

ABSTRACT

The K531 is a versatile ISO 14443 OEM module, able to read/write contactless memory cards (Mifare, STm SR176, Jewel...) and to dialog with ISO 14443-4 « T=CL » smartcards (Desfire, Mifare ProX or SmartMX). For optimal performance and reliability, the SpringProx API (available in C as well as various Windows compiled DLL) provides application developers with high-level functions, that can perform complex card operation in just one single call. But in some situations, for example in low-cost access control readers, developers don't need to read more than the serial number of the, and therefore porting the whole SpringProx API to a low-cost micro-controller may not worth the effort.

This application note focuses on the K531 "ASCII" communication protocol, and shows how easy it is to retrieve serial numbers of various cards in the RF field.

THE K531 ASCII COMMUNICATION PROTOCOL

The K531 is accessed through a serial communication line (TTL level at K531's RX/TX pins, RS-232, RS-485, USB virtual serial port... depending on the environment hardware). Default settings are 38400bps, 8 data bits, 1 stop bit, no parity, no flow control. Using those default settings, K531 is ready to accept commands in ASCII formatted Hexadecimal (the sequence 0x12 0x34 0x56 0xAB becomes the ASCII string "123456AB"). Communication is half-duplex : host talks first, and reader always answers.

See [k531-devguide.html](#) in K531 SDK for more details on the different communication protocols.

HOST TO K531

The host frame must start with '\$' (dollar sign), followed by the code of the command to execute (1 byte, i.e. 2 hex chars), the length of the command parameters (1 byte), and the command parameters (if some). Command frame ends with <CR><LF> (0x0D, 0x0A).

K531 TO HOST

The K531 response frame starts with '+' (plus sign), followed by the return status of the command (1 byte), the length of the response data (1 byte), and the response data (if some). Response frame ends also with <CR><LF>.

On successful execution, status is 00 (MI_OK), on failure status is the *absolute value* of the error code (i.e., status 01 maps to -1, that is MI_NOTAGERR). See [springprox.h](#) and related documentations for a complete list of error codes.

When the host frame is invalid (for example, length byte doesn't map to the actual length of command parameters), K531's answer starts with '-' (minus sign).

LOOKING FOR ISO 14443-A CARDS

The K531 implements the whole ISO 14443-A anti-collision scheme, that is, it possible to retrieve the serial number of all the 14443-A cards to be found in the RF field.

CONFIGURE THE K531 FOR ISO 14443-A OPERATION

Host to K531: **\$58020C01**
K531 to host: **+0000**

PERFORM ISO 14443-A ACTIVATION SEQUENCE (request-anticoll-select)

Host to K531: **\$9500**

If not card is available, response is :

K531 to host: **+0100**

If a Mifare card is found (length of UID=4), response is :

```
K531 to host:     +000804000804E297F600
                   ***** UID (serial number)
                   ^^ length of UID is 4
                   **** ATQ
                   ^^ SAK
                   ^^ status is OK
                   ^^ length of data is 8
```

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MULTI-PROTOCOL POLLING WITH K531

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Note: In Philip's literature, byte arrays are often presented in reverse order, so the "usual" representation of this Mifare card may be ATQ=0004, UID=00F6974E.

If a Desfire card is found (length of UID=7), response is :

```
K531 to host:      +000B44032007043208C9D8B850
                   ^^^^^^^^^^^^^^^^^^ UID (serial number)
                   ^^ length of UID is 7
                   ^^^^ ATQ
                   ^^ SAK
                   ^^ status is OK
                   ^^ length of data is 11
```

Note: in Philips' literature the Desfire card has ATQ=0344 (reverse order) but the UID is expressed in "normal" order, always starting with 04 (Philips' vendor ID).

HALT THE CARD

Once a card has been found, it can be halted by the reader so that it won't answer to subsequent requests. This allows to loop until all cards have been discovered.

```
Host to K531:      $9200
K531 to host:      +0000
```

Note: depending on the antenna size and tuning, it may be difficult to operate more than one card at the time, even if K531 allows it.

LOOKING FOR ISO 14443-B CARDS

The K531 doesn't provide the ISO 14443-B anti-collision scheme. It is not possible to distinguish between two cards present in the same time in the RF field.

Note: this feature is available only for K531 version 1.35 and above.

CONFIGURE THE K531 FOR ISO 14443-B OPERATION

```
Host to K531:      $58020C02
K531 to host:      +0000
```

PERFORM ISO 14443-B ACTIVATION SEQUENCE (request-anticoll-select)

```
Host to K531:      $4D00
```

If no card is available, response is :

```
K531 to host:      +0100
```

If a card is found, response is card's ATQB :

```
K531 to host:      +000C0C865723C8000000000051C3
                   ^^^^^^^^^^ PUPI ("pseudo unique identifier"; not actually the serial number)
                   ^^ status is OK
                   ^^ length of data is 12
```

Note: as its name says, the PUPI is "pseudo-unique". Some cards actually use a masked serial number (but it may be "unique" to this vendor only), where some others provide a random number; in this case, it is impossible to use this PUPI for identification !

LOOKING FOR CALYPSO CARDS

Note: this feature uses Calypso patented communication protocol and command code and is subject to Calypso license-fee. Only K531-C can use this feature.

CONFIGURE THE K531 FOR CALYPSO OPERATION

```
Host to K531:      $58020C02
K531 to host:      +0000
Host to K531:      $AC021723
K531 to host:      +0000
```

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Host to K531: \$AC021DFE
K531 to host: +0000

PERFORM CALYPSO "APGEN"

Host to K531: \$970D00060020018000000B3F800000

If not card is available,

K531 to host: +0100

Note: it is also possible to receive other error codes, showing framing, parity, CRC, or other kind of communication error. Every response starting with something different than +00 has to be considered as the "no card available" answer.

If a Calypso card is found, answer is :

```
K531 to host:     +001F001D0007248A0396FFC03B6F0000805A0A0103200311248A03968290000000
                   ^^^^^^^^^ UID (serial number)
                   ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^^ ATR
                   (UID is also available in the ATR) ^^^^^^^^^
^^ status is OK
^^ length of following data is 31
```

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