

## ICs for Chip Cards

### **SLE 4432/42**

Intelligent 256-Byte EEPROM

### **SLE 4440**

Intelligent 64-Byte EEPROM

### **SLE 4441**

Intelligent 128-Byte EEPROM

<b>SLE 4432/40/41/42 Data Sheet Extension</b>	
<b>Revision History: Original Version 09.98</b>	
Previous Releases:	
Page	Subjects (changes since last revision)

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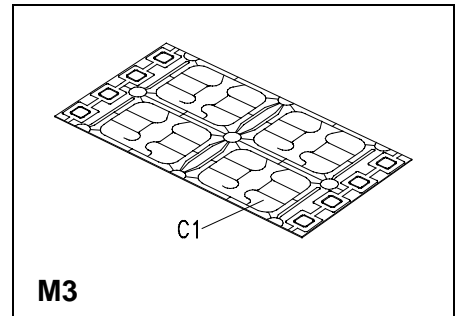
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**Intelligent 256-Byte EEPROM with Write Protect Function** **SLE 4432**

**Intelligent 256-Byte EEPROM with Write Protect Function and Programmable Security Code (PSC)** **SLE 4442**

## Features

- 256 x 8-bit EEPROM organization
- Byte-wise addressing
- Irreversible byte-wise protection of lowest 32 addresses (Byte 0...31)
- 32 x 1-bit organization of protection memory
- Two-wire link protocol
- End of processing indicated at data output
- Ambient temperature  $T_A$  -35... +80°C
- Supply voltage 5 V -5 / +10 %
- Supply current < 10 mA
- EEPROM programming time 5 ms
- ESD protection typical 4000 V
- Endurance minimum  $10^5$  write/erase cycles / bit<sup>1)</sup>
- Data retention for minimum of 10 years<sup>1)</sup>
- Contact configuration and Answer-to-Reset (synchronous transmission) in accordance to ISO standard 7816



## Additional Feature of SLE 4442

- Data can only be changed after entry of the correct 3-byte programmable security code

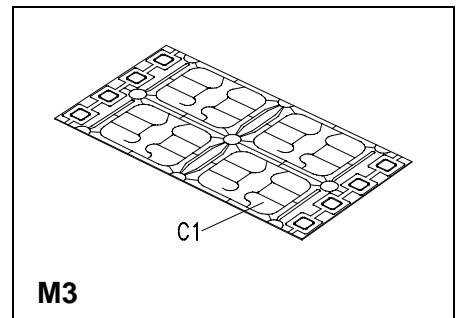
Type	Ordering Code	Package
SLE 4432 M3	on request	Wire-Bonded Module M3
SLE 4432 C	on request	Chip
SLE 4442 M3	on request	Wire-Bonded Module M3
SLE 4442 C	on request	Chip

<sup>1)</sup> Values are temperature dependent, for further information please refer to your Siemens Sales Office.

**Intelligent 64-Byte EEPROM with Write Protect Function and Programmable Security Code (PSC) SLE 4440**

**Intelligent 128-Byte EEPROM with Write Protect Function and Programmable Security Code (PSC) SLE 4441**

- 64 x 8-bit EEPROM organization (SLE 4440)
- 128 x 8-bit EEPROM organization (SLE 4441)
- Byte-wise addressing
- Irreversible byte-wise protection of lowest 32 addresses (Byte 0...31)
- 32 x 1-bit organization of protection memory
- Two-wire link protocol
- End of processing indicated at data output
- Ambient temperature  $T_A$  -35... +80°C
- Supply voltage 5 V -5 / +10 %
- Supply current < 10 mA
- EEPROM programming time 5 ms
- ESD protection typical 4000 V
- Endurance minimum  $10^5$  write/erase cycles / bit<sup>1)</sup>
- Data retention for minimum of 10 years<sup>1)</sup>
- Contact configuration and Answer-to-Reset (synchronous transmission) in accordance to ISO standard 7816
- Data can only be changed after entry of the correct 3-byte programmable security code



Type	Ordering Code	Package
SLE 4440 M3	on request	Wire-Bonded Module M3
SLE 4440 C	on request	Chip
SLE 4441 M3	on request	Wire-Bonded Module M3
SLE 4441 C	on request	Chip

<sup>1)</sup> Values are temperature dependent, for further information please refer to your Siemens Sales Office.

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## Introduction

This document describes changes and extensions of the Data Sheet 07.95 of SLE 4432 / SLE 4442. All information of the Data Sheet 07.95 are also valid for SLE 4440 and SLE 4441 (e.g. operational information) except the data mentioned in this document.

