Collis

SmartLink Box User Manual

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TABLE OF CONTENTS

1 INTRODUCTION

In June 1998, Collis started the development of a hardware interface that should facilitate the use of Collis' generic test-tool "Conclusion Smartlink" for testing SmartCards and SmartCard terminals. The result of this effort, the "Conclusion Smartlink Box" has been in use since early 1999.
Because of the rapid development in SmartCard technology, the original hardware no longer meets the demands placed on it by today's market. For example, it is not possible to use the device to communicate with terminal/card combinations that work at 3V supply voltage, commonly used in GSM.
Therefore a decision has been made to design a new version of the SmartLink Box that does meet these demands and is also more flexible and easier to upgrade. This document is the basis for this new hardware design.

2 FUNCTIONAL DESCRIPTION

The CIB-1894 (**C**hipcard **I**nterface **B**ox, hereafter referred to as: "the box") is a microprocessor controlled interface between Conclusion Smartlink (herafter referred to as: "the driver") and a chipcard / terminal that facilitates monitoring and/or modification of the communication between card and terminal. It is also possible to simulate the behaviour of either a card or a terminal.
The interface should be designed to work with all SmartCards and terminals currently in use and also –as much as possible- be prepared for future card/terminal combinations, in as far as this is compatible with the current ISO standards.

2.1 Signalling

The following events / statuses will be signalled by LEDs:

Item	Description	LED color
Power On	The presence of supply voltage to the box	green
Card Inserted	A card being fully inserted into the card slot	yellow
Vcc	The presence of supply voltage on the card interface	red
CLK	The presence of a clock signal on the card interface	red
RST	The presence of a RST signal on the card interface [1]	red
Card I/O	The presence of activity on the I/O line of the card [2]	green
Terminal I/O	The presence of activity on the I/O line of the terminal [2]	green

Table 2-1 Signals

2.2 Card/terminal interface, general

The box has three fundamental modes on the card/terminal interface: The Analyse Mode, the Intercept Mode, and the Cardreader Mode. In Analyse Mode there is a direct connection between card and terminal and the communication between them is merely monitored. In Intercept Mode, the communication between the card and the terminal is diverted *via* the driver, which enables modification of messages. In Cardreader Mode, all connections between card and terminal are separated and the card receives all necessary electrical signals from the box itself.
In Analyse and Intercept Mode the box wil automatically determine the frequency of the CLK signal as soon as the presence of VCC is detected. It will then continuously measure the CLK frequency and compare it to the previously measured frequency, so as to determine and signal any changes.

[1] The RST LED is on when the RST signal is low, *i.e.* the card is in Reset.
[2] In Analyse Mode these LEDs signal the origin of the communication. In Intercept Mode they show on which interface the communication is taking place.

The following events are automatically tracked and signalled to the driver:

- Insertion and removal of a card (event 0xB1, resp. 0xB0)
- Application and removal of supply voltage (Vcc) (event 0xA1, resp. 0xA0)
- Application of RST to the card (event 0xAF)
- CLK signal stop (event 0xAA)
- CLK signal (re)start (event 0xAB)
- Clockfrequency change (event 0xAC)
- Signaling of a Parity error by card or terminal (event 0xC0)

It will be possible to introduce Parity errors while sending data to the card or the terminal, in order to analyse the response to this. The result of the Parity check on received characters will be sent to the driver.

2.2.1 Card/terminal interface, Analyse Mode

In this mode all elektrical signals between the terminal and the card are functionally, though not physically, connected to eachother. The box will measure the supplyvoltage and clockfrequency presented by the terminal and determine the communication bitrate based on the clockfrequency and a divisor, preset by the driver. These parameters can be queried by the driver.
The box receives the data being sent between the terminal and the card and monitors the direction of this communication. The data received is sent directly to the driver, with information added about the message originator (card or terminal), possible parity errors and an optional timestamp. An end-of-message is determined by either a change in the direction of the communication or a preset timeout.

2.2.2 Card/terminal interface, Intercept Mode

This mode also connects all electrical signals between the terminal and the card, with the exception of the I/O line. As in Analyse Mode, the box will measure suplyvoltage and clockfrequency and determine the correct bitrate.
Upon release of the RST line, the box will send a string of characters, preset by the driver, to the terminal. This string will usually be the same as the ATR of the card that is used. The subsequent command received from the terminal will be sent to the driver, not the card. The driver will then send this command, or a modified version of it, to the card. The box will send the answer from the card to the driver, which then sends it to the terminal, *et cetera*.
Error signalling on the I/O line, as defined by ISO 7816-3, § 6.1.3, will be detected and signalled to the driver. The affected byte will be resent. Send Parity errors can be forced from the driver.
This mode is independent of the presence of a card and can therefore be used to completely simulate the behaviour of a card towards the terminal.

2.2.3 Card/terminal interface, Cardreader Mode

In this mode there is no connection between the card and the terminal. All elektrical signals are presented to the card by the the box itself. The driver can set the supply voltage, the clockfrequency and the bitrate divisor. Error signalling on the I/O line, as defined by ISO 7816-3, § 6.1.3, will be detected and signalled to the driver. The affected byte will be resent. Send Parity errors can be forced from the driver.

