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(54) **SYSTEM AND METHOD FOR A BASEBAND NEARFIELD MAGNETIC STRIPE DATA TRANSMITTER**

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(22) Filed: **Feb. 17, 2014**

Related U.S. Application Data

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(51) **Int. Cl.**
G06K 7/08 (2006.01)

(52) **U.S. Cl.**
USPC **235/449**; 235/493; 235/494; 235/380; 235/383

(58) **Field of Classification Search**
USPC 235/449, 493, 494, 380, 383
See application file for complete search history.

Primary Examiner — Kristy A Haupt

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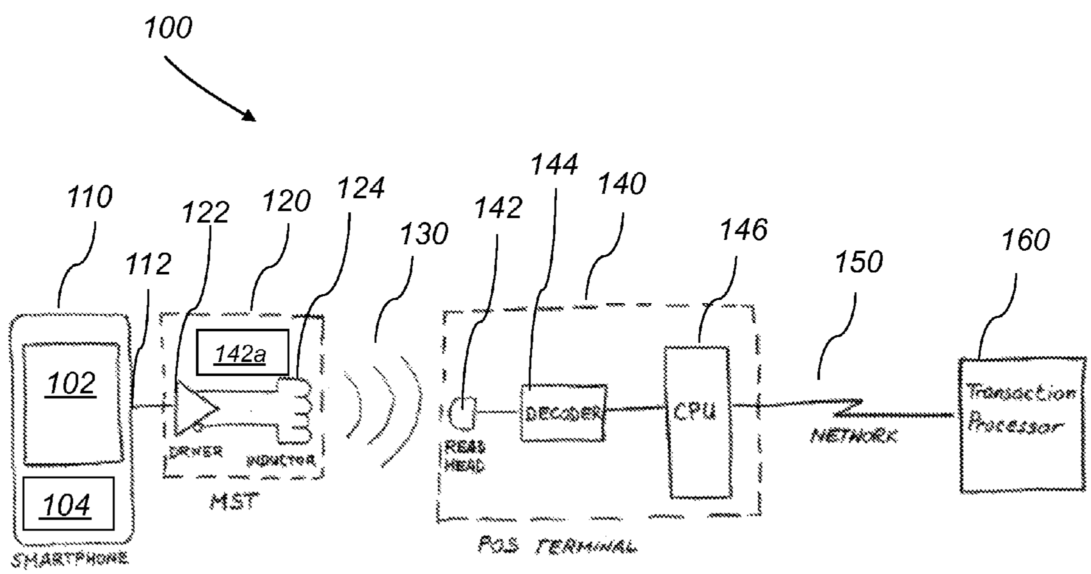
(57) **ABSTRACT**

A system for a baseband near field magnetic stripe data transmitter includes a mobile phone and a magnetic stripe transmission (MST) device. The mobile phone transmits a stream of pulses including magnetic stripe data of a payment card. The magnetic stripe transmission (MST) device includes a wave shaper, a driver and an induction device. The MST device receives the stream of pulses from the mobile phone, shapes and amplifies the received stream of pulses and generates and emits high energy magnetic pulses including the magnetic stripe data. The emitted high energy magnetic pulses are picked up remotely by a magnetic read head. The MST device shapes the stream of pulses to compensate for shielding, eddy current losses and limited inductance value of the magnetic read head.

18 Claims, 4 Drawing Sheets



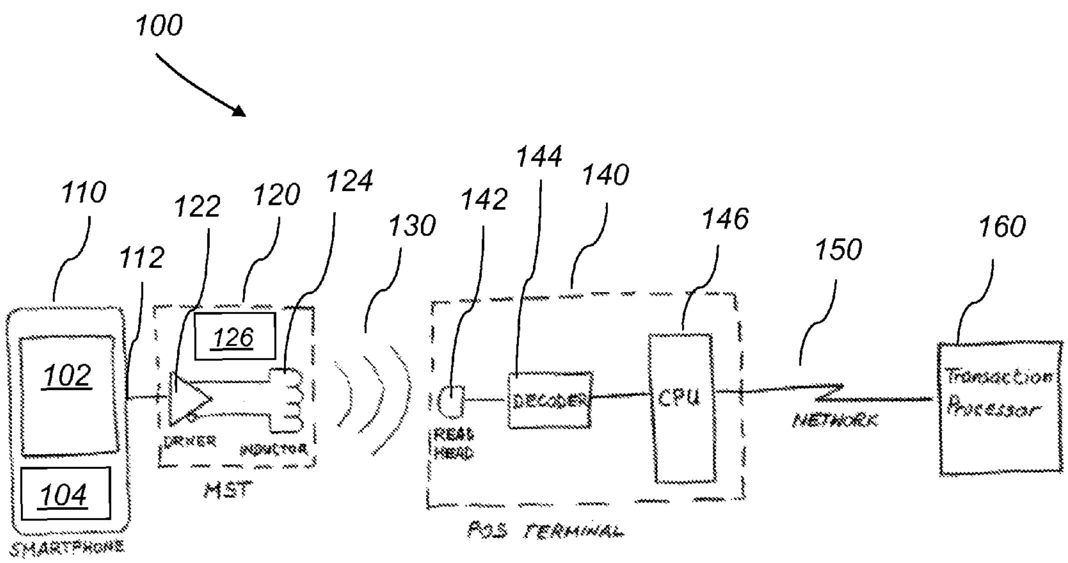

100
110
112
122
120
124
130
142
144
140
146
150
160
102
104
126
SMARTPHONE
DRIVER
INDUCTOR
MST
READ HEAD
DECODER
CPU
POS TERMINAL
NETWORK
Transaction Processor