In detail the following items are added or changed

- Memory size SLE 4440
- Memory size SLE 4441
- Ambient temperature  $T_A$   $-35^{\circ}\text{C} \dots +80^{\circ}\text{C}$
- ESD protection min. 1500 V, typical 4000 V
- Endurance minimum 100000 write/erase cycles / bit
- Package: Module M3
- Coding information

Especially the transmission protocol (2-wire) and commands are fully compatible for all chip types.

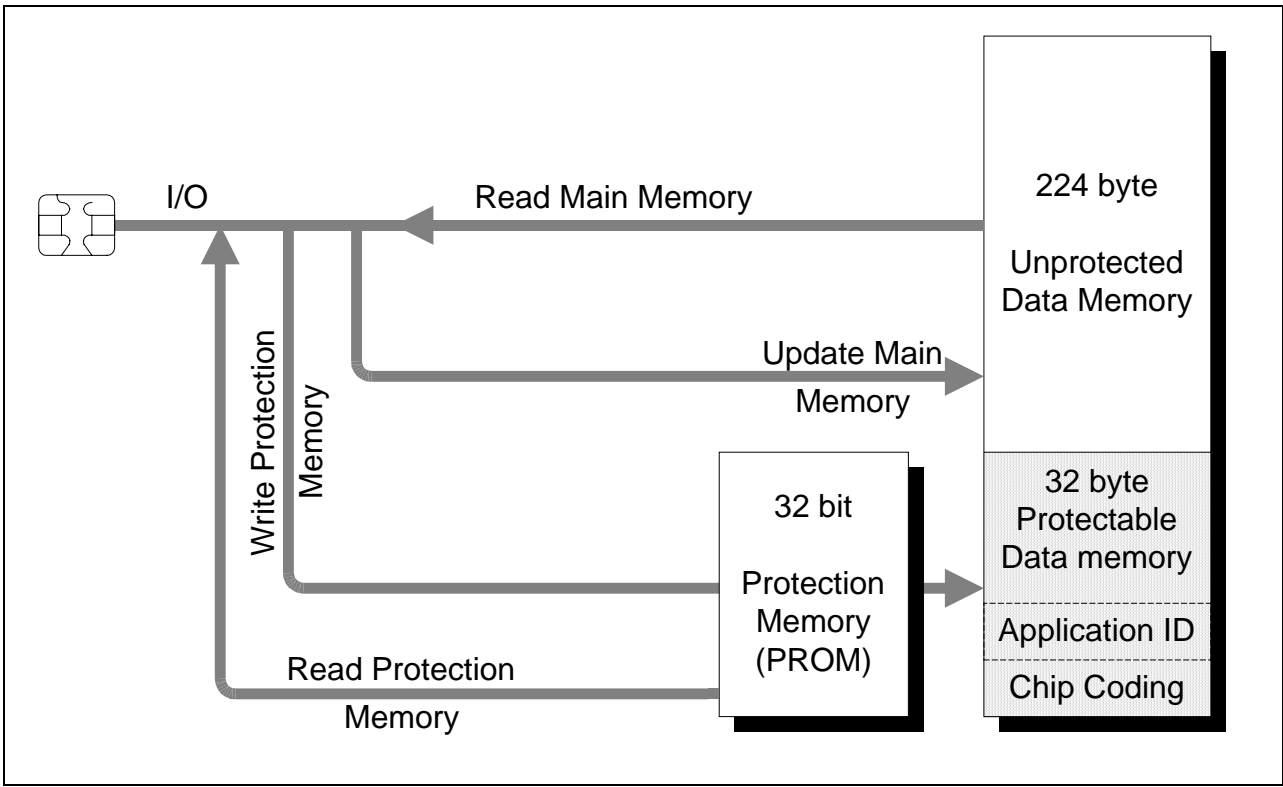
## 1. Memory Overview

The memory is organized in a **Main Memory** of

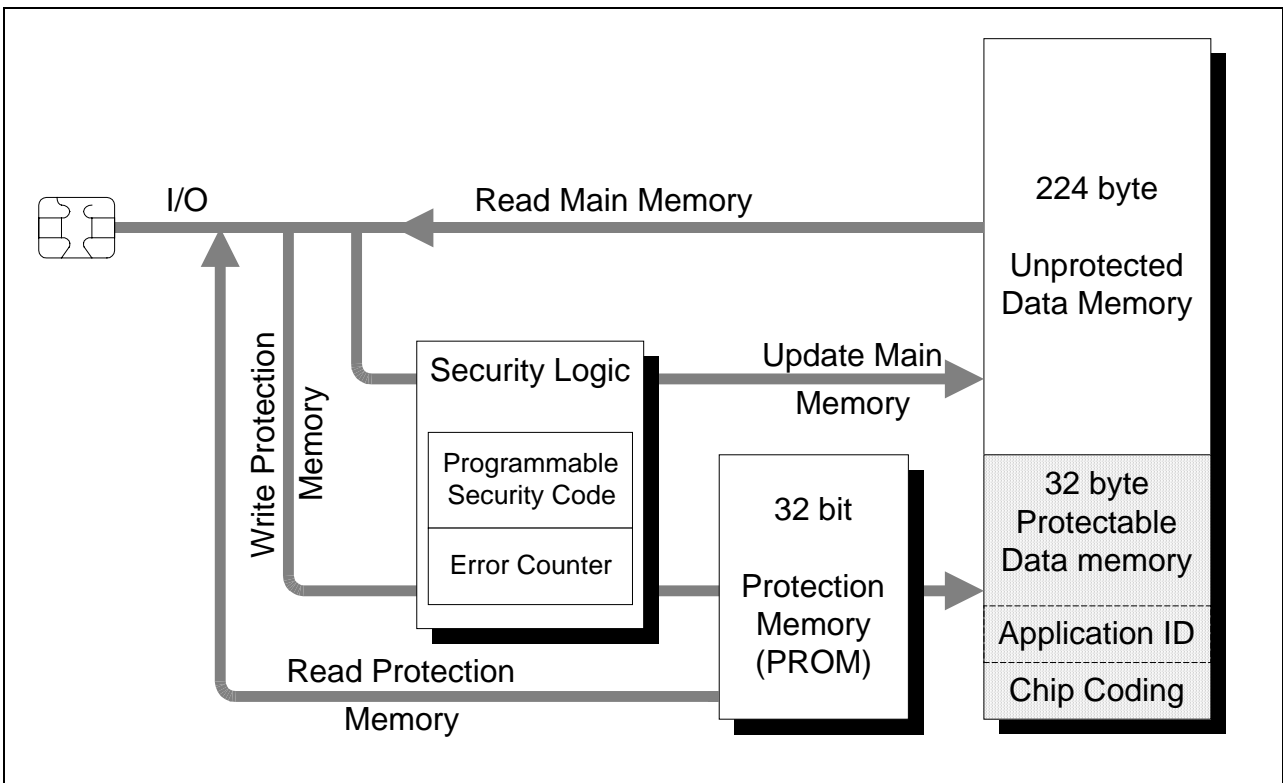
- 64 byte for SLE 4440
- 128 byte for SLE 4441
- 256 byte for SLE 4432 and SLE 4442

Each of the first 32 bytes of the Main Memory can be irreversibly protected against data change by writing the corresponding bit in the **Protection Memory** (32 bit). Dependent on the state of the protection bit the memory is read only (ROM) or may be erased and written again (EEPROM). Change of the manufacturer code is only possible by the chip manufacturer.