2.3 Box / driver interface

The interface between box and driver is primarily responsible for the transmission and reception of the datastream between terminal and card. This interface is also used to set and query box parameters and status.
The interface protocol will be a superset of that designed for the CIB-3580 (the first version of the box).

The interface will guarantee data transmission at a speed that is sufficient to enable Interception without problems caused by waiting times being too long. To this end, the data shall be sent in a streaming fashion, which means that every character received from the terminal or card shall be directly transmitted to the driver rather than the whole message being buffered.

To ensure data integrity, the interface shall implement hardware flow control to prevent buffer overflow.

Lastly, it will be possible to upload new firmware to the box, using this interface. From version 2.0.0 onwards, it will also be possible to reprogram the CPLD.

2.3.1 Specifics

The original design (2001) of the driver interface was based on an RS-232 connection. Since then (late 2003), a version (CIB-3390) has been released that uses USB. On the driver (=PC) side, this is still seen as a COM port, because the USB-driver supplied implements a Virtual Com Port (VCP). At protocol level however, the two versions (RS-232 and USB) are identical.

In contrast with all previous versions, the latest versions (CIB-189x) are powered by the USB.

2.3.2 Answer To Reset

As with a card, the box issues an Answer To Reset (ATR) string, on power-up as well as on reception of the RESET_BOX command. This ATR is of the following format:

CCS_xxxx Version y.y.y

where xxxx denotes the type of interface, *i.e.* 3390 is the 'old' USB version and 1890 is the USB-powered 1.8V version. 1894 is the high speed version.
y.y.y denotes the firmware version.

Although the box types are compatible at protocol level, their firmware is different and should not be mixed, because this will render the box useless.

3 TECHNICAL DESCRIPTION

3.1 Card / terminal interface

To ensure operational compatibility with as many combinations of card / terminal as possible, the card and terminal interface will comply with these specifications:

3.1.1 Analyse Mode

1.	Supplyvoltage (V_{CC}) from terminal:	1.65 VDC – 5.5 VDC
2.	Voltage differential V_{CC} (terminal -> card):	50 mV max.[3]
3.	"1" level on I/O line (transmission):	> V_{CC} – 0.2 V
4.	"0" level on I/O lijn (transmission):	0.4 V maximum
5.	"1" level on I/O lijn (reception):	min. 0.75 * Vcc
6.	"0" level on I/O lijn (reception):	max. 0.25 * Vcc
7.	Clockfrequency (f_{CLK}):	2 kHz – 30MHz[4]
8.	Bitrate on I/O:	1.25 Mbps maximum
9.	I/O signal delay (terminal <-> card):	100 ns maximum

3.1.2 Intercept Mode

The same specifications apply as for Analyse Mode.

3.1.3 Cardreader Mode

1.	Supplyvoltage (V_{CC}) :	1.6 VDC – 5.5 VDC ± 2%
2.	Maximum current :	50mA
3.	"1" level on CLK, RST and I/O line:	> V_{CC} – 0.2 V
4.	"0" level on CLK, RST and I/O line:	0.4 V maximum
5.	Clockfrequency (f_{CLK}):	500 kHz – 24 MHz
6.	CLK signal dutycycle:	45 – 55%
7.	CLK signal risetime:	< 5 ns
8.	Bitrate on I/O:	1.25 Mbps maximum

3.2 Driver interface

The Box contains a (USB 2.0 compliant) USB-to-UART bridge, which is seen as a Virtual COM Port on the driver side. The interface is set to communicate at 500,000 bps, irrespective of the COM Port setting. Other parameters are: 8 databits, Even Parity, 1 Stop-bit. The interface uses hardware flow-control.

[3] The voltage supplied to the card is internally limited to 5.5V. A terminal supply voltage larger than this will therefore result in a larger differential.

[4] The minimum frequency is determined by the response of the 'clock present' detector. The maximum frequency that can be measured is 32.767MHz. The serial receiver and transmitter remain functional at >60MHz

4 PROTOCOL DESCRIPTION

The box and the driver communicatie through a full-duplex connection. Full-duplex is necessary because both the box and the driver must be able to send data at any given time. This means that two communication sessions can be in progress simultaneously; one initiated by the box and one by the driver.
Each message consists of a Protocol Address and Control byte (PAC), one or more data fields and one or more Control byte(s). Among other things, the Control byte contains a More Data flag that indicates if any datafields will follow. A Control byte always relates to the previous Data byte.

PAC	DAT	CONTROL(1)	DAT	CONTROL(0)

For the protocol type PAC-LEN-DATA (bit PAC.0 eaqual to 0), each message contains 3 fields: PAC field, length field (LEN), data field (DAT).
When bit b8 of the most significant byte of the length field is set to 0, the length field consists of only one byte. Bits b7 to b1 code the number of bytes of the value field. The length field is within the range 1 to 127.
When bit b8 of the most significant byte of the length field is set to 1, the subsequent bits b7 to b1 of the most significant byte code the number of subsequent bytes in the length field. The subsequent bytes code an integer representing the number of bytes in the value field. Two bytes are necessary to express up to 255 bytes in the value field.