FIG. 1

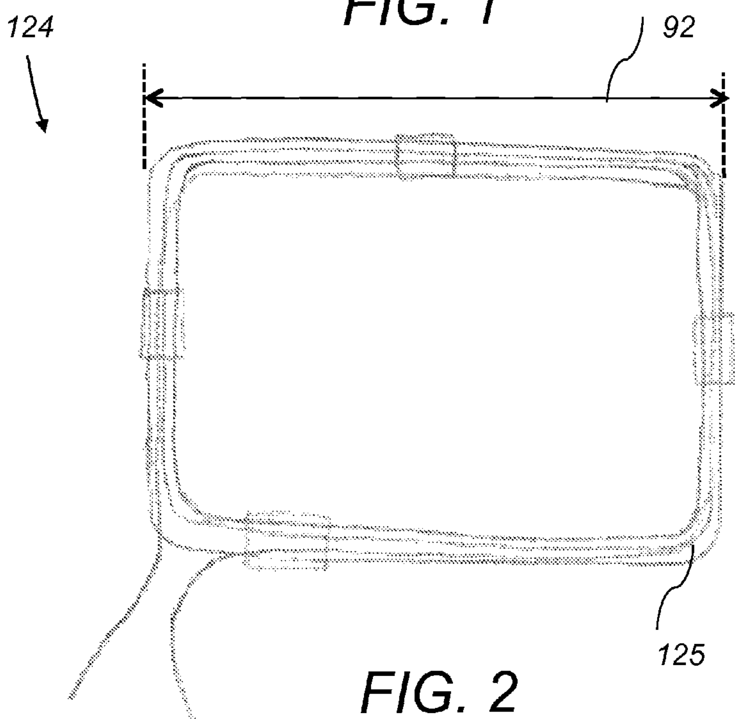

124
92
125

FIG. 2

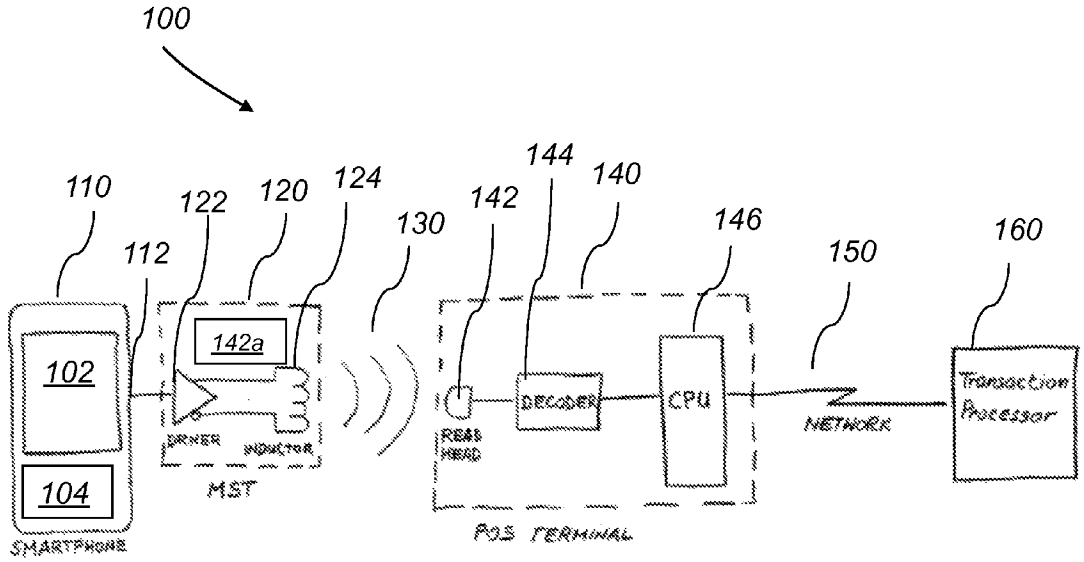

100
110
112
122
120
124
130
142
144
140
146
150
160
102
104
142a
DRIVER
INDUCTOR
MST
SMARTPHONE
READ HEAD
DECODER
CPU
NETWORK
Transaction Processor
POS TERMINAL