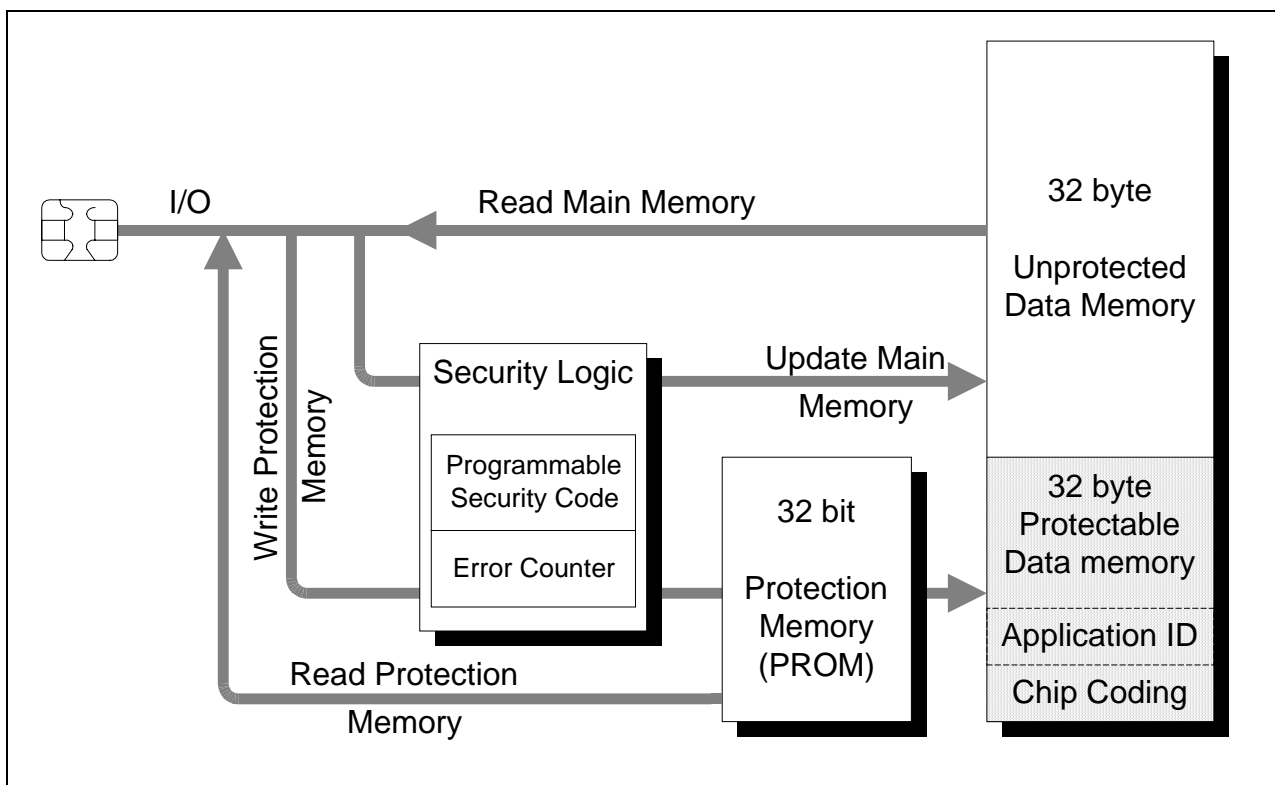
Change of data of the Main Memory and write a bit of the Protection Memory is only possible after a correct verification of the **P**rogrammable **S**ecurity **C**ode (**PSC**) for SLE 4440, SLE 4441 and SLE 4442.



