ATTACHMENT H.

- Theory of operation -

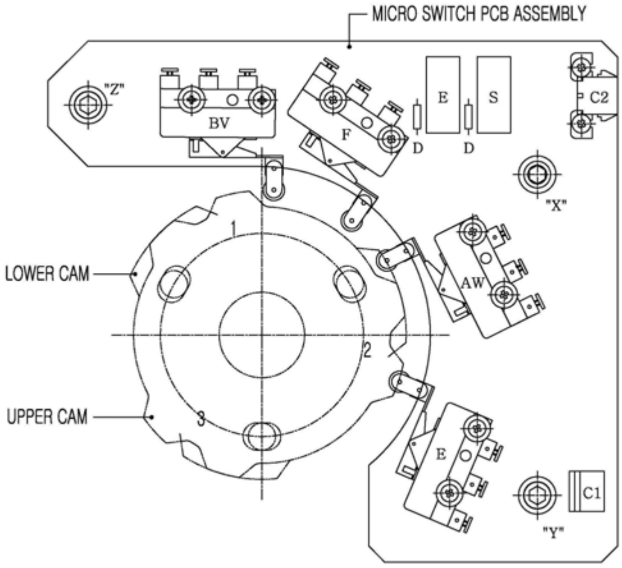
TURNSTILE GATE
User's Manual

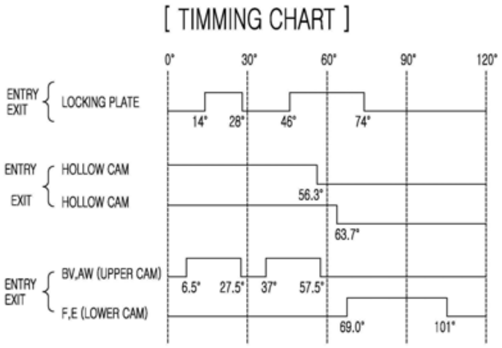
Ver 1.0

INDEX

1. TRIPOD ARM

1.1 TRIPOD ARM OPERATION



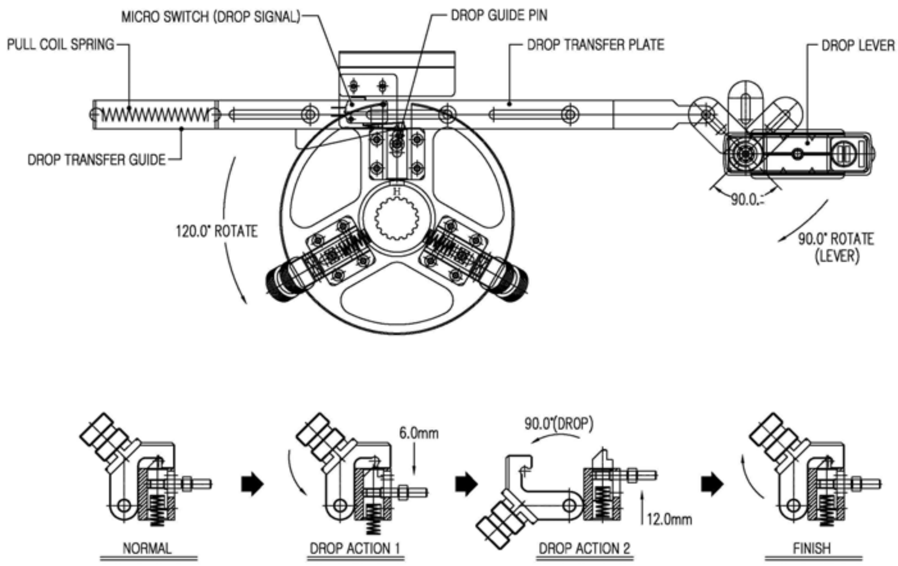


The releasing and locking of the tripod arm rotation is accomplished through the control of tripod arm mechanism using switch input and solenoid activation.

If one enters without granted access, the tripod arm will be detected by micro switch (BV) at the 6.5° rotary position which activates the solenoid and mechanically locks at the 14° rotary position.

With granted access, even with the micro switch (BV) in detection, the solenoid does not become activated, thus allowing completion of passage at the 46° rotary position through micro switch (F).

1.2 TRIPOD ARM DROP



[DROP ORDER ACTION]

TRIPOD ARM DROP applies to gates for the disabled where the arm is secured with a locking pin.

When the lever is rotated 90°, the drop guide pin will decline 6mm to release the locking pin. When this happens, the tripod arm descends freely and the guide pin inclines 12mm to activate the micro switch and transmit drop signal. In the drop mode, the lever maintains its 90° position through the guide pin, and retreats to its home position using coil spring when the arm is reinstated.

1.3 How to Operate TRIPOD ARM DROP

TRIPOD ARM DROP operates manually. For safety reasons, it is built to drop when the administrator is holding the bar with one hand while turning the lever with the other hand. For management purposes, the lever is equipped with a built-in lock.