FIG. 3

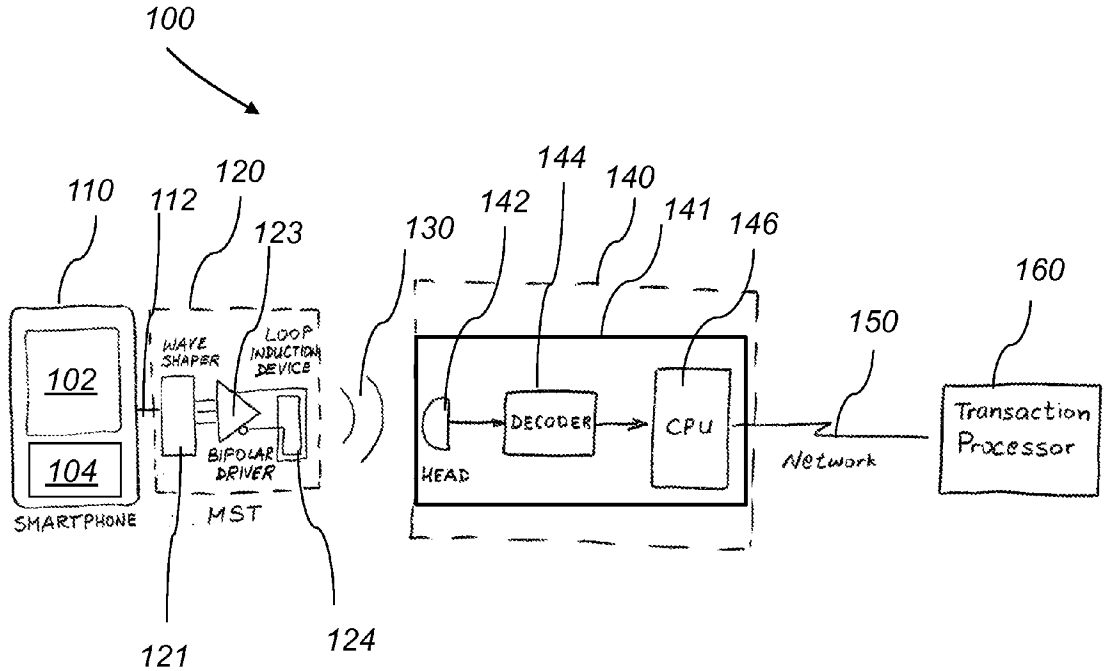

100
110
112
120
123
130
142
144
140
141
146
160
150
102
104
SMARTPHONE
WAVE SHAPER
LOOP INDUCTION DEVICE
BIPOLAR DRIVER
MST
HEAD
DECODER
CPU
Network
Transaction Processor
121
124