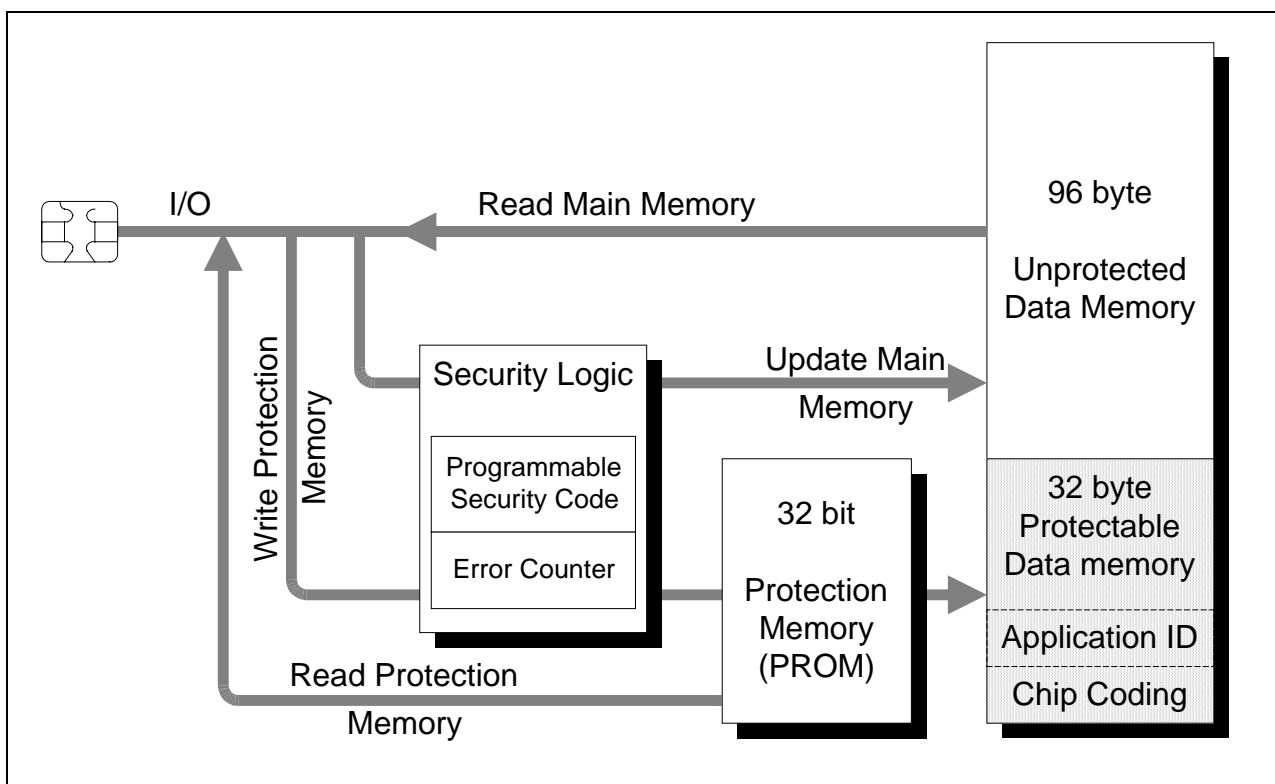
**Figure 1 Memory Overview SLE 4432**



**Figure 2 Memory Overview SLE 4442**



**Figure 3 Memory Overview SLE 4440**



**Figure 4 Memory Overview SLE 4441**

## 2. Coding

SLE 4432, SLE 4442, SLE 4440 and SLE 4441 are delivered with a customer related unique code in order to allow an unambiguous identification of the application. Thus a terminal can clearly accept or reject a card after reading the Answer-to-Reset and the identification data. The Answer-to-Reset (ATR) for synchronous IC cards according to ISO/IEC 7816 is a standardized procedure allowing to identify an IC card (ICC) supporting the synchronous Answer-to-Reset. The Answer-to-Reset data allow an interface device to select the appropriate chip type and operate the ICC according to the data sheet of the chip.

Two different coding schemes apply

- Extended coding using encoded BER-TLV data objects according to ISO/IEC 7816-4
- 16-bit manufacturer code registered at Pro Electron

Both schemes identify the application by the registered application provider identifier RID according to ISO/IEC 7816-5

### 2.1. Registered Application Provider Identifier RID

The application is generally identified by the customer specific 5-byte registered application provider identifier **RID** according to ISO/IEC 7816-5 using the registration category values 'A' and 'D'. The RID is a part of the **AID**. Thus the AID is constructed as following:

Application identifier <b>AID</b>	
Registered application provider identifier <b>RID (5 byte)</b>	Proprietary application provider identifier extension <b>PIX (≤11 byte)</b>

- Registered application provider identifier RID  
Customer specific RID provided by the registration authority to the applicant

RID	Meaning	Comment
'A x xx xx xx xx'	International registration	RID is registered by Tele Denmark
'D c cc xx xx xx'	National registration	RID is registered by a national authority
'c cc'	Country indicator	Country code according to ISO 3166
'xx xx xx'	Application provider sequence no.	Provided by national registration authority

- Proprietary application provider identifier extension PIX  
Extension for the RID holder in order to diversify own applications

Application forms for a RID are printed in the Annex A of ISO/IEC 7816-5.

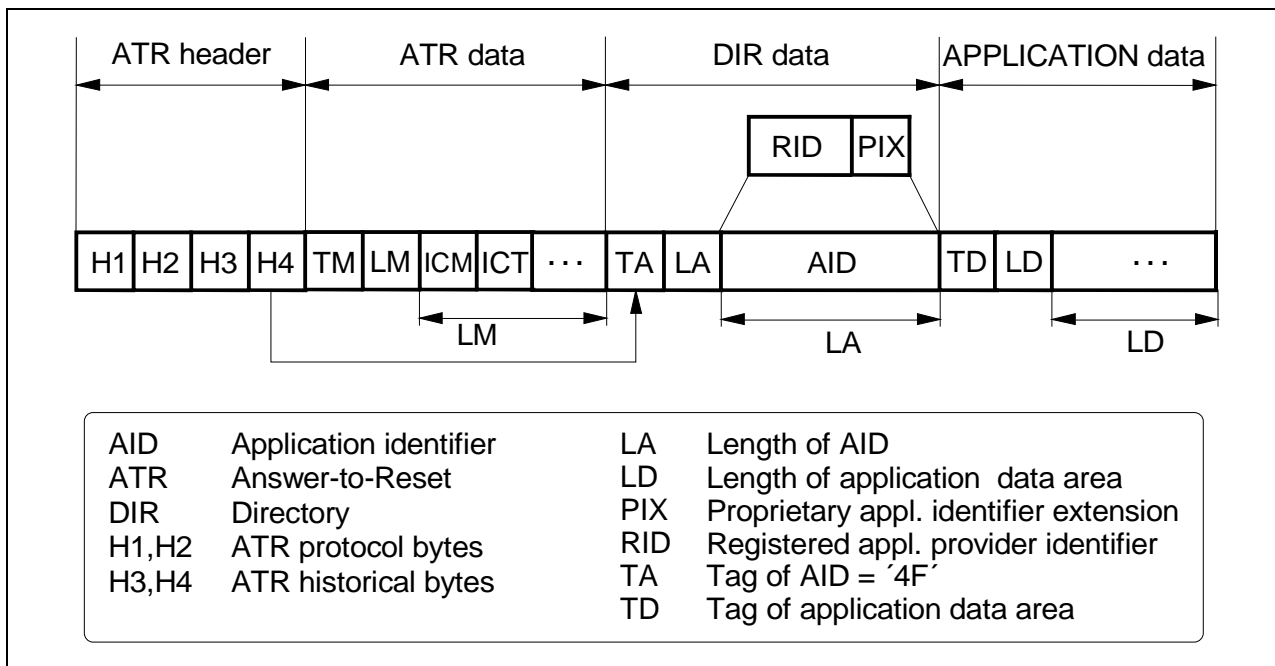
- For international registration one has to apply at the acting registration authority Tele Denmark for a RID indicated by 'A'. The contact address is printed in ISO/IEC 7816-5
- For national registration one has to apply at the relevant national standardization body or its acting registration authority for a RID indicated by 'D' followed by the country code