PAC	LEN	DAT

4.1 Node adressing

Four nodes must be adressed:

- Box
- Card
- Terminal
- Driver

Two bits can identify a node, so one nibble can be used to specify both sender and receiver.

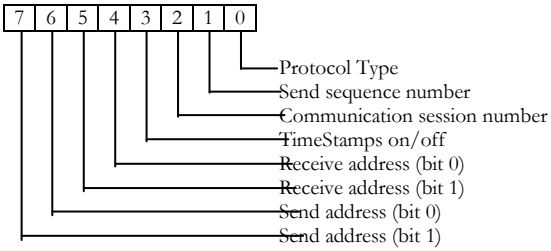
4.2 Communication scenarios

The following communication scenarios can be distinguished:

- Commands to the box from the Driver
- Messages from the Terminal sent to the Driver by the box
- Messages from the Card sent to the Driver by the box
- Messages from the Driver sent to the Terminal through the box
- Messages from the Driver sent to the Card through the box

The box will send either a command response or an ACK message in response to every command sent by the driver. Messages from the driver to the card or the terminal will only be replied to by the receiver concerned.

Protocol address and control byte (PAC)



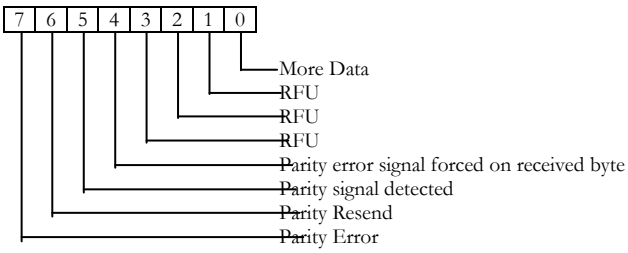
Node address nibble

7	6	5	4	
0	0	X	X	Sender is Box
0	1	X	X	Sender is Card
1	0	X	X	Sender is Terminal
1	1	X	X	Sender is Driver
X	X	0	0	Receiver is Box
X	X	0	1	Receiver is Card
X	X	1	0	Receiver is Terminal
X	X	1	1	Receiver is Driver

Protocol control nibble

3	2	1	0	
X	X	X	0	Protocol type PAC-LEN-DATA
X	X	X	1	Protocol type PAC-DATA-CONTROL
X	X	0	X	Current sequencenumber is 0
X	X	1	X	Current sequencenumber is 1
X	0	X	X	Session initiated by Box
X	1	X	X	Session initiated by Driver
0	X	X	X	TimeStamp not present
1	X	X	X	TimeStamp follows

Control byte



7	6	5	4	3	2	1	0	
X	X	X	X	X	X	X	0	Last byte sent
X	X	X	X	X	X	X	1	More data to follow
0	X	X	X	X	X	X	X	When sending Box -> Driver: Databyte from card/terminal received with correct parity When sending Driver -> Box: Send databyte to card/terminal with correct parity
1	X	X	X	X	X	X	X	When sending Box -> Driver: Databyte from card/terminal received with incorrect parity
1	0	X	X	X	X	X	X	When sending Driver -> Box: Send databyte to card/terminal with incorrect parity Resend with correct parity
1	1	X	X	X	X	X	X	When sending Driver -> Box: Send databyte to card/terminal with incorrect parity Resend with incorrect parity

4.3 Events

Certain events are outside the control of the box and the driver, because they are determined by the user or the terminal. Examples of such events are the insertion of a card and a change in clockfrequency. Because it would take too much time to let the driver poll these events, the box will send them asynchronously. These events are as follows:

Event	OpCode
Vcc not present	0xA0
Vcc present	0xA1
CLK stop	0xAA
CLK start	0xAB
CLK frequency changed	0xAC
RST active	0xAF
Card removed	0xB0
Card inserted	0xB1
Parity error detected	0xC0
Protocol Timeout	0xDF

Table 4-1 Events

4.4 Commands

The following commands will be supported by the box:

Command [5]	OpCode	Data [6]	Unit [7]	Range [8]	Default value	Applicable [9]
RESET_BOX	0x00	N/A				always
RESET_TIMESTAMPS	0x01	N/A				always
SET_TIMESTAMPS	0x02	uchar		0 / 1	0	always
SET_RELATIVE_TIMESTAMPS	0x03	uchar		0 / 1	0	Intercept and Cardreader Mode
SET_CLOCKFREQUENCY	0x04	uchar	x 50 kHz	20 ~ 200		always
SET_CLOCKFREQUENCY_EXTENDED	0x05	uint	x 1 kHz	500 ~ 24000	3579	always
SET_INTERCEPT_MODE	0x08	N/A				always
SET_ANALYSE_MODE	0x0C	N/A			*	always
SET_CARDREADER_MODE	0x0D	N/A				always
SET_PROTOCOL_TIMEOUT	0x0E	uchar	ms.	1 ~ 25		always
SET_BOX_BAUDRATE	0x0F	uchar		0 ~ 8	0	always
SET_PARITY_MODE	0x10	uchar		0 / 1	1	always
SET_FORCE_PARITY_SIGNAL	0x11	uchar		0 / 1	0	Intercept and Cardreader Mode
SET_T_MODE	0x12	uchar		0 / 1	0	always
SET_DIVIDER	0x13	uint		1 ~ 1023	372	always
SET_DIVISION_RATE	0x14	uchar		0 ~ 3	0	always
SET_GUARDTIME	***0x15***	***uint***	***etu***	***1 ~ 65523***	***3***	***always***
SET_CONVENTION	0x16	uchar		0 / 1	0	always
SET_ATR_CHARACTER_DELAY	0x17	uint	etu	1 ~ ***65523***	3	always
SET_TIME_OUT	0x18	uchar	etu	0 ~ 255	27	always
NO_DIRECTION_SWITCH	0x19	N/A				Intercept Mode
SET_TIME_OUT_EXTENDED	0x1A	uint	etu	0 ~ 65523	27	always
PRESET_DIVIDER_1	0x1B	uint		1 ~ 1023	372	always
PRESET_DIVIDER_2	0x1C	uint		1 ~ 1023	372	always