FIG. 4

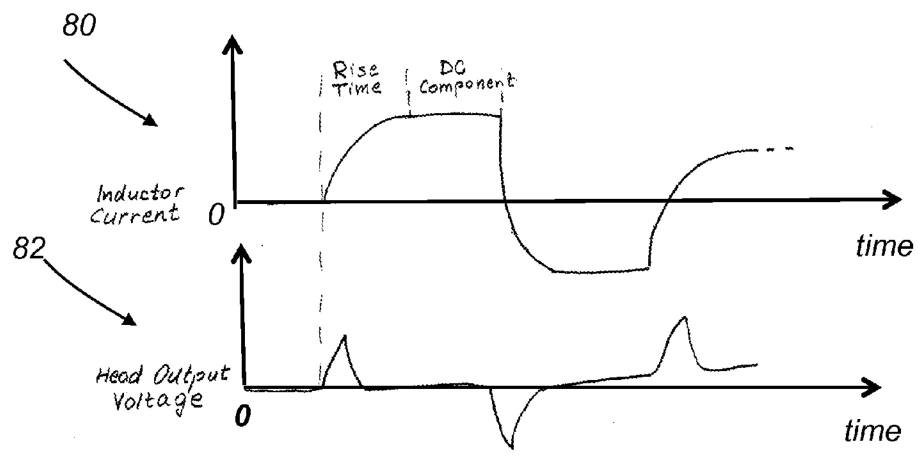

80
Rise Time
DC Component
Inductor Current
0
time
82
Head Output Voltage
0
time

FIG. 5

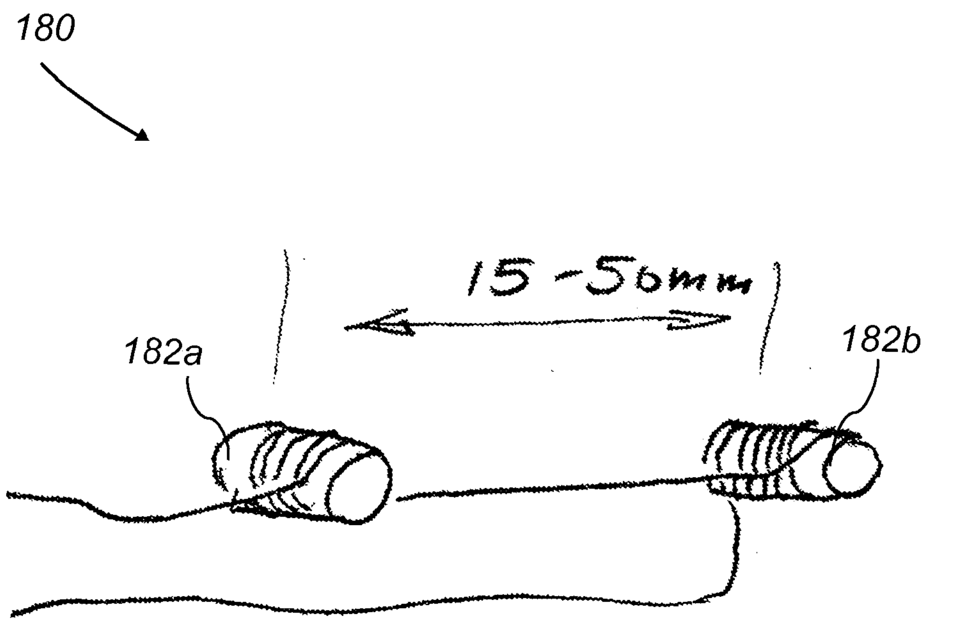


FIG. 6

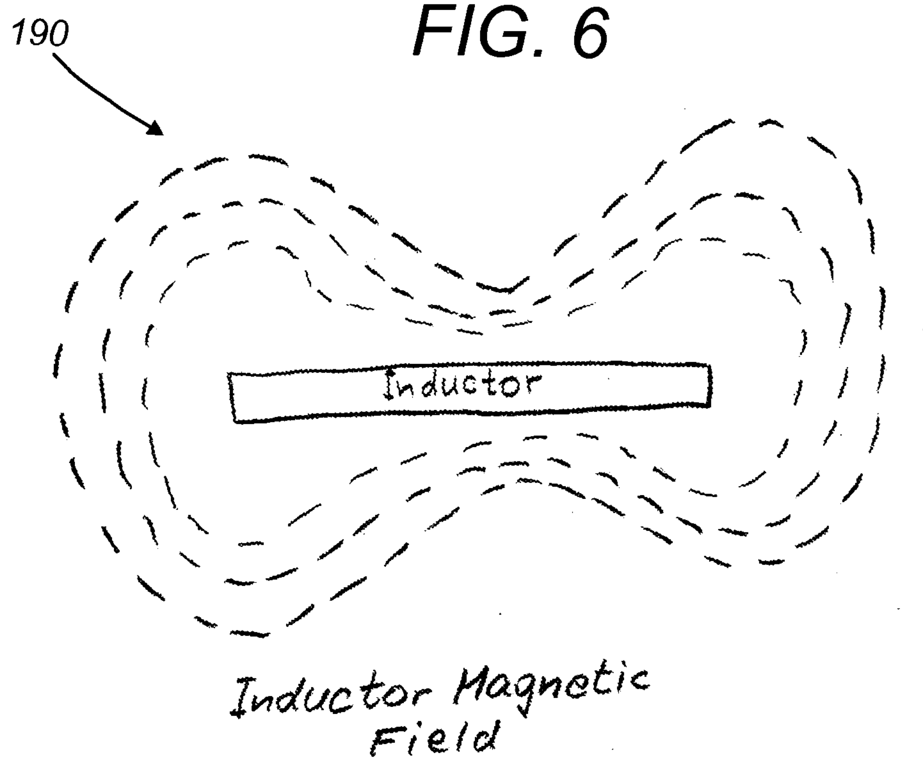


FIG. 7

SYSTEM AND METHOD FOR A BASEBAND NEARFIELD MAGNETIC STRIPE DATA TRANSMITTER

CROSS REFERENCE TO RELATED CO-PENDING APPLICATIONS

This application is a continuation-in-part and claims the benefit of U.S. application Ser. No. 13/826,101 filed on Mar. 14, 2013 and entitled SYSTEM AND METHOD FOR A BASEBAND NEARFIELD MAGNETIC STRIPE DATA TRANSMITTER, which is commonly assigned and the contents of which are expressly incorporated herein by reference.

FIELD OF THE INVENTION

The present invention relates to a system and a method for a baseband nearfield magnetic stripe data transmitter and in particular to a magnetic stripe data transmitter that transmits payment card data from a smart-phone, or other electronic device, into a Point of Sale transaction terminal.

BACKGROUND OF THE INVENTION

Magnetic stripe payment cards carry a magnetic stripe that contains the payment card data. Magnetic stripe payment cards include credit, debit, gift, and coupon cards, among others. The data is "written" onto the magnetic stripe by alternating the orientation of the magnetic particles embedded into the stripe. Card data is read from the magnetic stripe at a Point of Sale (POS) by swiping the card through a magnetic stripe reader. The reader includes of a reader head and its associated decoding circuitry. When the card is swiped through the reader the magnetic stripe moves in front of the reader head. The moving magnetic stripe, which contains the alternating polarity magnetic domains, creates a fluctuating magnetic field within the narrow sensing aperture of the reader head. The reader head converts this fluctuating magnetic field into an equivalent electrical signal. The decoding circuitry amplifies and digitizes this electrical signal, recreating the same data stream that was originally written onto the magnetic stripe. The encoding of the magnetic stripe is described in the international standard ISO 7811 and 7813.

With the increased popularity and capability of smart-phones, there is a growing desire to use them as mobile wallets and to use them to make payments at the point of sale. The key impediment to adoption has been the lack of data transfer channel between mobile phones and the point of sale terminal. A number of alternatives have been proposed. These include the manual keying of data displayed on the phone's screen into POS terminal, 2D barcodes displayed on the phone's screen and read by a 2D barcode reader, RF ID tags attached to phones and built-in Near Field Communications (NFC) hardware driven by an application in the phone. Of these methods, 2D barcodes and NFC are the most promising. Their wide scale adoption, however, is prevented by a lack of suitable reading devices at the point of sale, and in the case of NFC, also the lack of standardized NFC capability in many smart-phones.

Accordingly, there is a need for improved devices and methods for transmitting payment card data, or other information, from a smart-phone, or other electronic device, remotely into a Point of Sale transaction terminal.

SUMMARY OF THE INVENTION

The present invention describes a system and a method for a baseband near-field magnetic stripe data transmitter that transmits payment card data, or other information, from a smart-phone, or other electronic device, remotely into a Point of Sale transaction terminal via the terminal's magnetic stripe reader.

