

EEPROM Telephone Card – 1st Generation

- General
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- Memory organization
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- Security features
- Card commands

EEPROM Telephone Card - General

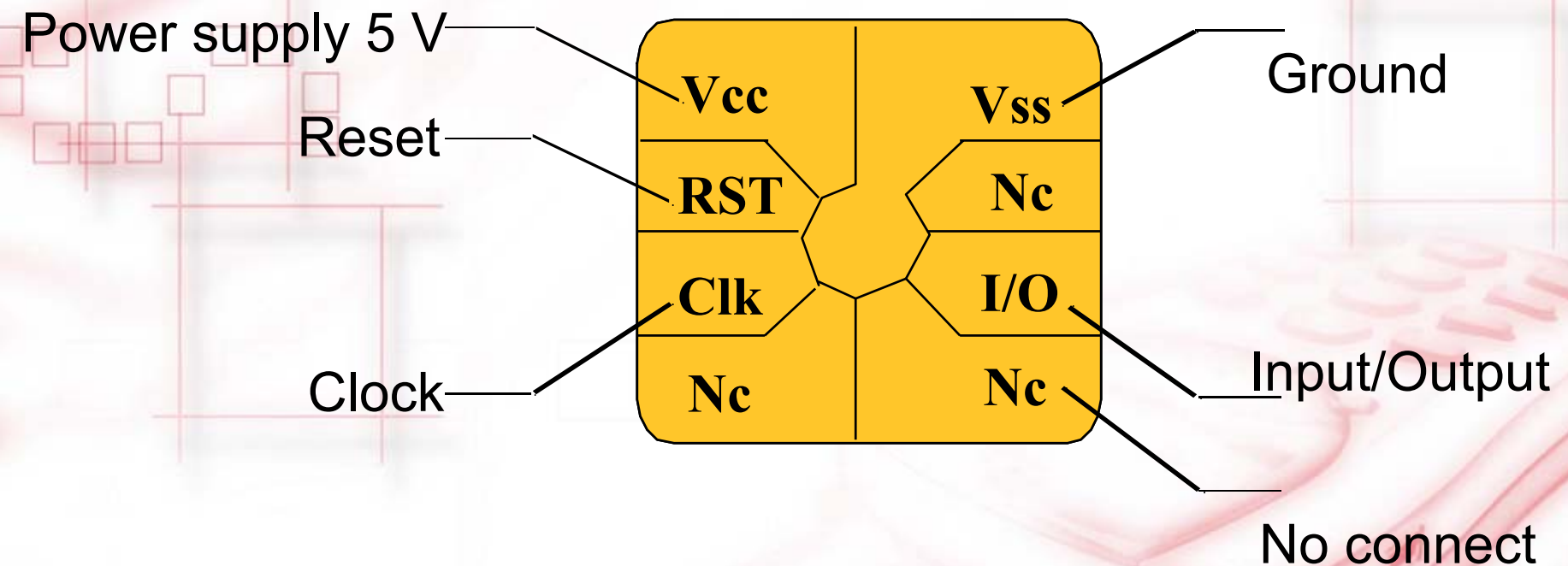
- Silicon produced by SGS-Thomson, ST-1305
- Silicon produced by Siemens, SLE-4406
- Largest volume - few hundred million cards per year
- Lowest price - approx US \$0.60 per card
- Used by many telecom operators world-wide
- Known as something 103 or 104 card e.g. GPM-103, FE-104
- Other variations but downward compatible to 4406
 - ◆ 4403 for German telecom, 4409 for GPT

Specifications

- EEPROM technology
- Memory divided into three areas:
 - ◆ A 24-bits protected **manufacturer** area
 - ◆ A 40-bits protected **issuer** area
 - ◆ A 5 stage 40-bits **abacus counter** for tokens
- Storage capacity : Up to 21 064 tokens (not reloadable)

