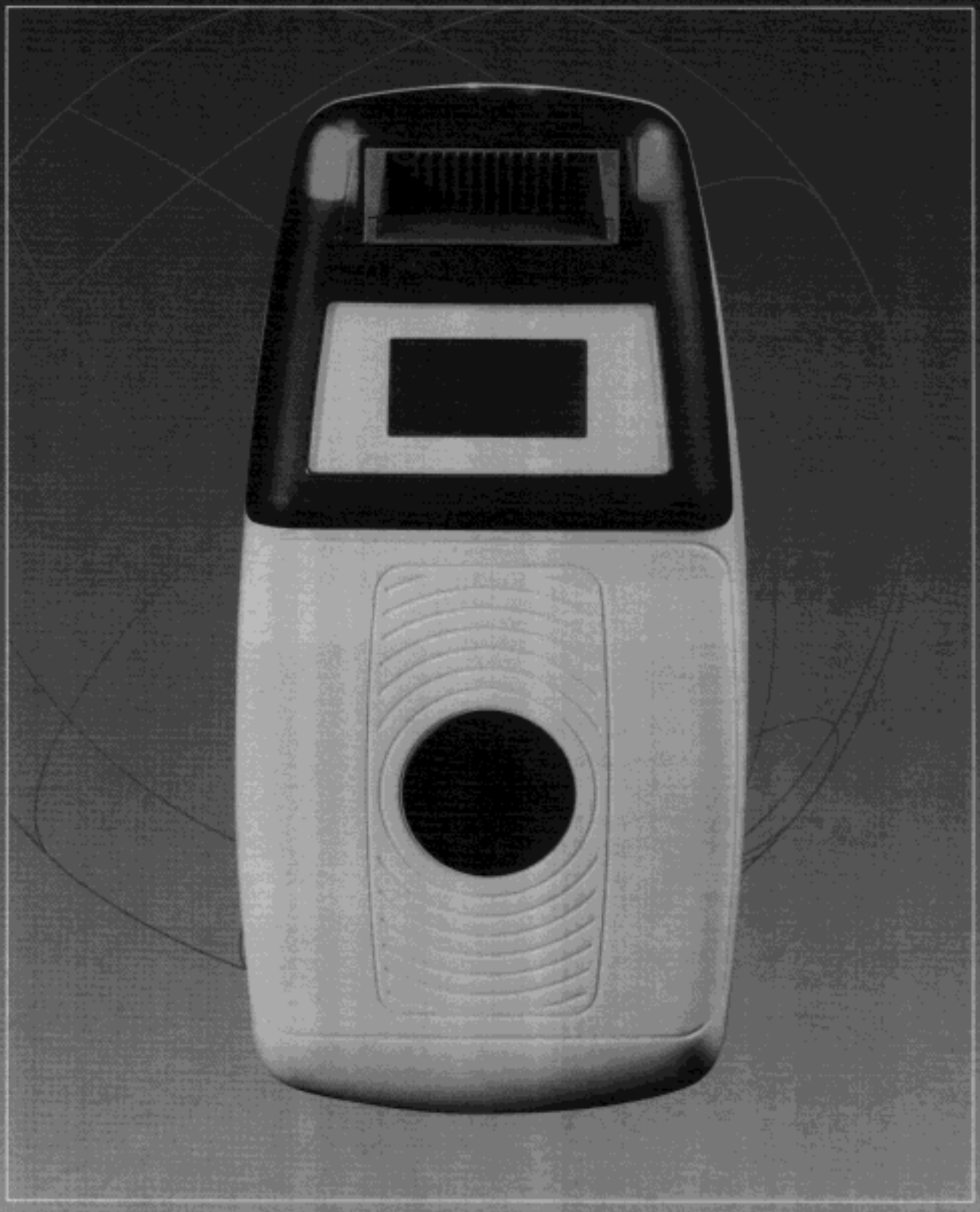
V3000 VALIDATOR



AES

GENERAL

The development of the new V3000 card validator is based on almost two decades of success with the V2000 validator. All aspects of the system have been reviewed and improved, resulting in an innovative product which has been specifically designed to read contactless smart cards and high coercivity magnetic stripe cards.