In general, one aspect of the invention provides a system for a baseband near field magnetic stripe data transmitter including a mobile phone and a magnetic stripe transmission (MST) device. The mobile phone is configured to transmit a stream of pulses comprising magnetic stripe data of a payment card. The magnetic stripe transmission (MST) device includes a wave shaper, a driver and an induction device. The MST device is configured to receive the stream of pulses from the mobile phone, to shape and amplify the received stream of pulses and to generate and emit high energy magnetic pulses comprising the magnetic stripe data. The emitted high energy magnetic pulses are configured to be picked up remotely by a magnetic read head. The MST device shapes the received stream of pulses to compensate for shielding, eddy current losses and limited inductance value of the magnetic read head.

Implementations of this aspect of the invention include the following. The magnetic read head is enclosed in a shielded enclosure, and the wave shaper adds a DC component to the emitted high energy magnetic pulses to compensate for a rapidly collapsing magnetic field inside the shielded enclosure. The magnetic read head includes an amplifier with a limited bandwidth and the wave shaper is configured to control a rise time of the emitted high energy magnetic pulses to be within the limited bandwidth of the magnetic read head amplifier. The limited bandwidth of the magnetic read head amplifier is in the range between 10 microseconds and 60 microseconds. The magnetic read head further includes a decoder and the wave shaper is configured to control the rise time of the emitted high energy magnetic pulses to be within timing constraints of the decoder. The magnetic read head is enclosed in a shielded enclosure and the driver comprises a bipolar driver and is configured to generate the emitted high energy magnetic pulses having an intensity sufficient to penetrate the shielded enclosure. The bipolar driver is configured to generate a bipolar inductor current having a value higher than 1 Ampere for the emitted high energy magnetic pulses. The magnetic read head includes a magnetic read head inductor and the induction device of the MST is configured to form a loosely coupled transformer with the magnetic read head inductor from a distance longer than 0.5 inches. The induction device of the MST includes a loop having one or more windings, and the one or more windings are configured to generate magnetic flux lines that are spread over a large enough area dimensioned to include a sensing aperture of the magnetic read head and to generate an inductance value that is configured to cause properly timed current pulses to reach their maximum value and thereby to cause maximum induced voltage in the magnetic read head inductor. The ratio of the inductance and resistance values of the one or more windings is in the range between 10 μH/Ohm and 80 μH/Ohm. The one or more windings enclose an area in the range between 600 square millimeters and 1700 square millimeters. The induction device includes an array of spatially distributed two or more inductors. The array of spatially distributed two or more inductors covers an area in the range between 600 square millimeters and 1700 square millimeters. The induction device includes an iron or ferrite core and the core is designed not to saturate under a high current flowing through the induction device. A portion of the magnetic stripe data of the payment card is replaced by a cryptographically generated dynamic element that prevents replay or copy attacks. The cryptographically generated dynamic element is generated either in the MST or the mobile phone. The cryptographically generated dynamic element comprises a secure hash generated using the magnetic stripe data of the payment card, an MST identification number, and a sequence number that is incremented for each data transmission and encrypted by an encryption key.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring to the figures, wherein like numerals represent like parts throughout the several views:

FIG. **1** is an overview diagram of the baseband near-field magnetic stripe data transmitter system, according to this invention;

FIG. **2** is a schematic diagram of a typical inductor used to generate the required magnetic field, according to this invention;

FIG. **3** is an overview diagram of another embodiment of the baseband near-field magnetic stripe data transmitter system, according to this invention;

FIG. **4** is an overview diagram of another embodiment of the baseband near-field magnetic stripe data transmitter system, according to this invention;

FIG. **5** is a graphical representation of the inductor current versus time and the magnetic reader head output voltage versus time, for the embodiment of FIG. **4**;

FIG. **6** depicts an array of two inductors; and

FIG. **7** depicts the inductor magnetic field.

DETAILED DESCRIPTION OF THE INVENTION

The present invention describes a system and a method for a baseband near field magnetic stripe data transmitter that transmits payment card data from a smart-phone, or other electronic device, into a Point of Sale transaction terminal.

Baseband Near Field Magnetic Stripe Transmission (MST), the subject of this invention, uses a pulse modulated magnetic field to transmit from a distance data from a smart-phone into a POS terminal. The system is able to transmit card data into the POS terminal's reader without it being in contact with, or in close proximity to (less then 1 mm), the reader head, or without the need to be inserted into the card reader slot. Furthermore, the system eliminates the need for the swiping motion required with magnetic stripe cards or prior-art magnetic stripe emulation or electronic magnetic stripes, as described by Narenda et al, in U.S. Pat. No. 7,954,716.

The magnetic field is generated by a specially designed inductor, driven by a high power driver circuit. The inductor's unique structure results in a complex omni-directional magnetic field that, from a distance, is able to penetrate the magnetic stripe reader head located in the POS terminal.

Referring to FIG. **2**, inductor **124** includes one or more rectangular wire bundle(s) **125** of approximately 40×30 mm outside dimensions with a 3 mm bundle thickness. Inductor **124** has an inductance of such a value that properly timed current pulses reach their maximum value at the end of each pulse. Also, the ratio of inductance and winding resistance values is critical in shaping the current from the driver circuit to result in a magnetic field that closely resembles the magnetic signal seen by the magnetic reader head when a magnetic stripe card is swiped in front of it. In one example, the ratio of inductance to winding resistance is 80 μH/Ohm.

