



NCB Protocol

Network Control Bus and RS-232 Protocol

User manual

Rev. 7

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Revision history

Current revision of this document is the uppermost in the table below.

Rev.	Repl.	Date	Sign	Change description
7	6	2010-03-10	NBS	Updated to Nevion manual template.
6	5	2008-04-22	NBS	Added more technical information; New Chapter 2, (3 and 4).
5	4	2007-11-15	NBS	New style; Added Sublime specific information.
4	3	2007-09-21	NBS	Replaced MIDI by NCB (where applicable).
3	2	2002-09-03	NBS	Replaced MIDI by NCB (where applicable).
2	1	2001-05-02	NBS	Corrected Chapter 1.2, removing ACKNOWLEDGE etc.
1	0	2001-03-01	NBS	Changed baud rate from 9600 to 19200 on RS 232 communication.
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1 1 Important notes regarding the Network Control Protocol

1.1 Binary Code

First of all: The VikinX RS-232 Protocol is *not* ASCII based. It is a binary protocol, thus it utilizes all 8 bits in each byte. The strings shown on the next pages are in binary coded format. Please be aware of the fact that any terminal program you may use to control a Network unit from a PC must be able to generate hexadecimal characters.

ASCII characters will not be accepted.

1.2 Echo

A matrix will reply on an X-point set command with an ECHO. In the case where an X-point is already set no ECHO will be sent. If the matrix is part of a NCB system an ECHO will be sent two times. Immediately after receiving the X-point set command the receiving matrix will send an immediate ECHO. The matrix will then wait for the command to pass the NCB system. When the message has passed the entire NCB system, another ECHO will be sent to indicate that all devices in the NCB system have been addressed.

1.3 RS-422 Matrixes

RS-422 Data Routers do not accept distribution of an input signal to several outputs. An input signal can only be routed to one single output. The Firmware of our RS-422 routers takes care of these limitations. If an input (Source) is already connected to a particular output (Destination) any connection of this input to another output will disconnect the previous connection. The router will in this case send the following message for the disconnected output: Output connected to input 128. Input 128 is an internal default for the disconnect status. Please see Network recommendations for use of RS-422 data routers for further information.

1.4 Timeout

The X-point Status Request message has a timeout, which means that you need to wait 1 second in between request messages.

1.5 Basic principles

Any message on any level that conforms to the standard arriving at either the NCB or the RS232 port will be re-sent on both NCB and RS232. The only exceptions are:

- a) A matrix that recognizes its level will not re-transmit the message if the X-point is already set.
- b) A matrix that recognizes its level will not re-transmit the message if the output number or input number exceeds its size. ***This does not apply to Sublime routers.***
- c) A unit (matrix or panel) will not re-transmit a message arriving at the NCB if it was re-transmitted a short while ago (typically 0.5 sec). This is done by grabbing a message, storing it for the timeout period, and comparing it with new messages. After the timeout period the unit will grab a new message for compare. This is done to remove unwanted (read: unknown) messages from the NCB ring.
- d) A message arriving at the RS232 will always be re-transmitted unless it is a matrix and one of the cases a) or b) is fulfilled.

1.5.1 Example: A single unit with no NCB connected

Messages sent to the RS232 of a single unit will be returned once no matter what level or input/output number the message has, unless it is a matrix which recognizes one of the conditions a) or b) above.

1.5.2 Example: Several units connected by NCB

Messages sent to the RS232 of a single unit will be returned once no matter what level or input/output number the message has, unless it is a matrix which recognizes one of the conditions a) or b) above.

If none of the cases a) or b) is fulfilled the message will also be transmitted on the NCB. Then if any unit on the NCB ring recognizes any of the cases a)/b) or c), the message will stop at that point. This means that the message will only be returned once on the RS232.

However, if none of the units on the NCB ring recognizes any of the cases a) to c), the message will return to the originator (the unit which received the message on RS232). This unit will re-transmit the message once more on both NCB and RS232. The message is therefore returned a second time on RS232. This time one of the cases a) or c) is sure to be identified by one of the units on the NCB ring, and the message is removed.