The V3000 contains a powerful 32 bit processor which makes it an extremely fast and reliable card validator with the capacity to read, write, verify and print a magnetic card in less than one second. With a combination of card technologies and a wide range of applications, the V3000 is a flexible product and an important addition to AES Prodata's range of validators.

The V3000 has been ergonomically designed and is modern, compact and user friendly. The unit is moulded around a pole which reduces the size of the footprint and makes it more difficult to vandalise. The wide magnetic slot is situated at the top of the machine and the contactless card reader is clearly visible guaranteeing ease of use for the passenger.

FEATURES

- Motor driven magnetic card reader/writer/printer ensuring fast transaction speeds.
- A range of contactless readers which can read, write and verify a card in less than 0,25 seconds, can be fitted as an option.
- Modern, impact resistant and fire retardant casing.
- Ceramic coated magnetic head ensuring long and problem free service.
- Thermal print head for high quality printing with up to 630 characters per ISO size card.
- Choice of different passenger display options:
  - simple indicator with backlit symbols
  - 8 character, alphanumeric high brightness LED display
  - full graphic liquid crystal display
- Flexible external communications; can be linked to a memory cassette, an infrared or radio communications system.
- Fast 32 bit processor.
- Optional 12 button configurable passenger keypad.
- Optional on board exit and entry turnstile link.
- Optional Security Access Module (SAM)

ANCILLARY PRODUCTS

An adaptation kit based on the V3000 mechanics and electronics can be integrated into an existing turnstile. This kit is fitted with a modified card in order to speed up the passenger flow.

OPTIONS

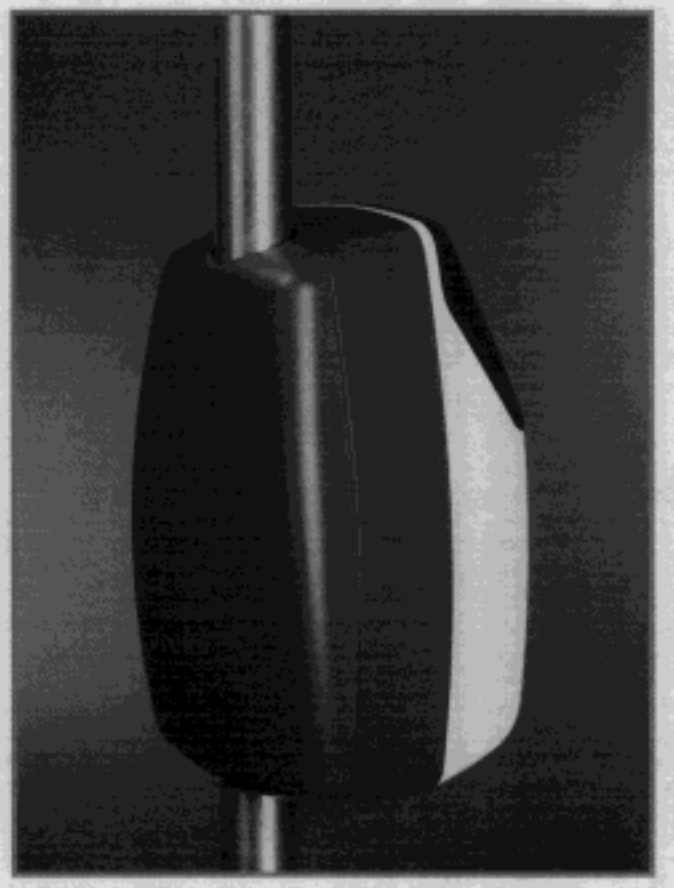
The V3000 has been designed to integrate different card technologies and it can be easily upgraded from magnetic to contact, contactless or hybrid smart card technology.


