
	400 ns for 32-bit addition
	2.8 us for 16 x 16-bit multiplication
Contactless functions	RF interface ISO 14443 Type B / C
	Carrier Frequency 13.56 MHz
	Data rate up to 212 Kbit/s
	Anticollision protocol for usage of several
	cards simultaneously
	512 Byte RAM
EEPROM	MONOS EEPROM Process
	32 KBytes EEPROM
	512 Bytes Extra EEPROM
	Easy access by single instruction
	1 to 64 Byte programming with one instruction
	Protected against accidental writing and erasing
	Data retention minimum 10 years
	Programming & erasing voltage generation onchip
	Endurance greater than 100,000 times
	Erase time 2ms
	Write time 4ms
	Overwrite time 2ms
ROM	128 KBytes
RAM	4.5 KBytes
Coprocessor	1024 bit Key length
	512 Byte RAM
	RSA / ECC Cryptography
Onchip functions	Several security features such as sensors
	Des-Engine for calculation of 56 bit DES key by
	Hardware Minimum execution time is 18 clock cycle.
	Watchdog timer supports real time OS & applications
	with exact time measurements
	RNG to provide hardware random numbers
	FMU Firewall Management Unit to support
	Multi-application
	UART
	PLL (Phase lock loop)
Power	Single voltage power supply
	4.5 V to 5.5 V
	2.7 V to 3.3 V
	Power Consumption
	Max 10 mA in operation
	Max 100µA in sleep mode (clock stoped)
External Clock	input
	fclk = 1 to 10 Mhz at 5V, fclk = 1 to 5 Mhz at 3V
Operating temperature:	
	Standard -25 to +85 C
Shipping Form 8 inch wafer	
	Sawn wafer, unsawn wafer
	Chip on tape (COT) Module

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