The RID is provided by the customer to Siemens.



**2.2. Extended Coding Scheme**

Due to the available memory space the coding principle according to ISO/IEC 7816-4 applies for SLE 4432, SLE 4442, SLE 4440 and SLE 4441. Data are coded according to the ASN 1 data objects basic encoding rules using the structure Tag - Length - Value (BER TLV).



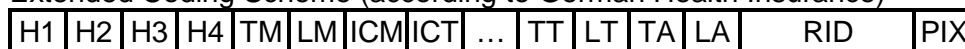
**Figure 5 Structure of a Mono- Application Memory IC Card with a simple DIR-Structure**

Two coding principles apply

- Extended Coding Scheme (Compressed)



- Extended Coding Scheme (according to German Health Insurance)



The byte definition is explained in the following:

**ATR header**

- Byte H1: Protocol type = 'A2' indicating two-wire link protocol
- Byte H2: Protocol parameter
- Byte H3: Historical byte "Category Indicator" = '10' indicating that the following byte H4 will be a DIR data reference
- Byte H4: Historical byte "DIR data reference" = a pointer (byte address) to the first byte of the directory section (i.e. TA for Extended Coding Scheme - Compressed or TT for Extended Coding Scheme - according to German Health Insurance)

### ATR data section

Byte TM: Tag manufacturing data object ('pre-issuing data') = '46'  
 Byte LM: Length of manufacturing data  
 Byte ICM: IC manufacturer = '05'. For existing applications ICM = '81' is still available  
 Byte ICT: IC Type

### DIR data section

The DIR data section contains according to ISO/IEC 7816-5 data objects for application selection. The following variants are possible:

- The IC card is a mono application card and only the data object 'application identifier' (tag TA = '4F') is present in the DIR data section. → Extended Coding Scheme (Compressed)
- The IC card is a mono application card with the data object 'application template' (tag TT = '61') in the DIR data section. The application template can contain along with the application identifier (tag TA = '4F') further data objects (e.g. application label - tag '50' or discretionary data - tag '53'). → Extended Coding Scheme (according to German Health Insurance)

**Note:** Bytes H1, H2, H3, H4, ICM, ICT and the customer specific RID are programmed by Siemens and protected against further changes.

## 2.3. 16-bit Coding Scheme

For applications requiring only a unique coding the following construction applies

2 byte	1 byte	5 byte
Manufacturer Code	Manufacturer data	Registered application provider identifier RID

- Manufacturer Code registered at Pro Electron  
 16-bit code provided by Siemens, fix for SLE 4432, SLE 4442, SLE 4440 and SLE 4441
- Manufacturer data  
 Differentiation of chip types SLE 4432, SLE 4442, SLE 4440 and SLE 4441
- Registered application provider identifier RID  
 Customer specific RID provided by the registration authority to the applicant

**Note:** The above mentioned 8 bytes are programmed by Siemens and protected against further changes.

## 2.4. Codes Overview

SLE 4432, SLE 4442, SLE 4440 and SLE 4441 are available with the coding schemes. Please note that according to ISO/IEC 7816-6 Amendment 1 **ICM = '05'** for new implementations. For existing applications ICM = '81' is still available. It is recommended that terminals accept both IC manufacturer codes.