1
2
3
4
5
6
7
9
10
11
12

AES PRODATA

V3000 Validator

V3000 TECHNICAL SPECIFICATIONS



- **Magnetic Encoder/Printer**
  Transaction speed: < 1 second
  Coercivity: 2750 oersted (standard) or 300 oersted (optional)
  Magnetic density: 37-165 BPI
  Print speed: 4 lines/sec

- **Optional contactless smart card reader/writer**

- **Electronic**
  Motorola MC68332 32 bit micro controller - 16.78 Mhz
  Up to 2 Mbyte flashrom and 2Mbyte CMOS rom.
  Standard 2 x 512 Kbyte
  Communication: RS485 and RS232
  Data transfer options:
  - infra red modem
    IR3000 @ 115,2 kbaud Ir Da (Ir Da) compatible
  - radio modem
  - memory cassette

- **Environmental**
  Working temperature: -10°C to +55°C
  Humidity: 10%-95% RH, non condensing
  Supply: 16-32V DC (24V standard, 12V optional)
  Vibration: IEC 68.2/6
  5 - 300 Hz 1 octave/min
  2 G 15h/ in 3 directions
  Shock: half sine 2 G, in 3 directions (IEC 68.2.27)
  Impact: EN50102 (depending on selected option)
  Water & Dust: IEC 529 (IP41) (depending on selected option)
  EMC/EMI: EN 50082/2 (criterion 2)
  EN 50081/2 (criterion 2)
  ISO 7637/2

- **Dimensions/Weight**
  Dimensions: 180 x 315 x 160 mm
  Weight (main unit): 3.3 kg
  Weight (cradle): 0.5 kg

- **Display options**
  1. Liquid crystal full graphics
  2. 16 character alphanumeric light emitting diodes
  3. Simple backlit indicators

NOTE
The use of option 2 or 3 permits an extended temperature range of -20°C to +60°C for the unit.

Technical specifications are subject to change without notice.

247-249 Balcatta Road
Balcatta, Perth,
Western Australia 6021
Telephone: +61 8 9273 1100

AES PRODATA

Leuvensesteenweg 540, B2
1930 Zaventem
Belgium
Telephone: +32 2 722 8911

AES PRODATA

Technical Description
V3000 Validator

RF READER / WRITER
ANTENNA TARGET

Date of Release and Verification of Compliance

PHILIPS Mifare ..... Date.....

AES Prodata .. .. Date.....

Technical Manual Insert to be distributed with Equipment to the End User.

4.5 CONTACTLESS SMART CARD READER/WRITER

4.5.1
Reader/Writer Module (RWD):

The mifare ® RWD Core Module (MCM) Type MF- 500 incorporated into the V3000 Validator, is the kernel of a Mifare ® read/write unit. It covers all of the front-end functions to access mifare ® cards. Its versatility allows a flexible and efficient application in different systems devices such as bus terminals, metro gate controllers, handheld devices, booking office terminals or PC's.

The MCM consists of the Radio Frequency (RF) circuit and VLSI Chip (MCM ASIC) which are mounted on the PCB. The RF circuitry is shielded by a metal housing. It combines all the primary functions in order to access the mifare ® basic functionality. These functions include Modulation, Demodulation (Load Detection), RF signal generation, and security management and anticollision recognition. The mifare ® CM500 is a proprietary PCB circuit assembly supplied by Philips Semiconductors.

The Antenna is mounted internally on the inner side of the front cover of the Validator.
The inductive Planar antenna is surface mounted to a PCB. This in turn is, mounted by four screws internally to the front cover of the V3000 enclosure. The antenna assembly is connected to the output of the RF Amplifier via a triax-shielded cable. The antenna assembly used in the V3000 is manufactured by AES Prodata Belgium. Mounted on the antenna is a coupling device necessary to achieve an impedance of 50 Ω. The MCM interfaces with the antenna on the RF side and with a microprocessor via a parallel 8bit μP on the logic side. The RF Oscillator operates at the assigned frequency of 13.560 MHz.

4.5.2
Communications:

The Reader/Writer (intentional radiator) communicates to the batteryless Contactless Smart Card (CSC) by means of a crystal controlled radio frequency signal operating at 13.560 MHz., in accordance with Part 15 of the US Federal Code of Regulations.

Communications between the Contactless Smart Card and the RF module is by a half duplex CRC 16bit communications protocol using a handshake. The Load Detector modulation of the card is filtered with the passive band pass filter tuned to the upper side band (13.560MHz. + 847 kHz.) and demodulated with a Shottky diode. This signal is then amplified and passed on to the Comparator.The Communications Controller via means of a Cyclic Redundancy Check (CRC) and Parity generators provide control of the communications between the RWD and the Card. The Contactless Smart Card (CSC) adjusts the memory contents at a 105.94 kBd. data communications rate, using a set of proprietary commands. The permissible distance between the antenna (target) and card is up to 100mm.