[5] Commands in ***bold italics*** are new compared to the previous version. Sending a command not listed in this table will result in the errormessage "Unknown Command" (see Command replies)
[6] N/A no data should be sent with the command. uchar is an Unsigned Char (1 byte; value 0 ~ 255), uint an Unsigned Integer (2 bytes; 0 ~ 65535) and ulong an Unsigned Long (4 bytes; 0 ~ $2^{32} - 1$). Multi-byte parameters are in Big Endian format.
[7] Etu is the "Elementary Time Unit" as defined by ISO7816. A "character" is a character as sent on the I/O line between card and terminal and is 12 etus long
[8] Sending data outside the specified range will lead to the errormessage "Out Of Range" (see Command replies). An exception is made for commands that require a 0/1 parameter. Here, all values not equal to '0' are considered '1' and will be accepted.
[9] Sending a non-applicable command will result in the errormessage "Command Not Valid" (see Command replies)

Command [5]	OpCode	Data [6]	Unit [7]	Range [8]	Default value	Applicable [9]
SET_DEFAULT_DIVIDER	0x1D	uint		1 ~ 1023	372	always
SET_NO_PPS	0x1E	N/A			off	always
SET_FORCE_PAR_COUNT	0x1F	uchar	characters	0 ~ 255	0	Intercept and Cardreader Mode
SET_FORCE_PAR_NUMBER	0x20	uchar		1 ~ 255	1	Intercept and Cardreader Mode
SET_ATR1	0x21	char[32]			<empty>	always
SET_ATR2	0x22	char[32]			<empty>	always
SET_TRIGGER_COUNT	0x25	uchar	characters	0 ~ 255	<empty>	Intercept and Cardreader Mode
SET_DELAYED_RESPONSE	0x26	char[32]			<empty>	Intercept and Cardreader Mode
SET_ATR_DELAY	0x2A	uint	etu	1 ~ 65523	12	always
SET_RESPONSE_DELAY	0x2B	uint	etu	1 ~ 65523	12	Intercept and Cardreader Mode
INITIALIZE_CARD	0x30	N/A				Cardreader Mode
DEINITIALIZE_CARD	0x31	N/A				Cardreader Mode
SWITCH_CLK	0x32	uchar		0 / 1		Cardreader Mode
CLK_OFF_LEVEL	0x33	uchar		0 / 1	0	Cardreader Mode
RESET_CARD	0x34	N/A				Cardreader Mode
SET_SUPPLY_VOLTAGE	0x36	uchar	x 100 mV.	0 ~ 55 and '0xFF'	50	always
SET_VCC_THRESHOLD	0x37	uchar	x 100mV.	10 ~ 45	24	always
SET_TIMESTAMP_EOT	0x38	uchar		0 / 1	0	always
GET_TIMESTAMP	0x41	uint	x 100 µs.	0 ~ 65535		always
GET_MODE	0x48	uchar		0 ~ 2		always
GET_PROTOCOL_TIMEOUT	0x4E	uchar	ms.	0 ~ 25		always
GET_SOFTWARE_VERSION	0x51	uchar				always
GET_DIVISION_RATE	0x53	uint		0 ~ 1023		always
GET_TERM_STATUS	0x60	uchar		0xA0 ~ 0xA1		always
GET_CARD_STATUS	0x70	uchar		0xB0 ~ 0xB1		always
GET_CLOCK_FREQUENCY	0x64	ulong	Hz	0 ~ $32x10^6$		always
GET_BAUDRATE	0x65	ulong	bps			always
GET_SUPPLY_VOLTAGE	0x66	uint	x 100 mV	0 ~ 63		always
GET_VCC_THRESHOLD	0x67	uchar	x 100mV.	10 ~ 45		always
GET_ATR_CHARACTER_DELAY	0x78	uint	etu	1 ~ 65523		always
GET_GUARDTIME	0x79	uint	etu	1 ~ 65523		always
GET_ATR1	0x71	char[32]				always
GET_ATR2	0x72	char[32]				always
GET_ATR_DELAY	0x7A	uint	etu	1 ~ 65523		always

Command [5]	OpCode	Data [6]	Unit [7]	Range [8]	Default value	Applicable [9]
GET_TIMEOUT_EOT	0x7B	uint	etu	0 ~ 65523		always
GET_CPLD_VERSION	0x7C	uchar[3]				always
START_SOFTWARE_DOWNLOAD	0xAA					always
START_CPLD_DOWNLOAD	0xCC					always
PROGRAM_CPLD	0xCD					always

Table 4-2 Command set

4.4.1 RESET_BOX

This command is used to reset the box. The effect of this is that all settings will assume their default values and all buffers will be cleared.