Address	0	1	2	3	4	5	6	7	8	9	10	...	14	15	(dec)
Address	0	1	2	3	4	5	6	7	8	9	A	...	E	F	(hex)
Meaning	H1	H2	H3	H4	TM	LM	ICM	ICT	TA	LA	RID		PIX		
Data	A2	13	10	88	46	02	05	05	4F		RID			SLE 4432	
Data	A2	13	10	88	46	02	05	15	4F		RID			SLE 4442	
Data	A2	03	10	88	46	02	05	17	4F		RID			SLE 4440	
Data	A2	0B	10	88	46	02	05	16	4F		RID			SLE 4441	

**Figure 6 Extended Coding Scheme (compressed)**

Address	0	1	2	3	4	5	6	7	...	17	18	19	20	21	...	25	26	(dec)
Address	0	1	2	3	4	5	6	7	...	11	12	13	14	15	...	19	1A	(hex)
Meaning	H1	H2	H3	H4	TM	LM	ICM	ICT		TT	LT	TA	LA	RID		PIX		
Data	A2	13	10	91			05	05						RID			SLE 4432	
Data	A2	13	10	91			05	15						RID			SLE 4442	
Data	A2	03	10	91			05	17						RID			SLE 4440	
Data	A2	0B	10	91			05	16						RID			SLE 4441	

**Figure 7 Extended Coding Scheme (according to German Health Insurance)**

Address	0		1		2		3		...		7		
Meaning	Manufacturer Code				Manufac-turer data		Registered application provider identifier RID						
Data	31		74		01		RID						SLE 4432
Data	31		74		02		RID						SLE 4442
Data	31		74		04		RID						SLE 4440
Data	31		74		08		RID						SLE 4441

**Figure 8 16-bit Coding Scheme**

The shaded bytes are programmed by Siemens and protected against further changes.

### 3. Operational Information

#### 3.1. Memory Map SLE 4440

Address (decimal)	Main Memory	Protection Memory	Security Memory
64	Data Byte 64 (D7...D0)		
:	:		
32	Data Byte 32 (D7...D0)		
31	Data Byte 31 (D7...D0)	Protection Bit 31 (D31)	
:	:	:	
4	Data Byte 4 (D7...D0)	Protection Bit 4 (D31)	
3	Data Byte 3 (D7...D0)	Protection Bit 3 (D3)	Reference Data Byte 3 (D7...D0)
2	Data Byte 2 (D7...D0)	Protection Bit 2 (D2)	Reference Data Byte 2 (D7...D0)
1	Data Byte 1 (D7...D0)	Protection Bit 1 (D1)	Reference Data Byte 1 (D7...D0)
0	Data Byte 0 (D7...D0)	Protection Bit 0 (D0)	Error Counter

The Data bytes 0 to 31 can be protected against further changes by programming the associated protection bit 0 to 31. The SLE 4440 allows data changing only after correct verification of the Reference Data bytes. Reading of the Data bytes and of the associated protection bits is always possible.

#### 3.2. Memory Map SLE 4441

Address (decimal)	Main Memory	Protection Memory	Security Memory
128	Data Byte 128 (D7...D0)		
:	:		
32	Data Byte 32 (D7...D0)		
31	Data Byte 31 (D7...D0)	Protection Bit 31 (D31)	
:	:	:	
4	Data Byte 4 (D7...D0)	Protection Bit 4 (D31)	
3	Data Byte 3 (D7...D0)	Protection Bit 3 (D3)	Reference Data Byte 3 (D7...D0)
2	Data Byte 2 (D7...D0)	Protection Bit 2 (D2)	Reference Data Byte 2 (D7...D0)
1	Data Byte 1 (D7...D0)	Protection Bit 1 (D1)	Reference Data Byte 1 (D7...D0)
0	Data Byte 0 (D7...D0)	Protection Bit 0 (D0)	Error Counter

The Data bytes 0 to 31 can be protected against further changes by programming the associated protection bit 0 to 31. The SLE 4441 allows data changing only after correct verification of the Reference Data bytes. Reading of the Data bytes and of the associated protection bits is always possible.

## 4. Electrical Characteristics

The listed characteristics are ensured over the operating range of the integrated circuit. Typical characteristics specify mean values expected over the production spread. If not otherwise specified, typical characteristics apply at  $T_A = 25^\circ\text{C}$  and the give supply voltage.

### 4.1. Absolute Maximum Ratings

Stresses above those listed may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this data sheet is not implied. Exposure to absolute maximum rating conditions for extended periods may effect device reliability, including EEPROM data retention and write/erase endurance.