4.5.3
The Reader/Writer as a Radio Frequency Device

The RF Part of the Reader/Writer functions in two distinct ways:
1) As a controlled power Transmitter (intentional radiator), transmitting energy and data to the CSC.
2) As a Load Detector (receiver) to recover the CSCs' response.

RWD as a Transmitter
The Load Detector/Transmitter are closely coupled with a serial link from and to the RF Module. The transmitter generates a digitally modulated RF Signal radiated to the Card via the RF Module and Antenna, also referred to as the Target.

The RWD as a Load Detector (receiver)

When the CSC radiates (communicates) data to the Reader/Writer, the CSC causes a variation in the antenna impedance of the Reader/Writer.

Due to the close mutual coupling between the CSC and the Reader/Writer antenna, these impedance changes are detected within the Reader/Writer as Load Modulation variations. The Reader/Writer converts these load variations into digital data by simple amplifier and level comparison circuits.

To power the CSC's the Reader/Writer continuously transmits the RF Carrier Signal at 13.56MHz. The CSC derives its internal power by detecting and rectifying the RF Carrier signal. When transmitting data to the CSC's, the Reader/Writer modulates the RF carrier with 100% ASK modulation using Miller Coding.

Transaction Sequence and Communications

Card Communications Protocol:

Typical Transaction Times Between System Elements

• Identification of a Card	3 ms. (Answer to request and Anti Collision)
• Read Block (16 Bytes)	2.5 ms. (excluding Authentication) 4.5 ms. (including Authentication)
• Write Block + Control Read	12 ms. (including Authentication for MF1 ICS50 02x) 14 ms. (including Authentication for MF1 ICS50 02x)
• Typical Ticketing Transaction	<100 ms Identification of the Card + 6 Blocks read (768 bit, 2 Sector Authentication) + 2 Blocks write (256) with Backup Management

RF Specifications

RF Power Output	600 mW	EIRP < 20μW.
Center Frequency	13.56 MHz.	
Frequency Tolerance	± 50 ppm.	
Frequency Stability	± 50 ppm.	
Class of Emission	-----	
Spurious Emission	according to FCC 15	

Band Pass Filter	: 13.56 MHz + 847kHz *.
Bandwidth	:~ 300kHz
Low Pass Filter	: ≈ 4MHz, 3rd Order. *

Note: (*) Bandwidth and Tuning Adjustments: Fixed at Factory

Communications method	: Half Duplex	
Data Transfer Rate	: 106 kBaud	
Carrier Frequency	: 13.56 MHz	
Modulation	: Receive:	Manchester Coded Sub Carrier
	: Transmit:	Miller
Modulation Bandwidth	: See Test results	
Antenna Impedance	: 50Ω ± 10 %	$f = 0° \pm 10°$
Operating Distance	: Up to 100 mm. (depending on antenna geometry) to allow convenient and fast transactions.	
Radiation Level	: See test Results	

Communications with Master Controller

Data communications between the Contactless Smart Card, the Reader/Writer Core Module and the V3000 Validator is maintained via the parallel 8 bit μC processor through the connector SK3

The V3000 Master Controller PCB is connected to the Mifare Core Module via the connector SK3.

The Reader/ Writer requires 12 volts DC to operate. The required voltages are developed within the V3000 Validator. Power to the Core Module is supplied by the device LT1074CT via SK3.

Functional Drawing (Block Diagram)

1) See Attachment Fig. 1 Drawing

Philips Mifare ® Core Module incorporated into the AES Prodata V3000 Validator.