2. Power and Network Cable

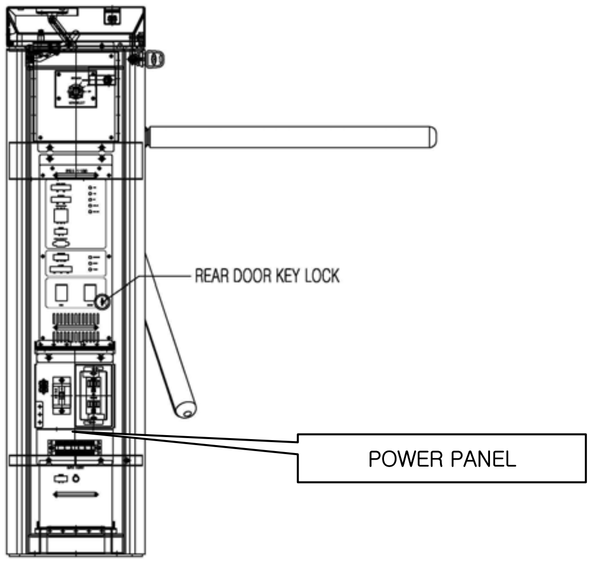
2.1 Power Input

INPUT VOLTAGE : AC 110V/220V (50~60Hz)

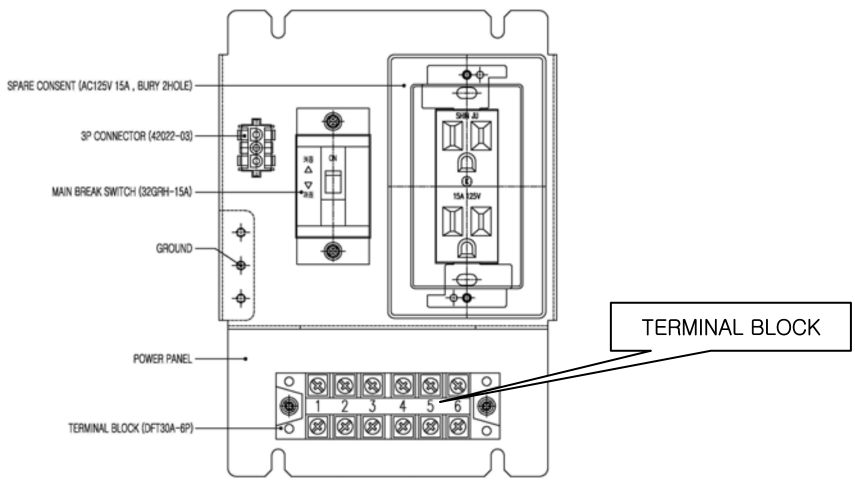
CABLE : UL 2464-3C 16AWG

TERMINAL : RING TYPE

2.2 How to Connect Power



<BACKSIDE>



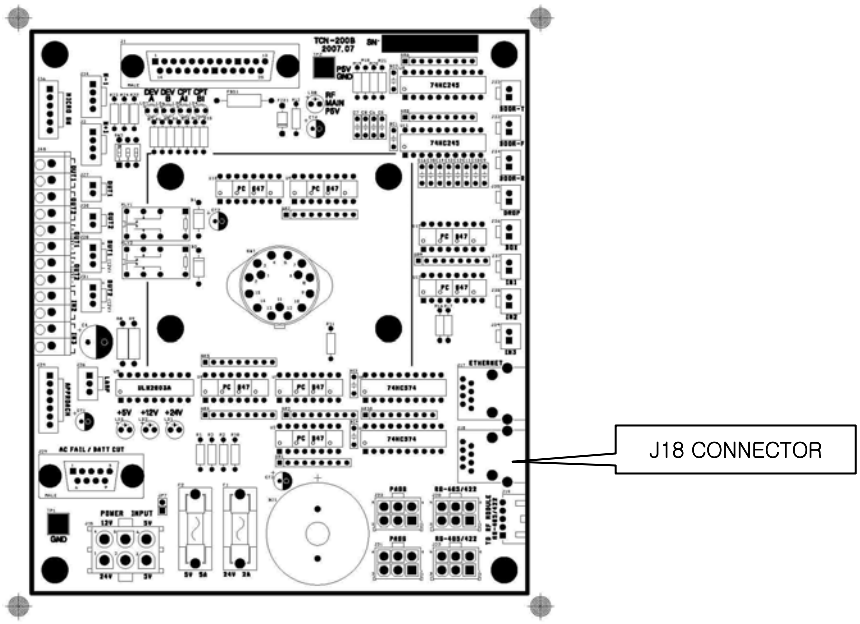
<Power Pannel>

Open the door on the backside of the gate to find the power panel toward the lower mid-section. Connect the AC input power cable to the terminal block inside the power panel.