The physical shape of the inductor ensures that the magnetic flux lines are spread over a large enough area to include the sensing aperture of the reader head. The inductor windings may be enamel insulated magnet wire, or alternatively, the inductor my be implemented as a spiral inductor formed by conductor traces laid out on rigid or flexible printed circuit substrates.

Although the inductor is stationary, the inductor is driven by a series of timed current pulses that result in a series of magnetic pulses that resemble the fluctuating magnetic field created by a moving magnetic stripe. The modulation of the field follows the standard magnetic stripe encoding, which in turn results in a stream of electrical pulses on the reader's output that is identical to what would be obtained from a magnetic stripe.

The key benefit of MST is that it works with the existing infrastructure of point of sale card payment terminals. Unlike with NFC or 2D barcode, no external reader or new terminal has to be installed.

Referring to FIG. **1**, in one embodiment of this invention **100**, a suitable driver **122** and inductor **124** are contained in a small capsule **120**, which is connected to the audio jack **112** of the phone **110**. Smart-phone **110** is loaded with a wallet software application **102**. The phone **110** is connected to the Magstripe Transmitter **120** via its audio jack **112**. To make a payment at a point of sale location equipped with a common card payment terminal capable of reading standard ISO/ABA magnetic stripe cards **140** the consumer selects the wallet application **102** on his smart-phone **110** and selects one of the pre-loaded payment cards (i.e., Visa, Mastercard, Amex) he wants to use for the payment. He holds the phone close (1 to 2 inches) to the point of sale terminal **140** and presses the pay icon/key **104** on the phone **110**. The wallet application **102** in the phone **110** sends to the MST **120** via the audio jack **112** a stream of pulses that contain the selected card's magnetic stripe data. The MST **120** amplifies, shapes and emits the pulses in the form of suitably modulated high energy magnetic impulses **130**. The magnetic impulses **130** are picked up by the magstripe reader head **142** located in the point of sale payment terminal **140** and are converted into electrical pulses. The resulting electrical pulses are decoded by decoder **144** and processed by its central processing unit (CPU) **146**, just like it would process a standard magnetic stripe card that was swiped through its reader slot. The merchant enters the payment amount and the transaction is sent by the POS terminal **140** via the network **150** to the payment transaction processor **160**. The transaction processor **160** returns the transaction authorization and the POS terminal **140** prints a receipt. With the exception of the card entry method, the entire transaction is completed in the same manner as with a standard magnetic stripe card.

In another embodiment of MST **120**, security is improved by the smart-phone supplementing the transaction transmitted through the payment terminal with a separate secure wireless message sent to the processor, where the two transactions are combined for the purposes of authentication.

Referring to FIG. **3**, in another embodiment, the MST **120** is integrated with a magnetic stripe reader (MSR) head **142***a*, creating a single device able to both read and transmit magnetic stripe information. The combination of the MST and MSR in conjunction with an electronic wallet **102**, provides a convenient and secure means of loading payment cards into an electronic wallet and the subsequent transmission of the payment card data to a POS system **140**. Furthermore, this embodiment allows convenient person to person payments using credit or debit cards, where each person is equipped with an MST and is able to transmit his card information into the other persons mobile phone with the card reader included in that person's MST.

In another embodiment, magnetic stripe transmission is used to transmit tokenized card data to the point of sale terminal. In this embodiment, the actual payment card number is substituted by a cryptographically generated token, which is formatted as track data, including token data formatted to resemble a standard Primary Account Number (PAN). The PAN may contain a valid Bank Identification Number (BIN). Such token is either downloaded from the card issuer, another online source, or is locally generated. The MST transmission of tokens replaces the transmission of valid card numbers by transmitting cryptographically generated tokens that are valid only for one transaction and thus eliminates the security risk inherent in the standard magnetic stripe, all without the need to change the existing point of sale hardware. In other embodiments, more than one track data are transmitted in order to increase compatibility with existing point of sale hardware and software. In these embodiments, the transmission of Track 1 data may be followed by the transmission of Track 2 data, or Track 2 data may be followed by Track 1 data.

In a further embodiment, the MST **120** also contains a secure microcontroller **126** which provides secure local storage of the card data and directly drives the inductor driver circuit **122**. This embodiment allows the MST to operate detached from the phone in a store-and-transmit mode. In some embodiments, the MST further includes volatile and non-volatile memory for the secure storage of card data and other personal information.

Yet another possible implementation uses BlueTooth™ communications between the phone **110** and the MST **120**, where two-way communications is used for enhanced security and flexibility, including the retrieval by the phone of card data stored in the secure element formed by the MST's secure microcontroller **126**.

In yet another possible implementation the MST **120** uses its built-in secure microcontroller **126** to encrypt, either partially or fully, the card data and transmits it via the magnetic field to the point of sale card reader.

In yet another possible implementation the payment card data comprise card verification value (CVV) data that are changed dynamically. In this case, the security of a transaction is improved due to the dynamic changing of the CVV data.