RF Specifications

RF Power Output	600 mW	EIRP < 20μW.
Center Frequency	13.56 MHz.	
Frequency Tolerance	± 50 ppm.	
Frequency Stability	± 50 ppm.	
Class of Emission	-----	
Spurious Emission	according to FCC 15	

Band Pass Filter	: 13.56 MHz + 847kHz *.
Bandwidth	:~ 300kHz
Low Pass Filter	: ≈ 4MHz, 3rd Order. *

Note: (*) Bandwidth and Tuning Adjustments: Fixed at Factory

Communications method	: Half Duplex	
Data Transfer Rate	: 106 kBaud	
Carrier Frequency	: 13.56 MHz	
Modulation	: Receive:	Manchester Coded Sub Carrier
	: Transmit:	Miller
Modulation Bandwidth	: See Test results	
Antenna Impedance	: 50Ω ± 10 %	f = 0° ± 10°
Operating Distance	: Up to 100 mm. (depending on antenna geometry) to allow convenient and fast transactions.	
Radiation Level	: See test Results	

Communications with Master Controller

Data communications between the Contactless Smart Card, the Reader/Writer Core Module and the V3000 Validator is maintained via the parallel 8 bit μC processor through the connector SK3

The V3000 Master Controller PCB is connected to the Mifare Core Module via the connector SK3.

The Reader/ Writer requires 12 volts DC to operate. The required voltages are developed within the V3000 Validator. Power to the Core Module is supplied by the device LT1074CT via SK3.

Functional Drawing (Block Diagram)

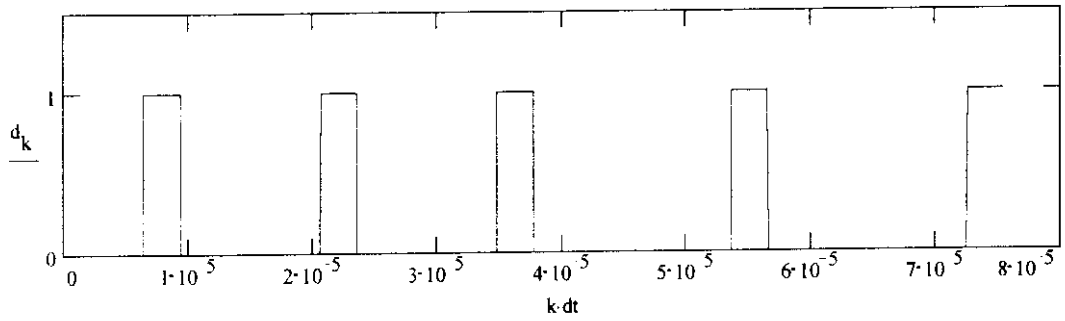
1) See Attachment Fig. 1 Drawing

Philips Mifare ® Core Module incorporated into the AES Prodata V3000 Validator.

Filtering of modified miller coded signal

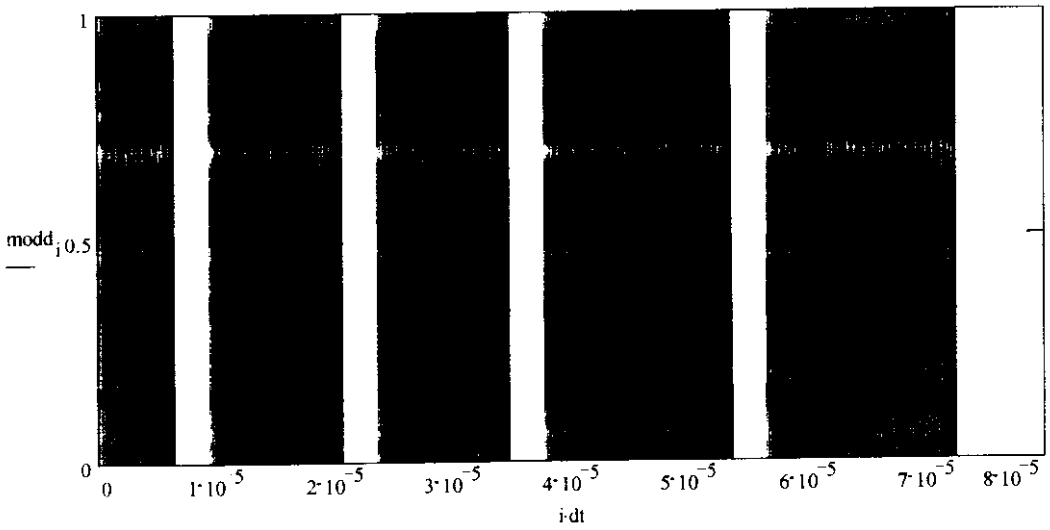
In order to check, if parts of the spectrum generated by modulating a carrier (100% ASK; 106 kbps, carrier: 13.56MHz) are spurious according to the FCC definition the following simulations have been performed:

Bitsequence:

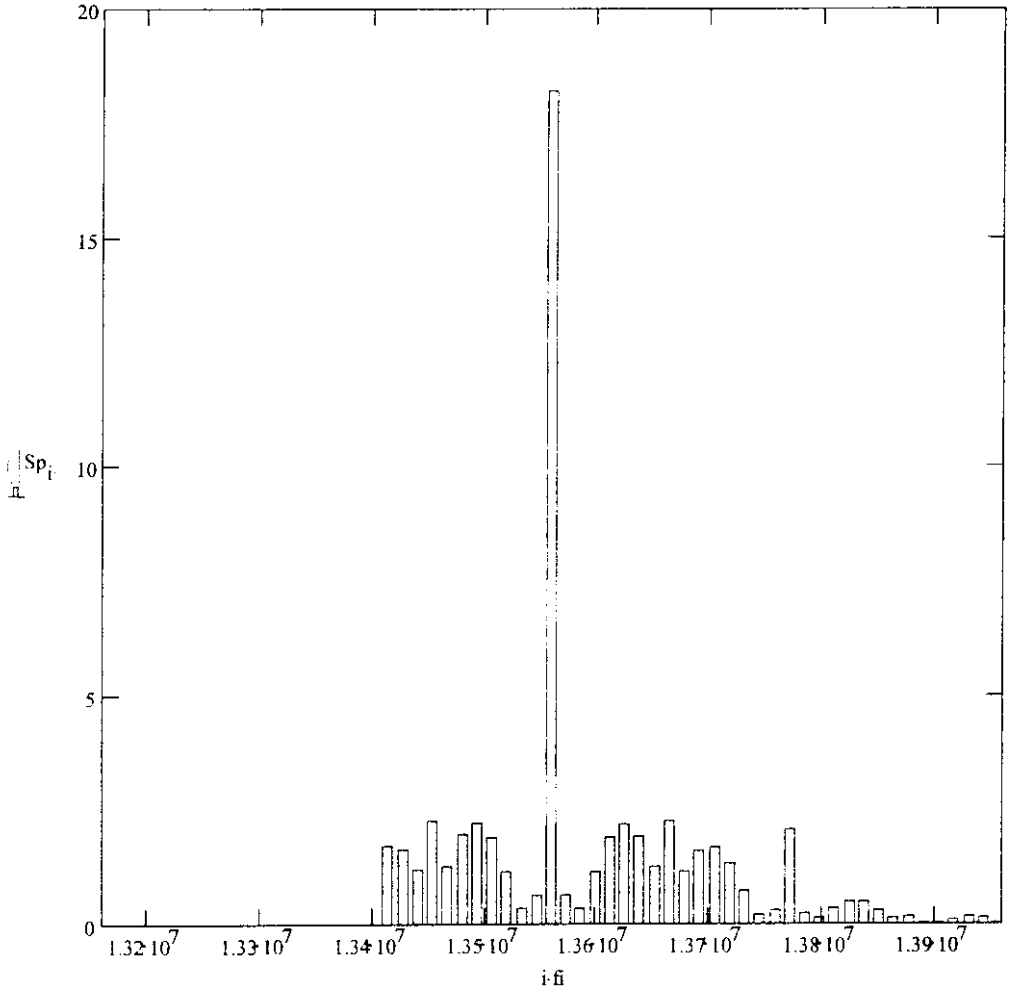


If dk=1 the carrier is modulated 100%

Modulated signal (ASK)