4.4.2 RESET_TIMESTAMPS

Use this command to reset the Timestamp counter.

4.4.3 SET_TIMESTAMPS

This command switches sending of Timestamp information on (Data = 1) or off (Data = 0) When the Timestamps are 'on', a 16-bit Timestamp will be added to each of the following messages:

1. Vcc on / off
2. Card in / out
3. RST active (= '1' -> '0' !)
4. Message received from card or terminal
5. CLK on/off

In case 4. one TimeStamp is sent that signifies the moment the first character of the message was received.

4.4.4 SET_RELATIVE_TIMESTAMPS

This command switches between Relative Timestamps on (Data = 1) and off (Data = 0). Relative Timestamps differ from normal Timestamps in that a). they are only applicable in Intercept and Cardreader Modes and b). the Timestamp counter is reset at the last byte of each message that is sent to the Card or the Terminal. The actual Timestamp is still added to messages received (see SET_TIMESTAMPS), thus it enables the user to get an idea of the responsetime of either the Card or the Terminal.

Note that the Timestamp reset coincides with the start of the last character sent by the box. The actual responsetime is therefore 2 charactertimes shorter than indicated by the Timestamp.

4.4.5 SET_CLOCKFREQUENCY

This command sets the frequency of the CLK signal when the box is in Cardreader Mode. This command is a "Compatibility Command", that is being implemented to maintain compatibility with the old box.

4.4.6 SET_CLOCKFREQUENCY_EXTENDED

A different type of generator enables the new box to generate clockfrequencies over a wider range and with improved resolution. This command is added to make optimum use of this new generator and is the preferred command over SET_CLOCKFREQUENCY.

The frequency can be set over a range of 500 kHz to 24 MHz, in steps of 1 kHz. The default value is 3579, which equates to a generated clock frequency of 3.579 MHz.

4.4.7 SET_INTERCEPT_MODE

This command is used to switch the box to Intercept Mode. This will disconnect the I/O line between card and terminal and all messages will be routed to the driver interface. The Vcc, CLK and RST on the card side are still determined by the terminal.

4.4.8 SET_ANALYSE_MODE

This command is used to set the box to Analyse Mode. This is the default mode when the box is powered.

4.4.9 SET_CARDREADER_MODE

This command is used to set the box to Cardreader Mode. All electrical signals between card and terminal are now disconnected.

4.4.10 SET_PROTOCOL_TIMEOUT

This command is used to set the timeout used for communication with the driver. If data is expected, but not received within the set timeout, the box will send the errormessage "Protocol Timeout" to the driver.
The timeout is set in milliseconds. At a communication speed of 500,000 bps one millisecond equals about 40 characters.

4.4.11 SET_BOX_BAUDRATE

This command is kept for compatibility with the previous version of the Box.

The USB interface is set to communicate at 500,000 bps at all times, so this command no longer has any meaning.

4.4.12 SET_ PARITY_MODE

This command switches reception and transmission on the card/terminal side between "No Parity" (parameter == 0) and "Parity" (parameter != 0).
With "No Parity" selected, the length of a full character frame is 10 bit-times (Start, 8 data, Stop).

4.4.13 SET_FORCE_PARITY_SIGNAL

Use this command to force the box to generate a parity error signal on the first received byte from the Terminal (parameter == 0) or the Card (parameter != 0). This command works only once after issuing and should therefore be sent again for every time the error signal is to be generated.

4.4.14 SET_T_MODE

In order to correctly handle Parity error signalling, the Box needs to 'know' whether the transmission uses T=0 or T=1.
In T=1 mode, the box will ignore any Parity error signalling. It is 'highly recommended' to set this mode when working with T=1 cards, because due to the possible shorter inter-character timing, the box might miss characters or falsely interpret a startbit as Parity error signal.

4.4.15 SET_DIVIDER

The bitrate of the communication between card and terminal is determined by the division of the clock frequency by an integer number. This command is used to set this number, so that the box will be able to correctly set the communication speed.
The default value is 372 (cf. ISO7816).

Driver->Box:	→Card(command)	SET_DIVIDER(93)	→Terminal(response)	→Card(command)
Divisor:	372	93	93	93

4.4.16 SET_DIVISION_RATE

This command can be used to set the baudrate divisor (see SET_DIVIDER) to one of four standard values:

0. 372
1. 186
2. 93
3. 46

This command is implemented for compatibility with the old box.