Referring to FIG. **4**, in another embodiment of this invention **100**, Magstripe Transmitter (MST) **120** includes a wave shaper **121**, a bipolar driver **123** and a loop inductor **124**. Smart-phone **110** is loaded with a wallet software application **102**, and is connected to the Magstripe Transmitter **120** via its audio jack **112**. To make a payment at a point of sale location equipped with a common card payment terminal capable of reading standard ISO/ABA magnetic stripe cards **140**, the consumer selects the wallet application **102** on his smart-phone **110** and selects one of the pre-loaded payment cards (i.e., Visa, Mastercard, Amex) he wants to use for the payment. He holds the phone close (1 to 2 inches) to the point of sale terminal **140** and presses the pay icon/key **104** on the phone **110**. The wallet application **102** in the phone **110** sends to the MST **120** via the audio jack **112** a stream of pulses that contain the selected card's magnetic stripe data. The MST **120** amplifies, shapes and emits the pulses in the form of suitably modulated high energy magnetic impulses **130**. The magnetic impulses **130** are picked up by the magstripe reader head **142** located in the point of sale payment terminal **140** and are converted into electrical pulses. The resulting electrical pulses are decoded by decoder **144** and processed by its central processing unit (CPU) **146**, just like it would process a standard magnetic stripe card that was swiped through its reader slot. The merchant enters the payment amount and the transaction is sent by the POS terminal **140** via the network **150** to the payment transaction processor **160**. The transaction processor **160** returns the transaction authorization and the POS terminal **140** prints a receipt. With the exception of the card entry method, the entire transaction is completed in the same manner as with a standard magnetic stripe card.

The magnetic stripe reader-heads used in point of sale terminals are designed to be sensitive only to magnetic fields that originate close to and within their sensing aperture, which is located right in front of the head. They are designed to ignore external magnetic fields outside this sensing aperture. The intended pick-up distance is a fraction of an inch and the field of sensitivity is only a few degrees wide. Additionally, reader heads are surrounded by a metal shield **141** that greatly attenuates changing magnetic fields outside the head's intended sensing aperture, shown in FIG. **4**. Further, the shield **141** is connected to the terminal's frame ground, which shunts to ground coupled common mode signals originating externally. These design features are aimed at ensuring that the head does not pick up noise from nearby electrical equipment, transmitters or cell-phones. These same design features also prevent remote induction of card data when using an ordinary inductor and pulses that resemble those generated by a moving magnetic stripe. Accordingly, penetrating the shielding **141** of the reader-head from a distance longer than 0.5 inches, and from most angles, requires special techniques, which are the subject of this invention. These techniques assure that the signal reaching the head's internal inductor is free of distortion and have the right shape and timings. In order to meet these requirements, the MST **120** pre-shapes the waves with the wave shaper **121** to compensate for the effects of the shielding, eddy currents and the limited inductance of the reader head **142**. Referring to FIG. **5**, a large DC component **81** is added to the inductor current **80** to compensate for the rapidly collapsing magnetic fields inside the head's **142** shielded enclosure **141** and the effects of the relatively low inductance of the reader-head winding. Additionally, the reader-head amplifier has limited bandwidth. To achieve sufficient induced signal amplitudes, the pulse rise times **82** is controlled to be between 10 and 60 microseconds. This ensures that that the pulse rise times fall within the bandwidth of the reader-head amplifier but not outside the timing constraints of the decoder circuit.

Furthermore, in order to achieve the required penetration from a distance larger than 0.5 inches, a suitable driver **123** must deliver magnetic pulses having a large enough current, that exceeds 1 Ampere. Additionally, to create the right output on the reader-head, the current must be bipolar and must contain a large DC component, which is in excess of 40% of the peak current.

The inductive device **124** of the MST is specially designed to form a loosely coupled transformer, from a distance longer than 0.5 inches, with the card reader-head **142**, where the MST's inductor **124** is the primary and the reader-head's inductor is the secondary. Because the coupling between this primary and secondary is very lose, and because of the high losses caused by the head's shielding **141**, as well as the losses caused by eddy currents, the current driving the inductor must be of a special level and shape. The magnetic field thus generated must be of a sufficient intensity that these losses are compensated for and sufficient signal is induced into the reader head's inductor.

Therefore inductor **124** is designed to have a very specific set of characteristics to make it suitable for the transmission function. It has low enough winding resistance to allow the large current needed to generate the intense magnetic field. At the same time, it has sufficient inductance to control the rise time of the current pulses. The inductance required mandates a large number of turns (over **20**), without increasing the winding resistance beyond 3 ohms. Concurrent with that, the inductor is shaped to provide a sufficiently well distributed magnetic field with few nulls, as shown in FIG. **7**. Such an inductor is either a single inductor that encloses a large area (between 600 and 1700 square mm), shown in FIG. **2**, or an array **180** of spatially distributed two or more inductors **182***a*, **182***b* covering the same area, shown in FIG. **6**. The inductor (or inductors) may have either, iron or ferrite core(s), which is designed such as to not saturate under the high current driven through the inductor(s). In one example, the inductor **124** has a length **92** in the range between 15 mm to 50 mm. In another example, the MST **120** includes an array **180** of two inductors **182***a*, **182***b* separated by a distance in the range of 15 mm to 50 mm.

The traditional magnetic stripe data format does not contain features that protect it against copying. While the MST transmits the card data in a magnetic stripe format, the actual data transmitted does not have to be identical to the data contained in the magnetic stripe of the physical card.