Terminal	Description
1	INPUT AC
2	INPUT AC
3	OUTPUT AC(AC on Side Gate)
4	OUTPTU AC(AC on Side Gate)
5	F.G
6	OUTPUT F.G(F.G on Side Gate)

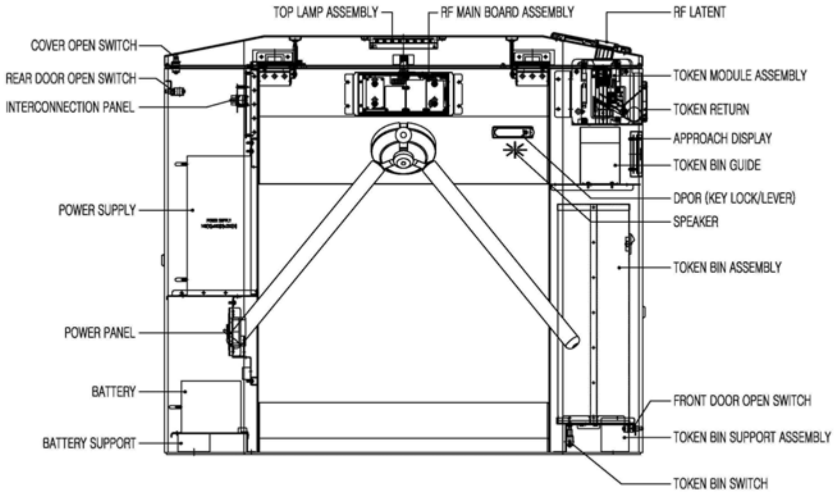
Connect #3, #4, #6 , if needed.

2.3 How to Connect Network Cable

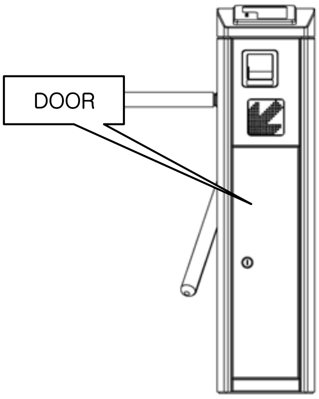


Connect network cable (ETHERNET) to RJ45 Connector (J18) on the interconnection board near the door on the backside of the gate.

3. Maintanance Door

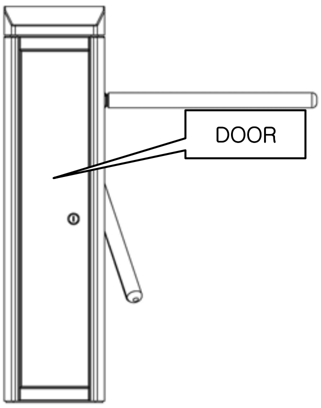


3.1 FRONT DOOR



Facing the entrance direction, this door is located on the front end of the gate and is used to remove the token box. This door is equipped with a lock in the center and unlike other maintenance doors, it has a separate key for security purposes.

3.2 REAR DOOR



This door, located behind the gate on the exit end, is used for maintenance as well as for mode conversion. It is equipped with a lock in the center and performs the following maintenances:

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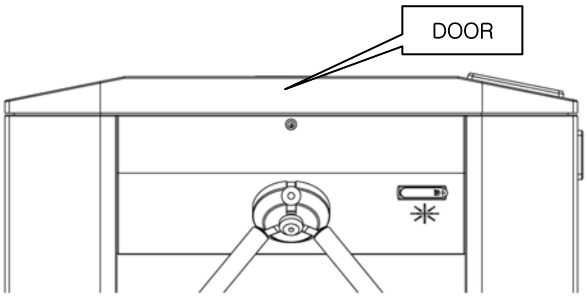
	Maintanance Category
1	AC Connection / Network Cable Connection
2	Power ON/OFF
3	Power Supply Maintanance
4	Battery Replacement / Inspection
5	Mode Conversion
6	Interconnection Board Maintanance
7	Rear Switch Maintanance

3.3 TOP COVER DOOR



Located on the topside of the gate for maintenance, this door is equipped with a lock in the center.

It performs the following maintenances:

	Maintanance Category
1	Tripod Arm Mechanism Maintanance
2	RF Main Maintanance
3	RF Latent Maintanance
4	RF Token Module Maintanance
5	Apporach Module Maintanance
6	Bar Lamp Maintanance
7	Speaker Maintanance
8	Cover Switch Maintanance
9	Drop Mechanism Maintnanace