4.4.17 SET_GUARDTIME

This command sets the ISO7816 parameter "Extra Guardtime". This is the waitingtime – in etu – between two consecutive characters. This parameter is used by the box while sending data in Intercept- and Cardreader Mode.
The actual minimum delay time will be 3 etus in T_Mode 0, and 1 etu in T_Mode 1.

4.4.18 SET_CONVENTION

Use this command to switch between Normal Convention ("0"), where a 'high' level on the I/O line signifies a logic '1' and data is sent LSB-first, and Inverse Convention, where a 'high' level on the I/O line signifies a logic '0' and data is sent MSB-first. This switch must be made in order to make sure the value of the Parity bit can be correctly determined by the box.
The convention is determined by the driver, using the first character of the card ATR.

4.4.19 SET_ATR_CHARACTER_DELAY

This command sets an additional waitingtime – in etu – between consecutive characters in the ATR. This parameter is used by the box when sending an ATR in Intercept Mode. It can be used to force the time taken by the box to send the ATR to be at least as long as the time taken by the card. This helps to prevent the terminal command being sent to the card while it is still busy sending its ATR.
The actual minimum delay time will be 3 etus in T_Mode 0, and 1 etu in T_Mode 1.

4.4.20 SET_TIME_OUT

Sets the timeout (in etu) for the card / terminal interface. Based on this parameter the box will determine the end of a message.
Note: The timeout value plus 10 etu should be equal or bigger than the delay between the leading edges of two consecutive character in order to keep them received as one message.

4.4.21 NO_DIRECTION_SWITCH

The box' I/O configuration is 'hard' half-duplex, which means that it can communicate in only one direction; when sending to the terminal, the receiver will be connected to the card and the other way round. This reversal happens automatically in Intercept mode, after a message has been fully sent. This is usually the logical way of doing things, because the side (card or terminal) that has last received a message will be the first to send one in response. There is, however, one exception to this, in the case where the card sends a Waiting Time Extention message. This message is sent to the terminal, but the next message will come from the card as well. To prevent this next message from being lost, this command should be issued before the WTX message is sent to the terminal. This will prevent the direction being reversed and thus the receiver will remain connected to the card side.
This command is once-only, meaning that it is only valid for the message immediately following it. Thus, it should be issued before each message where the direction should remain unaltered.

4.4.22 SET_TIME_OUT_EXTENDED

Sets the timeout (in etu) for the card / terminal interface. Based on this parameter the box will determine the end of a message. This is basically the same command as SET_TIME_OUT, but takes an integer, rather than a char as parameter.

4.4.23 PRESET_DIVIDER_1

This command can be used in Intercept Mode and Analyse Mode to preset a certain bitrate division factor.
In Intercepter Mode, this factor will be applied when ATR1 has been fully sent. This is useful to ensure correct and timely baudrate switching with an ATR that specifies non-default values for F and D.
In Analyse Mode, after same amount of bytes as pre-defined in ATR1 received from Card side, this factor will be applied. This factor can be used specially to support specific mode switch in analyse mode, and it will not be applied if ATR1 is not preset by host.

4.4.24 PRESET_DIVIDER_2

This is essentially the same command as PRESET_DIVIDER_1, exept that the specified value will be applied after sending/receving ATR2.

4.4.25 SET_DEFAULT_DIVIDER

Use this command to set the default division ratio (F/D) that will be applied after a Reset

4.4.26 SET_NO_PPS

Issuing this command switches off PPS detection and handling in the Box. This command will remain effective until the Box is reset.

4.4.27 SET_FORCE_PAR_COUNT

Used in conjunction with SET_FORCE_PARITY_SIGNAL.
Sets the number of characters to be received before forcing the parity error signal is generated. *I.e.* the value 0 (the default) will generate the error signal on the first character.

When used, this command **must** be issued before the SET_FORCE_PARITY_SIGNAL command.

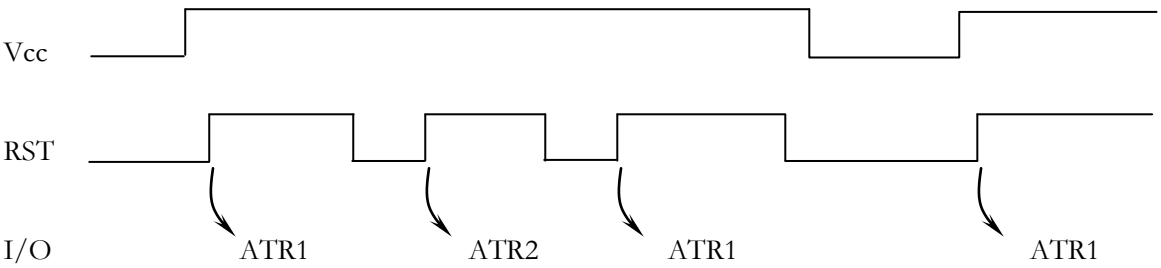
4.4.28 SET_FORCE_PAR_NUMBER

Used in conjunction with SET_FORCE_PARITY_SIGNAL.
Sets the number of consecutive times the parity error signal will be generated.

When used, this command **must** be issued before the "SET_FORCE_PARITY_SIGNAL" command.