The card when in used is in Countdown Mode

PIN Assignments



ISO 7816-1 / -2 compatible

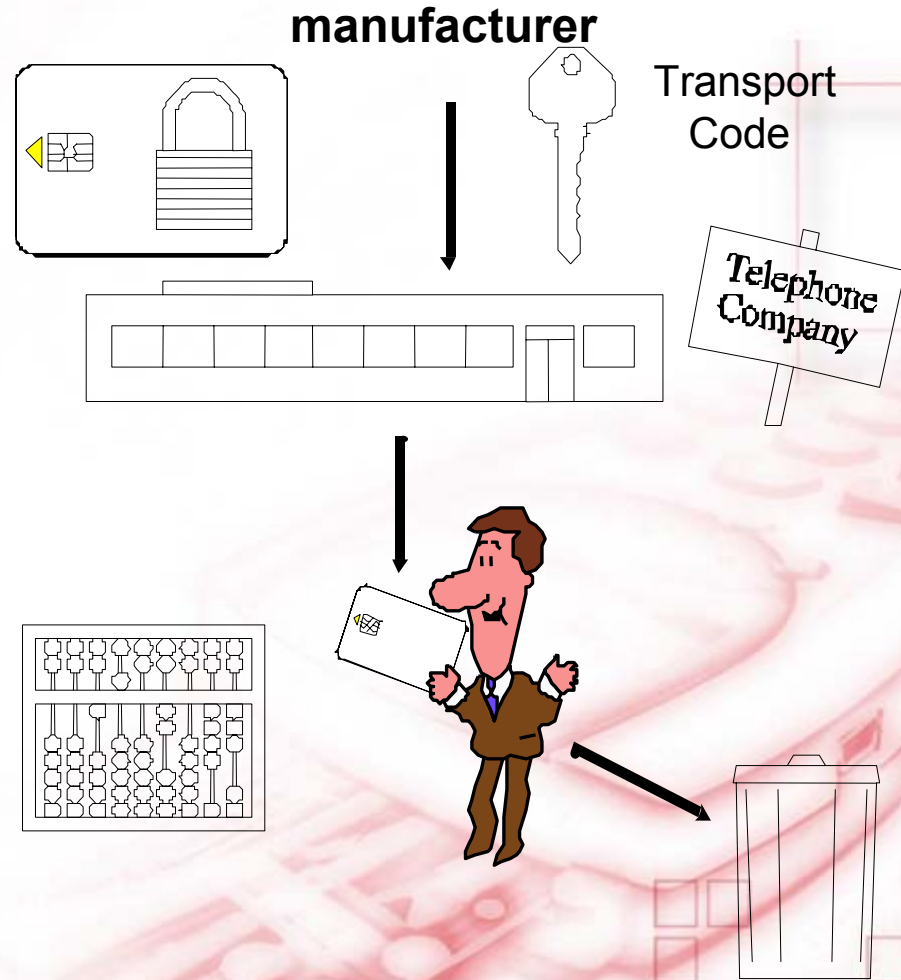
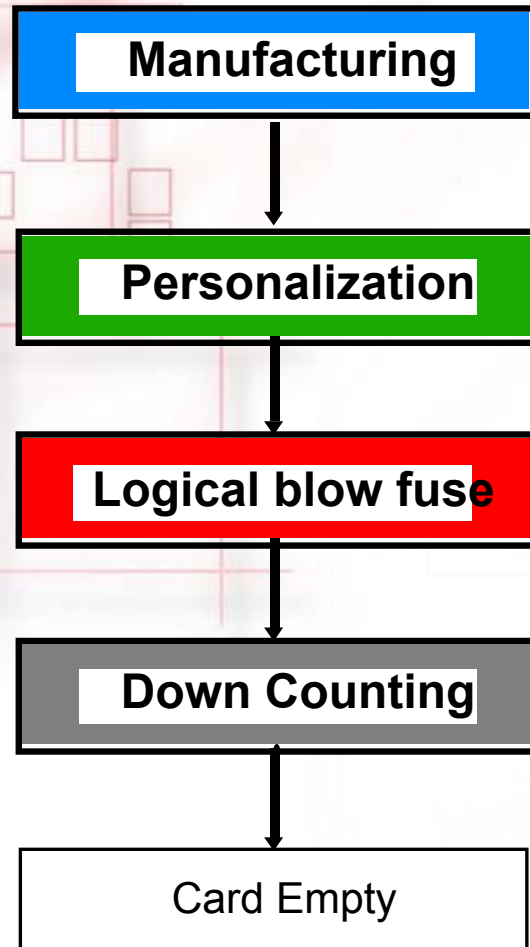
Electrical Assignments