4. RF Card and Token Operation

4.1 RF Card and Token

Contactless Philips Mifare 14443 Type A Card are accepted이다

ASK 100 % , 106kbs

Carrier frequency 13.56 MHz

1024 Bytes EEProm

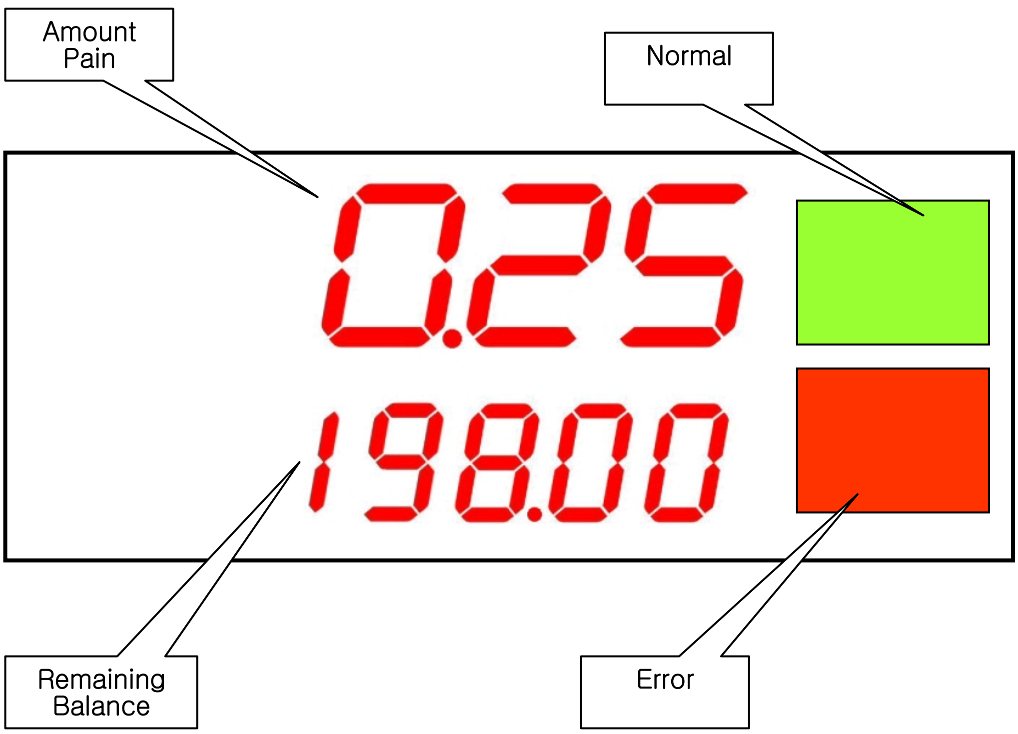
4.2 Gate Operation

User tags the RF card or inserts single use token to pass the gate.

User can confirm card balance and the current fare deducted through the display at the gate.

The gate operates in normal mode or emergency mode. In normal mode, card or token is used to operate the gate typically. Likewise, in emergency mode, card or token can still be used, but the gate becomes free to pass in both directions.

4.3 User Display (Latent)



5. Hardware Specification

Category	Description
CPU	- Intel PXA255 , 32bit , 400Mhz
Memory	- SDRAM (Main Memory) : 32MByte - NOR Flash Memory : 16MByte (Boot Loader,OS Kernel,RAMDISK, Application Program) - NAND Flash Memory : 128MByte (Fare Table, Transaction Data, Error Data, Voice Data) Saves more than 100,000 transaction records (over 10 days' worth if 10,000 transactions occur per day)
SAM	- PLCC Type : 2 socket, - SIM Type : 4 socket (Security Module for Ticket Processing)
Latent (User Display)	- 8bit RISC CPU - Program Memory 128KBytes - RF Module : RC531 (Mifare Standard, ISO14443 Type A, B Card Acceptable) - Fee Display : Over 4 Digits (88.88 $) - Balance Display : Over 5 Digits (888.88 $) - Green LED , Red LED
Interface	- Ethernet 10-Base T (10Mbps)
Sound	- Quality : 16KHz (Sampling frequency) - Ticket Processing Result - Volume Control Available
Case	- Stainless Steel : 1.5mm (Hair-Line treatment)
Tripod ARM	- Aluminum , Diameter 40mm ,
Backup Battery	- Main Power Source for RF Reader (approx. 10 minutes) - With embedded protector against excessive discharge/charge
RF Token BOX	- Able to hold over 3,000 tokens - Able to secure position
Environment	- Temperature : -10℃~45℃ - Humidity : Up to 90% relative humidity내
Procession Speed	- Ticket Processing Speed: Less than 1 second from access to antenna - Single Pass Token Processing Speed: Less than 2 seconds from insertion - Passing Speed/Minute: More than 30 passengers
Power Usage	- Input Voltage : AC 110 ~ 220V ± 10% - Input Freguency : 50 ~ 60 Hz ± 2 % - Earth : Type 3 Grounding

❑User’s Information

1. **Cautions**

Modifications not expressly approved by the party responsible for compliance could void the user’s authority to operate the equipment.

2. **FCC compliance Information**

This device complies with part 15 of FCC Rules. Operation is subject to the following two conditions: 1. This device may not cause harmful interference, and 2. This device must accept any interference received. Including interference that may cause undesired operation.

3. **Information to User**

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Theory of Operation

The MFRC531 is member of a family of highly integrated reader Ics for contactless communication based on 13.56MHz. The MFrc531 Supports all layers of ISO 14443. Figure 1 shows a simplified blockdiagram.