4.4.29 SET_ATR1

To comply with the ISO7816 demand that a card should react to a Reset within 40,000 clock cycles, the box itself must send an ATR to the terminal in Intercept Mode. This command is used to set this ATR.
ATR1 is sent after a "cold start" (Reset after application of Vcc). ATR1 and ATR2 are sent intermittantly, meaning that after a cold start ATR1 will always be sent, after the next Reset ATR2 will be sent, at the third Reset ATR1, *et cetera*.



4.4.30 SET_ATR2

Some cards have what is known as a "Specific Mode", which can be activated by issuing a second Reset while Vcc is still applied. The card will then respond with a different ATR. This ATR can be set with this command.
For cards that do not have a Specific Mode, ATR2 should be set to the same value as ATR1.

4.4.31 SET_TRIGGER_COUNT

Sets the number of bytes to be received from the card to trigger sending the DELAYED_RESPONSE.

4.4.32 SET_DELAYED_RESPONSE

Sets a sequence of bytes to be sent to the card after a certain number of bytes (set by SET_TRIGGER_COUNT) has been received. Sending of this sequence is started after a preset delay.

4.4.33 SET_PAR_ERROR_NUMBER

Sets the number of times a character will be sent with (forced) parity error, before normal transmission is resumed.

4.4.34 SET_TRIGGER_OUT_EVENT

Selects which signal will be routed to the Box' 'Direction' output. The actual direction signal is the default selection, but other signals can be selected so as to provide a convenient trigger for oscilloscope viewing of several events.

Available selections are:

00. Direction
01. Forced parity signal
02. Forced parity error

Five more selections are available for future use.

Note: In order to avoid possible false triggers, it is highly recommended to issue this command at the earliest possible stage in a script.

4.4.35 SET_ATR_DELAY

Sets the delay (in etu) between detection of the RST event and sending the first byte of the ATR. The minimum delay time could be set is 1 etu.

4.4.36 SET_RESPONSE_DELAY

Sets the required delay between the "delayed response" trigger (4.4.31) and sending the first byte in the response sequence (4.4.32).

4.4.37 EXTEND_PAR_SIGNAL_TIMING

Use this command to influence the timing of the forced parity error signal (enabled by SET_FORCE_PARITY_SIGNAL). By default, the signal will start at t = 10.5 etu, which corresponds to a parameter value of 0. The timing can be shortened or lenghtened by up to 0.9 etu. A negative value for the parameter will shorten the timing, *i.e.* a value of –2 will let the signal start at t = 10.3 etu.

The actual change in timing is achieved by setting the clock divider to a different value for the duration of one bit time. This "different value" (N') is calculated as follows:

$$N' = (N * 10 * (10 + x)) / 100$$

Where N is the Clock divider and x is the parameter value .

As th divider can only accept integer values, this means the accuracy of the timing may vary somewhat, although at higher values of the divider (like the default 372) it will be accurate enough.

Note: This command is mutually exclusive with the EXTEND_GUARDTIME command. When issued one after the other in the same session, only the last command will be effective.

4.4.38 EXTEND_GUARDTIME

Use this command to influence the timing of the Guardtime. By default, the time between two consecutive characters is 11 (or 12, for T=0) etu, plus an optional extra Guardtime. This corresponds to a parameter value of 0. The timing can be shortened or lenghtened by up to 0.9 etu. A negative value for the parameter will shorten the timing, *i.e.* a value of –2 will let the next character start at t = 10.8 + ETG etu.

The considerations for timing accuracy as described for EXTEND_PAR_SIGNAL_TIMING apply equally to this command.

4.4.39 INITIALIZE_CARD

Used in Cardreader Mode to initialise a card. Activates Vcc, then CLK and then deactivates RST. The card should now respond with an ATR.

4.4.40 DEINITIALIZE_CARD

Used in Cardreader Mode to deactivate a card. Activates RST, then deactivates CLK and finally deactivates Vcc.

4.4.41 SWITCH_CLK

Used in Cardreader Mode to switch CLK signal on or off. The 'off' level is determined by the "CLK_OFF_LEVEL" command.

4.4.42 CLK_OFF_LEVEL

Used in Cardreader Mode to set the logic level at which the CLK line to the card will be when the signal is switched 'off'.

4.4.43 RESET_CARD

Used in Cardreader Mode to reset the card. Activates RST, the deactivates it again after about 2ms.

4.4.44 SET_SUPPLY_VOLTAGE

Used in all modes to set card Vcc in 100 mV steps. Range is 1.6V to 5.5V.

In Analyse and Intercept mode the card Vcc will normally follow the terminal Vcc. Using this command, the card Vcc can be set to a different value, so that, for example, a 3V card can be used in conjunction with a 5V terminal. Issuing this command with parameter '0x0FF' will restore the coupling between terminal and card Vcc.

In Cardreader mode the default Vcc is 5.0V.

4.4.45 SET_VCC_THRESHOLD

Used in all modes to set the threshold level for 'Vcc On'. This setting affects the voltage at which the 'Vcc Present' event will be triggered, as well as the lighting of the front-panel Vcc LED.

Resolution is 100mV, *cf.* SET_SUPPLY_VOLTAGE.