- 5V supply voltage (VCC)
- Access Time :
 - ◆ 10 ms to write
 - ◆ 10 ms to erase
- Low power consumption
- Operating range : 0°C to +50°C
- Ten years minimum data retention

104 Card Memory Organization

Byte			TSC=0	TSC=1
0	Manufacturer Area	}	Read	R/W
1				
2				
3	Issuer Area	}	Read	R/W
4				
5				
6				
7	Fuse	}	Read	R/W
8				
9	Presentation Counter	}	R/W	R/W
10	Transport	}	None	R/W Erase
11	Secret			
12	Code			

Card Life Phases



Manufacturer Area (Read-Only)**Bit**

0

Chip Type**Chip Version**

7

8

**Chip
Manufacturer****Card Manufacturer
Code**

15

16

Application Code

23

Personalization (Done by Card Manufacturer)

- Present Transport code
- Write Issuer Area
- Clear counters
- Blow logical fuse
- Set initial value

104 Card Memory Organization

Byte

0

1

2

3

4

5

6

7

8

9

10

11

12

Manufacturer Area

Issuer Area

0 C4096 0 0 0

C512

C64

C8

C1

Read - Only

Read - Only

**Abacus
Counters
(Read/Write)**

Fuse Blow

8

64

1

71



8

64

0

71

Writing to the Logical Fuse (Bit 64**) changes the 4406 from
Personalization Mode to Count Down Mode
This is irreversible**

Before and After Fuse Blow

■ Before (**Personalization Mode**)

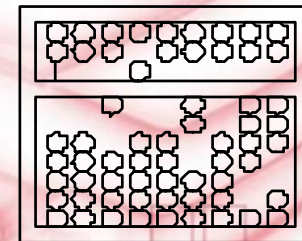
- ◆ 24-bits manufacturing information (read only)
- ◆ Blank one time write 80-bits Issuer Area
- ◆ Protected by 24-bits transport code
- ◆ 7 attempts to present transport code then the card is useless
- ◆ Loadable counter with value 0-21,064

■ After (**Count Down Mode**)

- ◆ Down Counter from loaded value to zero
- ◆ Issuer and manufacturer information is read only