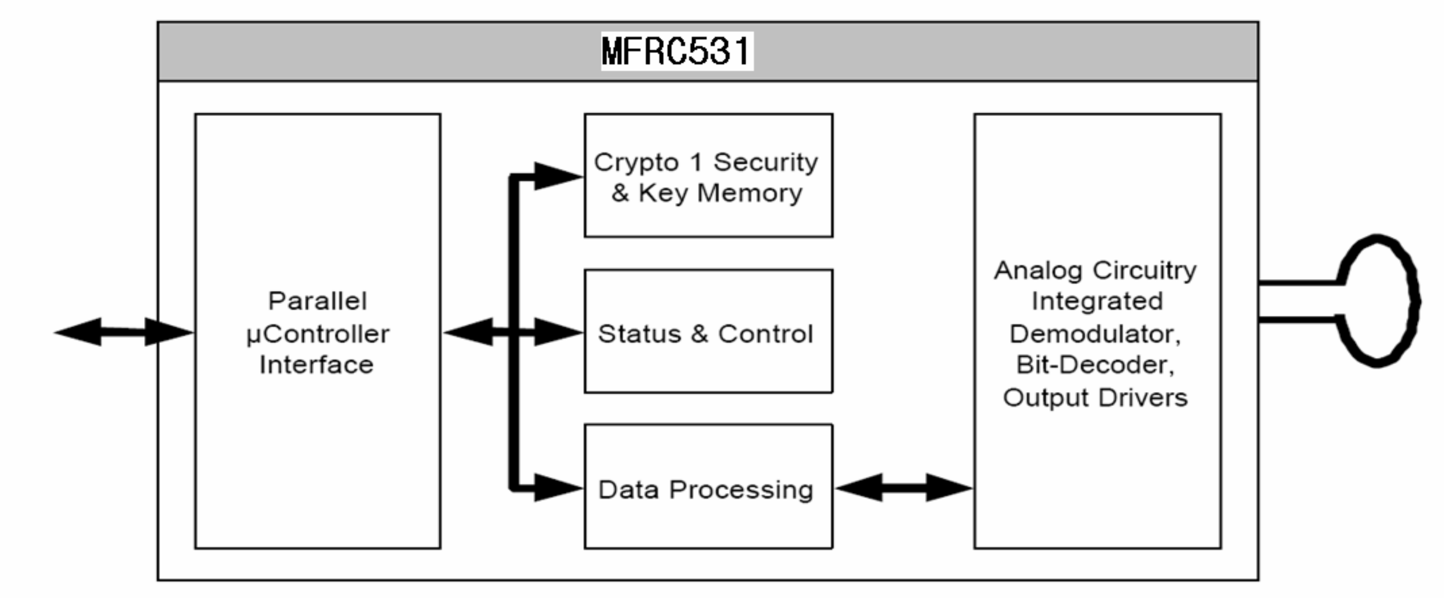


Figure1 : Simplified MFRC531 Block Diagram

-The parallel u-Controller interface detects automatically the connected 8bit parallel interface

-The data procesing part performs the parallel to serial conversion of the data.It supports the framing generation check.the CRC/Parity generation and check as well as the bit coding and processing. All layers of ISO14443-A are supported,as the MFRC531 operates in transparent mode.

-The status amd control part allows the configuration of the device to environmental influences to achieve the best performance for each application.

-The Cryto1 stream cipher unit is implemented to support communication to MIFARE CLASSIC products

-A secure non-volatile key memory is included to store Crypto 1 key-sets.

-The analog part includes two internal bridge driver outputs to achieve an operating distance up to 100m depending on the antenna coil and environmental influences.Futhermore,the internal receiving part allows the receiving and decoding of data without external filtering.

7.1 RF Interface

The MIFARE technology describes an ISO 14443-Type A compliant RF interface for a communication between a reader and a contactless card.

Overview MIFARE RF Interface

- Energy transmission : Transformer principle; MIFARE card is passive

-Operating frequency : 13.56MHz

- Communication structure : Half duplex,reader talks first

-Data rate : 105.6KHz

-Data transmission : Both directions

RWD → Card : 100%ASK,Miller coded

Card → RWD : subcarrier load modulation,subcarrier frequency 847.5KHz,OOK,Manchester Code

7.2 Energy Transmission

The energy transmission between the reader antenna and passive PICC is based on the transformer principle.At PCD side an antenna coil is required as well as a card coil implemented in the MIFARE card Figure 2 shows the basic principle and the equivalent electronic circuitry.