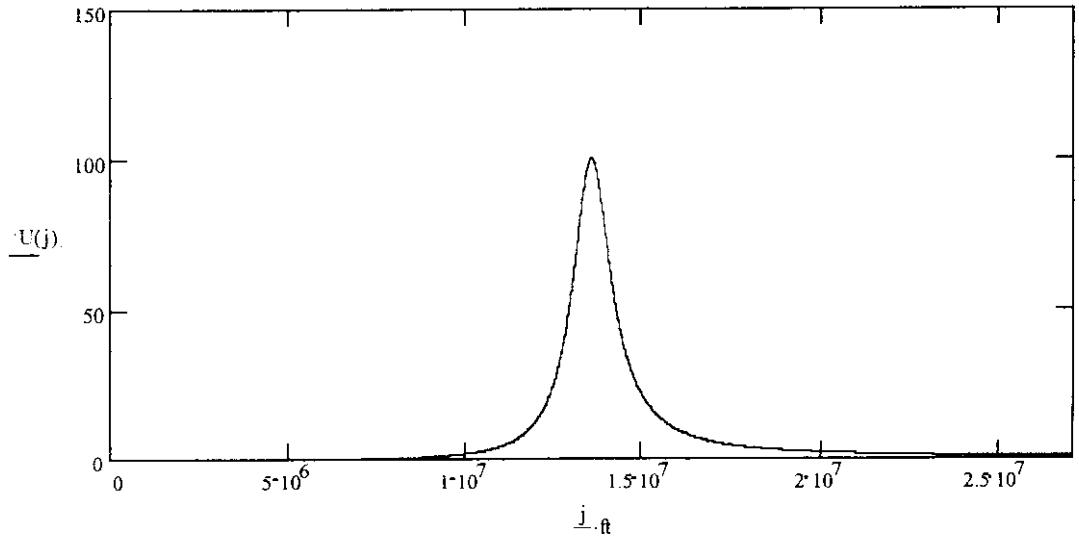


At a next step frequencies below 13.41 MHz is filtered completely
Below see resulting spectrum:

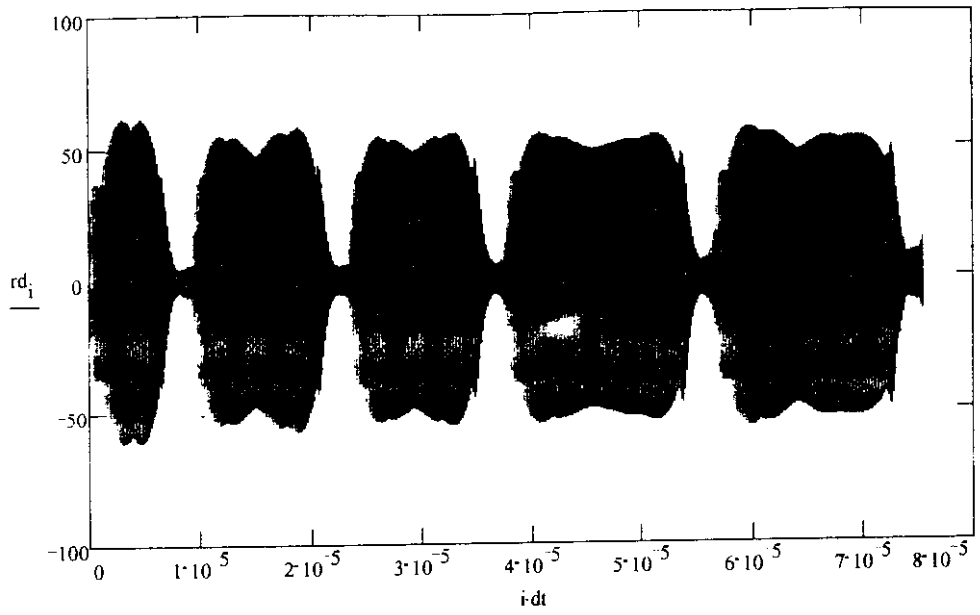


This signal is filtered by a reader antenna with linear characteristic.
The reader antennas function is the following

$$U(j) := \frac{i(j)^3}{1 - a \cdot i(j) + b \cdot i(j)^2 + a \cdot i(j)^3 - i(j)^4}$$



The resulting signal in the time domaine looks like the following



The demodulator detects pauses if the amplitude goes below approximately below 1/3 of the amplitude. Although the signal was filtered (the level of frequency components below 13.41 MHz was reduced and fully suppressed) the corresponding transmission of information has not been effected!
It can be easily seen that detection is possible.

Thus frequencies below 13.41 MHz are Spurious Emissions according to FCC and have to be below 30µV/m.