Count Down Phase

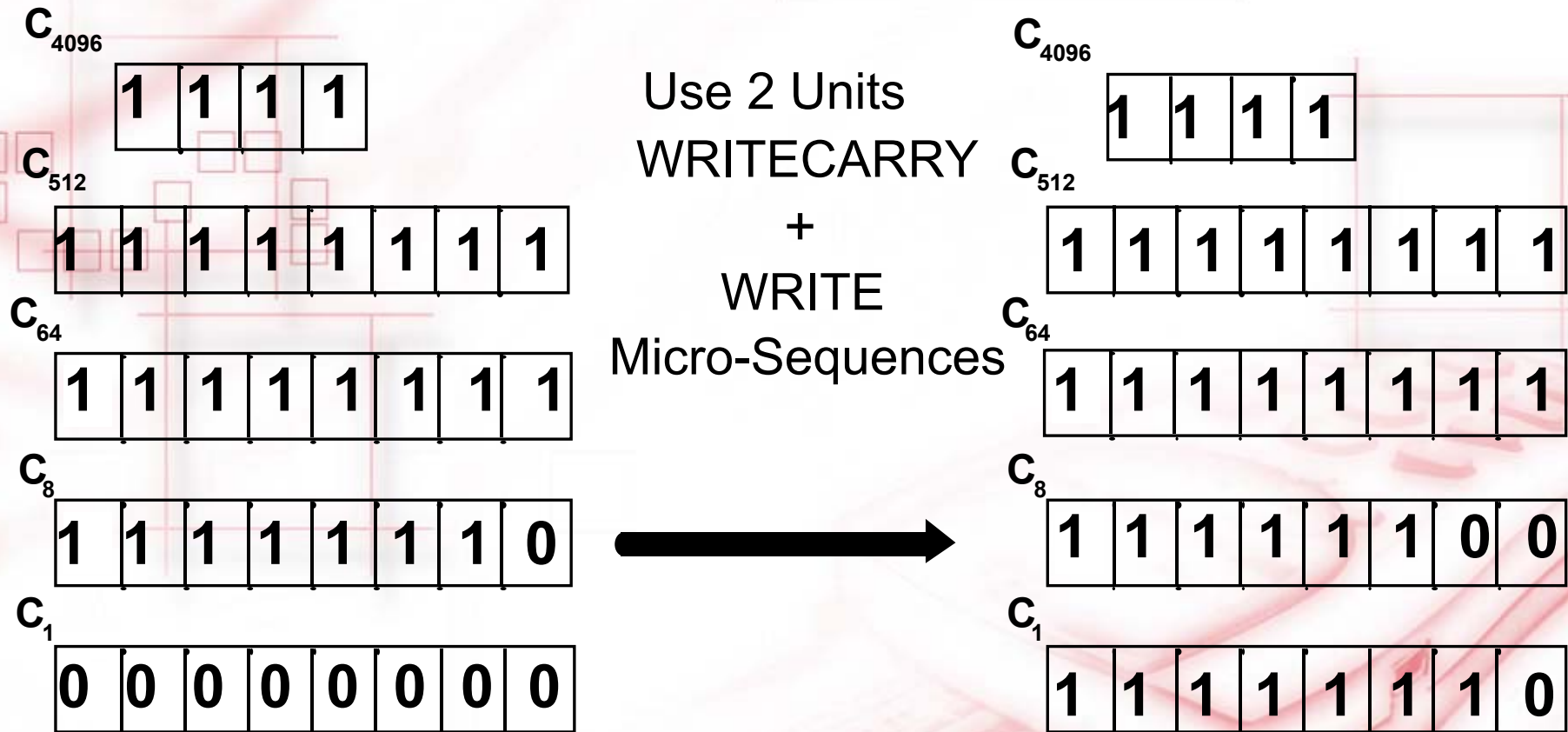
- Verify Issuer Data and Manufacturer Data for valid card
- Count down units, Issue Service
- If empty, throw away



Count Mode

- Any unwritten counter bit can be written at any time
- **WRITE** Micro-Sequence
 - Counter can be loaded with any value at personalization
 - A new value can be given to counter without stepping through all intermediate values
 - Counters C_1 , C_8 , C_{64} and C_{512} can be erased (refilled) by writing an unwritten bit in the next level counter
- **WRITECARRY** Micro-Sequence
 - Counter C_{4096} cannot be erased
 - Card does not propagate carries between counters
 - Carry propagation must be performed by the reader with additional WRITECARRY instructions

Count Mode Scheme



Counter status

Erasing Counter With WRITECARRY

To Erase counter	WRITECARRY in
C1	C8
C8	C64
C64	C512
C512	C4096 or Logical Fuse
C4096	Impossible

The WRITECARRY micro-sequence must be performed on an unwritten bit to erase a counter

Security Features

- The manufacturer area contains information unique to one application (for large orders) and are only sold to a specific customer
- The Manufacturer Area cannot be modified
- The manufacturing of ICs and cards are controlled by strict security
 - ◆ Secured transfer
 - ◆ All materials are traced
 - ◆ Rejects destroyed
- Protected by Transport Code from silicon to card manufacturer
- Impossibility to reload counter

Card Commands

- Reset Address Counter (**RESET**)
- Increment Address Counter and Read Bit (**INCREMENT**)
- Write Bit (**WRITE**)
- Present Transport Code (**PRESENT**)
- Write Carry and Erase Counter Stage (**WRITECARRY**)

104 Card Comments

- 104 card is among the lowest priced card, but security offered is very limited
- Security relies on procedural control of chip and card manufacturers
- Application not limited to telephone prepaid card application but designer's creativity
- Issuer must have control of the terminals to prevent card emulation
- Tokens may be lost if card is pulled out between write and write-carry
- This card is obsolete