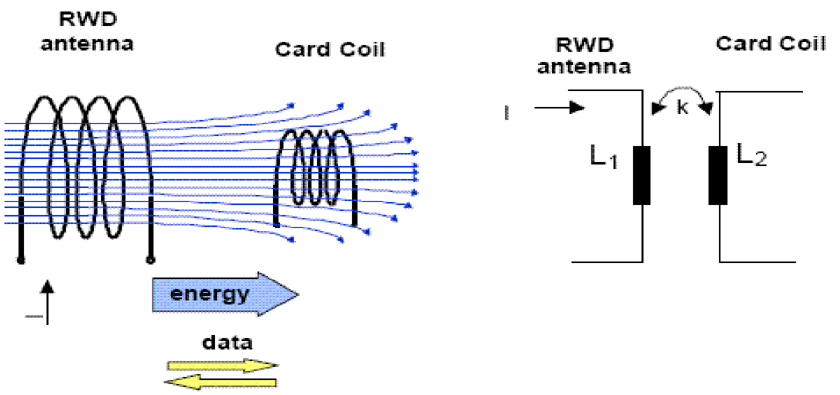


Figure 2 :Transformer Model

The current in the RWD antenna coil generates a magnetic flux.Parts of this flux flow through the card coil and induce voltage in the card itself.This voltage will vary within the distance between reader antenn and transferred power.The right part shows the equivalent electical circuitry,the transformer model.

7.3 Data transmission RWD → Card

To transfer data between the PCD and the PICC a half-duplex communication structure is used.The PCD always starts the communication.The data tranmission from the PCD to the PICC uses a 100% ASK modulation to the ISO14443 Type A.Figure 3 shows a typical Signal shape.

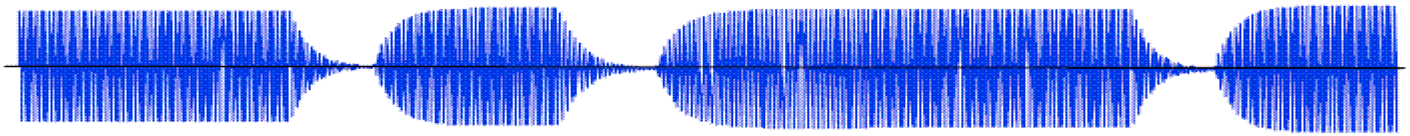


Figure3: Data Transmission PCD →PICC,typical signal shape

Due to the Quality factor Q of the antenna the transmitted Signal is deformed to the shape shown in Figure 4. This shape can be used to measure the tuning of the antenna.

As the PICC is passive,the energy for the PICC has to be provided during the communication between PCD and PICC.Therefore, ISO 14444A uses an optimised coding to provide a constant level of energy independently from the data transmitted to the PICC.This id the modufied Miller code,which is shown is shown in Figure5 in detail

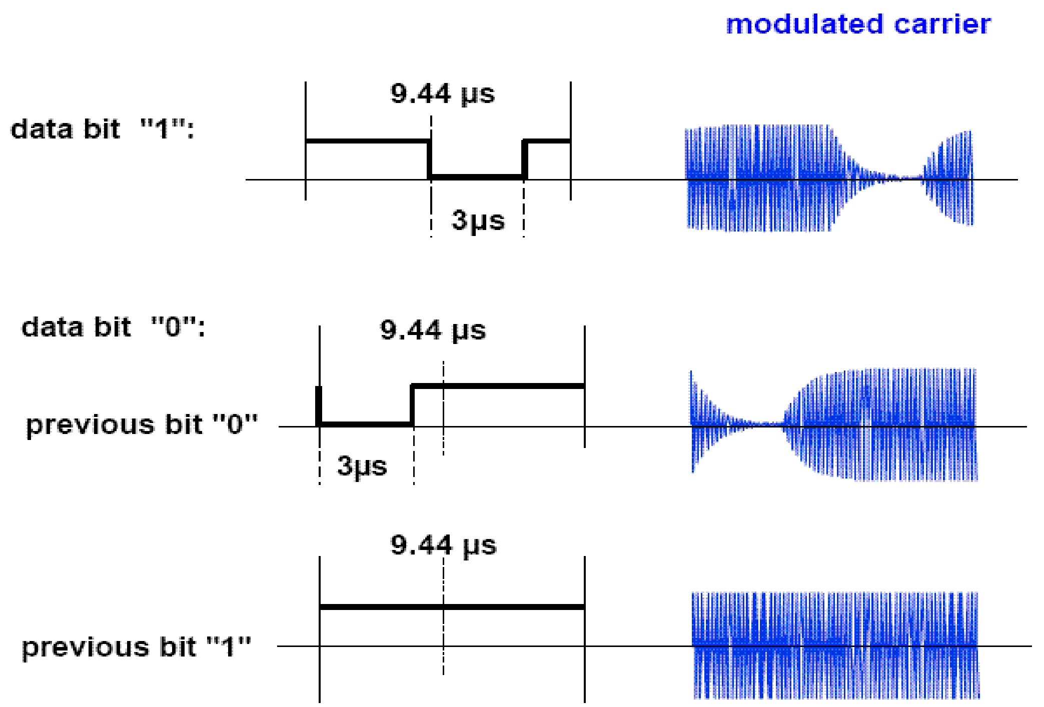


Figure 4 : Data Transmission PCD → PICC,Miller Coding

The data rate of MIFARE is 105.9KHz,so the length of a frame is 9.44us.A pulse in the Miller coding has a length of 3us.
A logical '1' expressed with a pulse in the centre of the bit frame.
Two possibilities are given to code a logical '0' Tis coding depends on the previou bit;
If the previous bit was a'0',the following '0' is expressed with apulse of 3us at in the first half of the next bit frame.
If the previous bit was a'1',the following'0'the following'0' is expressed without a pulse in the next bit frame.