The MST invention includes a secure transmission option where the card data is suitably modified by replacing part of the discretionary data field with a cryptographically generated dynamic element. This security data element, generated either in the phone or in the hardware of the MST, contains a secure hash which is generated using the card data, the MST ID and a sequence number that is incremented for each transmission, and encrypted by a Key supplied by either the card issuer of another third party. The issuer of the Key is able to calculate this secure hash, using the Key, and thus able to verify that a transaction has originated from a legitimate device using legitimate card data. Because the secure hash changes with every transaction in an unpredictable way, a fraudster (who does not know the Key) can not calculate a valid hash for a new transaction. As each transaction contains a sequence number, the recipient is able to identify a replay. Also, because the secure hash replaces a crucial part of the original discretionary data field, data captured from an MST transaction is unsuitable for creating a valid counterfeit card.

By modifying only the part of the card data which is not used by the retailer and the acquirer, this scheme preserves compatibility with existing retail POS and acquirer processing system.

Several embodiments of the present invention have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the invention. Accordingly, other embodiments are within the scope of the following claims.

What is claimed is:

1. A system for a baseband near field magnetic stripe data transmitter comprising:

a mobile phone configured to transmit a stream of pulses comprising magnetic stripe data of a payment card;

a magnetic stripe transmission (MST) device comprising a wave shaper, a driver and an induction device, wherein the MST device is configured to receive the stream of pulses from the mobile phone, to shape and amplify the received stream of pulses and to generate and emit high energy magnetic pulses comprising the magnetic stripe data;

wherein the emitted high energy magnetic pulses are configured to be picked up remotely by a magnetic read head; and

wherein the MST device shapes the received stream of pulses to compensate for shielding, eddy current losses and limited inductance value of the magnetic read head.

2. The system of claim **1**, wherein the magnetic read head is enclosed in a shielded enclosure, and wherein the wave shaper adds a DC component to the emitted high energy magnetic pulses to compensate for a rapidly collapsing magnetic field inside the shielded enclosure.

3. The system of claim **1**, wherein the magnetic read head comprises an amplifier with a limited bandwidth and wherein the wave shaper is configured to control a rise time of the emitted high energy magnetic pulses to be within the limited bandwidth of the magnetic read head amplifier.

4. The system of claim **3**, wherein the limited bandwidth of the magnetic read head amplifier is in the range between 10 microseconds and 60 microseconds.

5. The system of claim **3**, wherein the magnetic read head further comprises a decoder and wherein the wave shaper is configured to control the rise time of the emitted high energy magnetic pulses to be within timing constraints of the decoder.

6. The system of claim **1**, wherein the magnetic read head is enclosed in a shielded enclosure and wherein the driver comprises a bipolar driver and is configured to generate the emitted high energy magnetic pulses having an intensity sufficient to penetrate the shielded enclosure.

7. The system of claim **6**, wherein the bipolar driver is configured to generate a bipolar inductor current having a value higher than 1 Ampere for the emitted high energy magnetic pulses.

8. The system of claim **1**, wherein the magnetic read head comprises a magnetic read head inductor and wherein the induction device of the MST is configured to form a loosely coupled transformer with the magnetic read head inductor from a distance longer than 0.5 inches.

9. The system of claim **1**, wherein the induction device of the MST comprises a loop having one or more windings, and wherein said one or more windings are configured to generate magnetic flux lines that are spread over a large enough area dimensioned to include a sensing aperture of the magnetic read head and to generate an inductance value that is configured to cause properly timed current pulses to reach their maximum value and thereby to cause maximum induced voltage in the magnetic read head inductor.

10. The system of claim **9**, wherein the ratio of the inductance and resistance values of the one or more windings is in the range between 10 μH/Ohm and 80 μH/Ohm.

11. The system of claim **9**, wherein the one or more windings enclose an area in the range between 600 square millimeters and 1700 square millimeters.

12. The system of claim **1**, wherein the induction device comprises an array of spatially distributed two or more inductors.

13. The system of claim **12**, wherein the array of spatially distributed two or more inductors covers an area in the range between 600 square millimeters and 1700 square millimeters.

14. The system of claim **1**, wherein the induction device comprises an iron or ferrite core and wherein said core is designed not to saturate under a high current flowing through the induction device.

15. The system of claim **1**, wherein a portion of the magnetic stripe data of the payment card is replaced by a cryptographically generated dynamic element that prevents replay or copy attacks.

16. The system of claim **15**, wherein the cryptographically generated dynamic element is generated either in the MST or the mobile phone.

17. The system of claim **15**, wherein the cryptographically generated dynamic element comprises a secure hash generated using the magnetic stripe data of the payment card, an

MST identification number, and a sequence number that is incremented for each data transmission and encrypted by an encryption key.

18. A magnetic stripe transmission (MST) device comprising:

a wave shaper;

a driver; and

an induction device;

wherein the MST device is configured to receive the stream of pulses from a mobile phone, to shape and amplify the received stream of pulses and to generate and emit high energy magnetic pulses comprising the magnetic stripe data;

wherein the emitted high energy magnetic pulses are configured to be picked up remotely by a magnetic read head; and

wherein the wave shaper shapes the received stream of pulses to compensate for shielding, eddy current losses and limited inductance value of the magnetic read head.

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