The default setting is 2.4V. This is sufficient for use with 5V and 3V systems. For lower voltages, the setting should be adjusted accordingly. As a rule of thumb: 10-15% lower than the applied VCC voltage. For example, 1.6V would be a good setting for a 1.8V terminal.

4.4.46 SET_TIMESTAMP_EOT

Option to switches on/off Timestamp information on EOT. This command should be used with combination if timestamping is enabled in the box by SET_TIMESTAMP, a 16-bit Timestamp will be attached to end of the each message received from card or terminal.

This TimeStamp is sent at the moment when a timeout EOT is detected (depend on the Timeout EOT setting).

For example:

Assume box received a message contains N bytes from card, and this message will be sent to PC with two timestamps attached(namely, T1 and T2), then

$T2 - T1 = (N-1) * T_{char} + (10 + EOT) * T_{etu}$

Where:

T_{char} : the delay between the leading edges of two consecutive characters

EOT: the timeout value set by SET_TIME_OUT command

T_{etu} : one etu duration

Note: Above equation is true only if the end of the message is determined before a new message comes. If the timeout setting is too big, then T2-T1 will indicate the delay between the leading edges of the two consecutive MESSAGES.

4.4.47 GET_TIMESTAMP

Returns the current value of the Timestamp counter. This is the time elapsed since the last RESET_TIMESTAMPS command.

4.4.48 GET_MODE

Returns the current box mode.

0. Cardreader Mode
1. Intercept Mode
2. Analyse Mode

4.4.49 GET_PROTOCOL_TIMEOUT

Returns the value (in ms.) of the set timeout (see 4.4.10)

4.4.50 GET_SOFTWARE_VERSION

Returns the current firmware version. The first nibble is the Major version, the second nibble the Minor.

4.4.51 GET_DIVISION_RATE

Returns the set bitrate divisor (see 4.4.15 en4.4.16).

4.4.52 GET_TERM_STATUS

Returns presence (0xA1) or absence (0xA0) of card Vcc. In Analyse and Intercept Mode this can be used as an indication of whether or not a terminal is connected.

4.4.53 GET_CARD_STATUS

Returns the presence (0xB1) or absence (0xB0) of a card in the box' cardslot.

4.4.54 GET_CLOCK_FREQUENCY

Returns the frequency of the CLK, as measured (in Analyse and Intercept Mode) or as set (in Cardreader Mode).

4.4.55 GET_BAUDRATE

Returns the baudrate on the I/O line, as calculated using the clockfrequency and the set divisor (see 4.4.15).

4.4.56 GET_SUPPLY_VOLTAGE

Returns the voltage on Vcc, in 100 mV steps. In Analyse and Intercept mode this is the Vcc voltage coming from the terminal. In Cardreader mode it is the voltage presented to the card. (see 4.4.44).

4.4.57 GET_VCC_THRESHOLD

Returns the current threshold level for 'Vcc On', in 100mV steps. (see 4.4.45).

4.4.58 GET_ATR_CHARACTER_DELAY

Returns the value set by the SET_ATR_CHARACTER_DELAY command (see 4.4.19).

4.4.59 GET_GUARDTIME

Returns the value for Extra Guardtime (see 4.4.17).

4.4.60 GET_ATR1

Returns the string set for ATR1 (see 4.4.29), otherwise return 0 if ATR1 is not pre-loaded.

4.4.61 GET_ATR2

Returns the string set for ATR2 (see 4.4.30), otherwise return 0 if ATR2 is not pre-loaded.

4.4.62 GET_ATR_DELAY

Returns the value set by the SET_ATR_DELAY command (see 4.4.35).

4.4.63 GET_TIMEOUT_EOT

Returns the value set by the SET_TIME_OUT and SET_TIME_OUT_EXTENDED commands (4.4.20 and 4.4.22).

4.4.64 GET_CPLD_VERSION

This command returns the version number of the CPLD content as ASCII text in the form: "major.minor".

4.4.65 START_SOFTWARE_DOWNLOAD

This command is used to initiate the download of new firmware. The download protocol is described in a separate document.

4.4.66 START_CPLD_DOWNLOAD

This command is used to initiate the download of new CPLD content. The download protocol is described in a separate document.

4.4.67 PROGRAM_CPLD

This command is used to initiate programming of the CPLD. The protocol is described in a separate document.

4.5 Command replies

The following replies are specified in answer to commands from the driver to the box:

Reply	OpCode	Description
ACK	0x80	Command has been received and processed
Unknown Command	0xC8	An unknown command was received
Command Not Valid	0xC9	The command is not valid for the current mode (example "RESET_CARD" in Analyse Mode)
Constant Out Of Range	0xD0	The parameter was out of range (example "SET_PROTOCOL_TIMEOUT" with parameter 40)

Table 4-3 Command replies

5 APPENDIX

5.1 FCC Statement

Compliance statement (part 15.19)
This device complies with part 15 of the FCC Rules for a Class B digital device.
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.
Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This Class B digital apparatus complies with Canadian ICES-003.

Warning (part 15.21)
Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Please use only the supplied USB interface cable with a ferrite bead when connecting this device to a computer to avoid interference to radio and TV reception.