Parameter	Symbol	Limit Values			Unit	Test Condition
		min.	typ.	max.		
ESD protection	$V_S$	1500	4000		V	ISO/IEC 7816-1
Endurance <sup>1)</sup> (write/erase cycles/bit)		$10^5$				—
Data retention <sup>1)</sup>		10			years	—

1) Values are temperature dependent, for further information please refer to your Siemens Sales Office.

### 4.2. Operation Range

Parameter	Symbol	Limit Values			Unit	Test Condition
		min.	typ.	max.		
Ambient temperature	$T_A$	-35		+80	$^\circ\text{C}$	—

5. Package

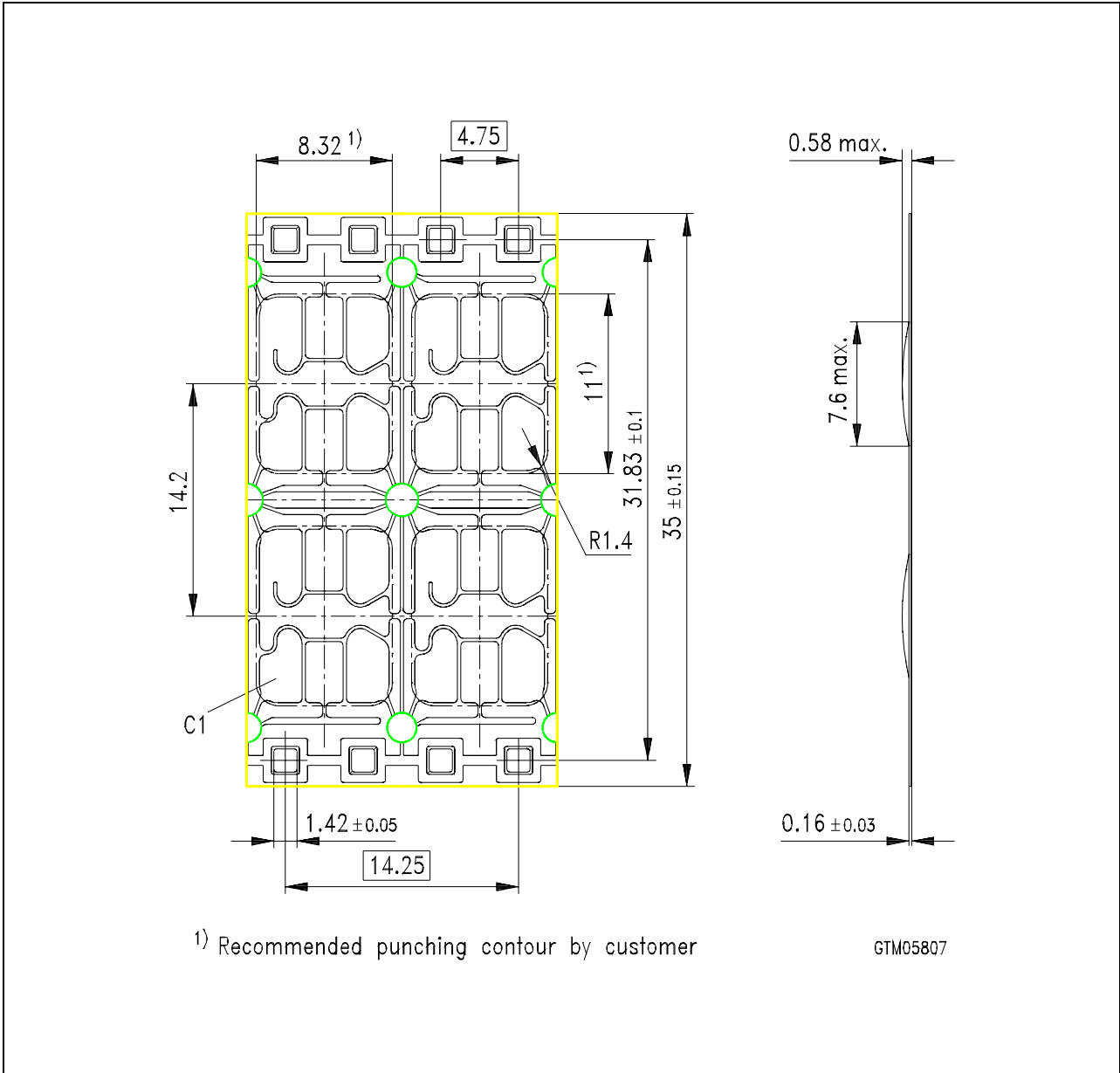


Figure 9 Package Outlines Wire-Bonded Module M3