7.4 Data Transmission PICC → PCD

Subcarrier load modulation principle

The data transmission from the PICC back to the PCD uses the principle of load modulation shown in Figure 5. The PICC is designed as a resonance circuitry and consumes energy generated by the PCD.This energy consumption has a feedback effect as a coltage drop on PCD side.This effect is used to transfer data from the PICC back to the PCD by changing the load in the card IC.

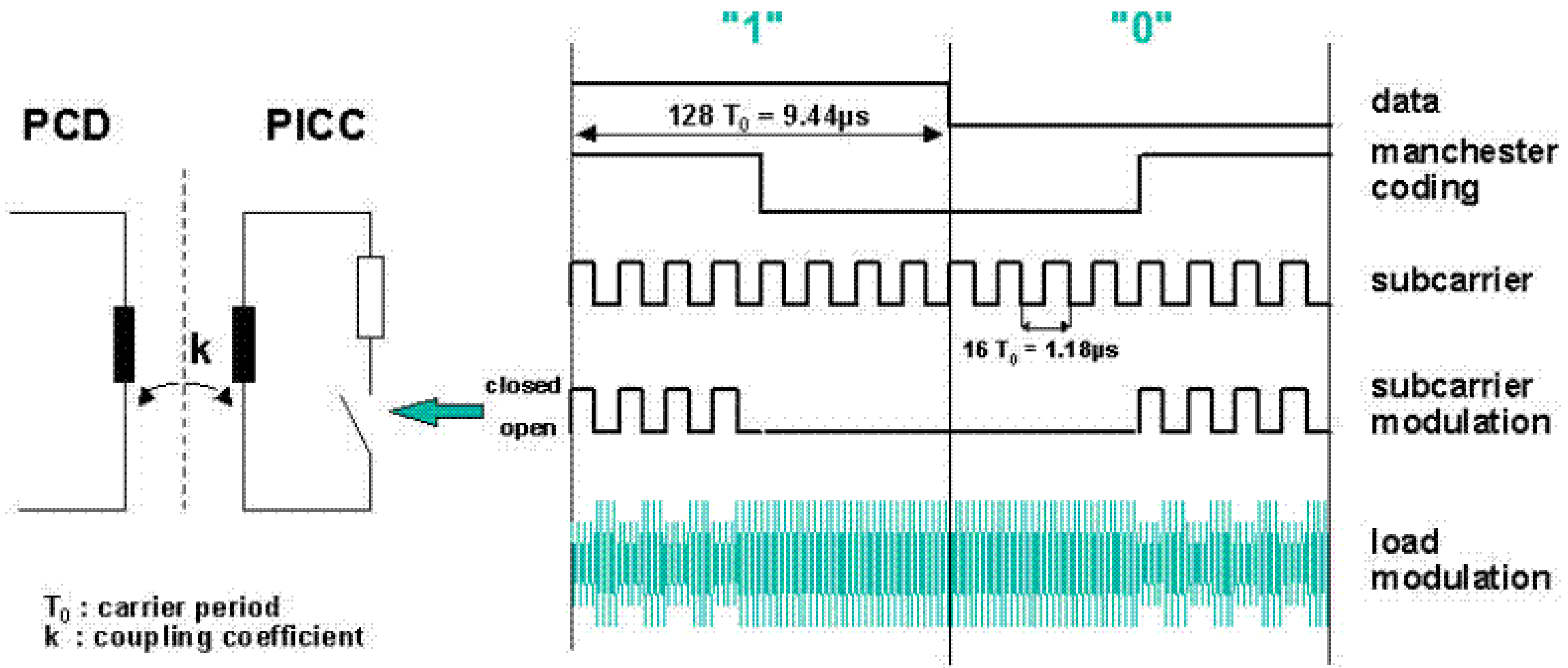


Figure 5: Subcarrier Load Modulation Principle

The PCD antenna is tuned to a resonance frequency Fr=13.56MHz. The time T0 expresses he pulse length of the operationg frequency T0=1/Fr 74ns. In fact,this resonance curcuit generates voltages at the PCD antenna several times higher than the supply voltage.Due to small coupling factor between the PCD and PICC antenna PICC's reponse is up to 60dB below thw voltage generated by the reader.To detect such a signal,it requires a well designed receiving circuit.

The PICC data transfer back to the PCD uses a data rate of 105.9kbit/s with Manchester coding.At Manchester Coding each bit is represented by either a raising or a falling edge in the centre of a bit frame.For the MIFARE principle this is shown on the right side of Figure5 :

A logical '1' is expressed with a falling egde in the centre of the bit frame.

A logical '0' is expressed with a rising edge in the centre of the bit frame.

This Manchester coded data modulates a sub carrier F sub = Fr/16 =847.5KHz.

Finally, this modulated sub carrier switches the load of the PICC,which result in the load modulation as shown in the last line of Figure5, and which is received and decoded again by the PCD.

Figure 6 shows the relation between the time and the frequency domain of the load modulation.Due to the data of

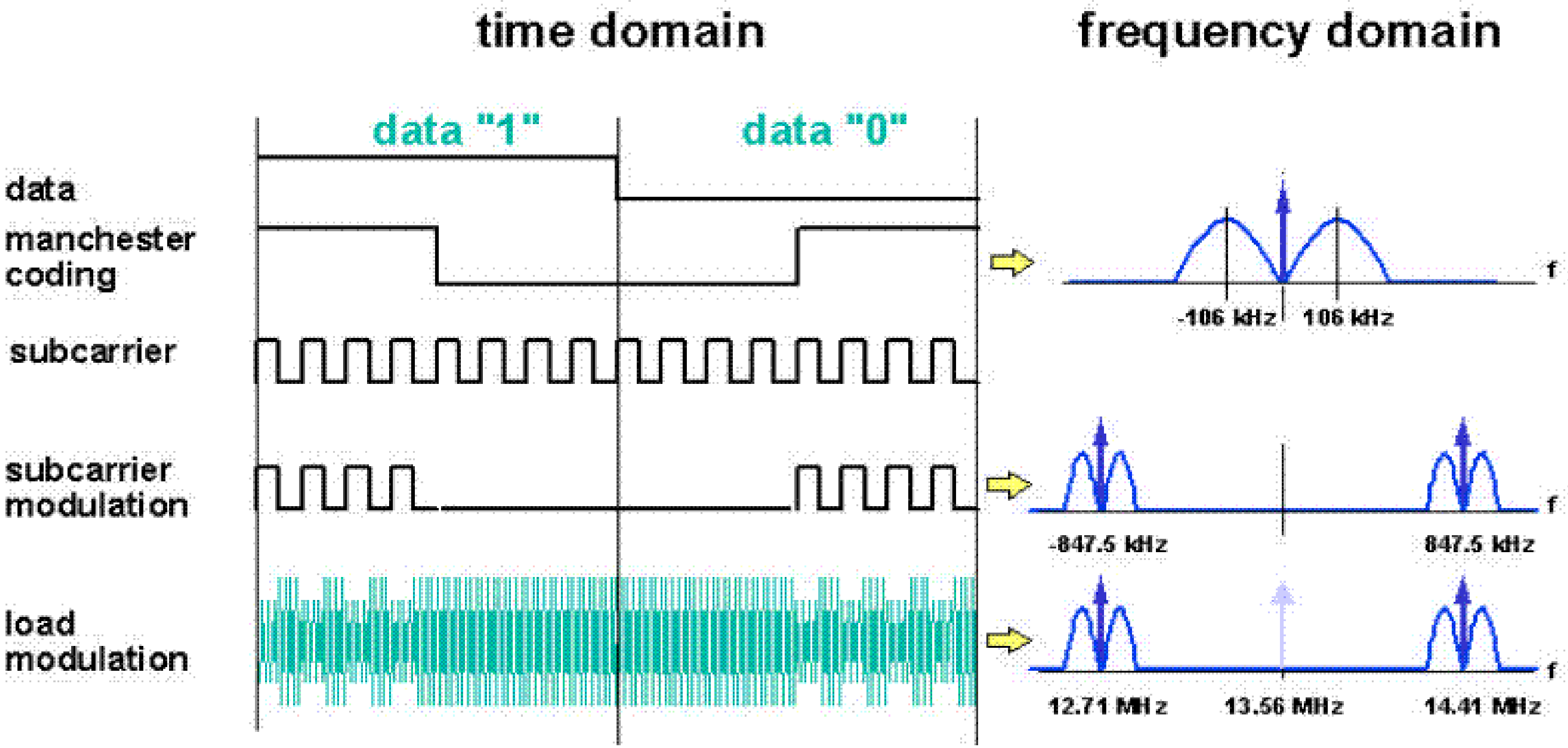
$$v \approx 106kBd \approx \frac{1}{9.44\mu s}$$

The Manchester cde generates sidebands at both of the sub carrier frequency:

$$f_{mSUB} = 847.5kHz\Big|_{Subcarrier} \pm 106kHz\Big|_{Data}$$

The modulation sub then generates sidebands at both sides of the carrier frequency:

$$f_{mR} = 13.56MHz\Big|_{Carrier} \pm 847.5kHz\Big|_{Subcarrier} \pm 106kHz\Big|_{Data}$$



Figuren6 : Principle of Data Coding PICC→ PCD,Time and Frequency Domain

Antenna Specification

ANTENNA	**PCB Pattern Antenna**
ANTENNA STYLE	**50 ohm Match , Loop Antenna**
ANTENNA SIZE	**Width : 83.19 mm , Length : 85.72 mm**