There is however one more special case: If several messages for unused levels are transmitted with only little delay, one might experience that some messages are returned several times, as the store/compare/remove function in case c) can only handle a single message at the time. We therefore recommend that the user avoid sending messages to unused levels.

1.6 RS232

The RS-232 port is used for external control of Network units. The RS-232 port allows the customer to control the equipment via Multicon¹, or self-defined customized solutions.

Connector for the RS-232 port is a DS9 female.

Pin 2 - Tx.

Pin 3 - Rx

Pin 5 - GND

A standard DCE (Data Communication Equipment) cable can be used for connection between PC and Network equipment. The connection between the connectors is made one-to-one.

Data-rate is 19200 baud/sec.

8 data-bit, 1 stop-bit, no parity.

1.7 NCB

The NCB is used for interconnection between several Network units. Up to 50 routers and/or control panels can be linked together to form a routing system with many operational features.

The NCB utilizes a 5 mA current loop with opto-coupled ports. Standard connector is RJ45.

Standard MIDI cables can be used to interconnect several Network units.

Data-rate is 31.25 Kbps.

1 start-bit, 8 data-bit, no parity, 1 stop-bit. Logical 0 = current ON.

¹ Or ETH-CON. See www.nevion.com for options.

2 Message structure

The basic structure of the protocol is adapted from MIDI, in conformity with the physical interface of the bus connection. But, except from that, the protocol is not a full MIDI protocol. It will be possible to let a MIDI sequencer run control of the routers via MIDI, but apart from that, NCB is not compatible to the MIDI standard.

Mainly, a 3-byte message is used, but sometimes a 2-byte message is used. The first byte in a message is always a “header”. The difference from the other bytes is that bit 7 (msb – most significant bit) is set high (1). Only the header byte must have msb set high, the other bytes must have msb set low (0).

The way the system is designed, it is easy to detect the start of a new message, as only the header may have msb=1.

We usually note the messages in a “hexadecimal” notation, where each byte is divided into two 4-bit blocks; each block may thus have a value between 0 and 15. This value is translated into a character. The corresponding numbers represents the values 0 – 9, while the values 10 – 15 are represented by the letters A – F. Hexadecimal notation often use the prefix “0x”, and sometimes the suffix “h”. This document uses the suffix “h”.

Taking into account the just mentioned limitations; we have the following legal values for headers and non-headers:

- Header; legal values: 80h – FFh
- Other (non-headers); legal values: 00h – 7Fh.

2.1 Three-byte messages

Header:

1	X	X	X	X	X	X	X
---	---	---	---	---	---	---	---

Byte 2:

0	X	X	X	X	X	X	X
---	---	---	---	---	---	---	---

Byte 3:

0	X	X	X	X	X	X	X
---	---	---	---	---	---	---	---

Where, X = 0 or 1.

Most of the message headers must have 2 following bytes, thus forming a 3-byte message. These headers are;

- 80h – BFh
- D0h – FFh

2.2 Two-byte messages

Header:

1	X	X	X	X	X	X	X
---	---	---	---	---	---	---	---

Byte 2:

0	X	X	X	X	X	X	X
---	---	---	---	---	---	---	---

Where, X = 0 or 1.

The following headers form the only exception from the 3-byte message structure:

- C0h – CFh

If such a header is received, just 1 following byte is expected, thus forming a 2-byte message. These are used for status requests, which are presented later.

2.3 Message types in present system

The message system is designed to address up to 16 different router levels. This has been achieved by using the last 4-bit block in the header to indicate which level is addressed. This is applied on most message types in the basic system for the NCB, while the more advanced amendments that has been introduced later, deviate from this. More details about this are given later in this document.

Header	Message function.
<i>VikinX Compact control protocol</i>	
90h – 9Fh	Audio X-point message, level 1 – 16.
A0h – AFh	Video X-point message, level 1 – 16.
C0h – CFh	Audio/Video status request ² .
F0h – FFh	THOR-CP commands, but also in use by <i>Revis</i> protocol.
<i>VikinX Sublime specific additions to the protocol</i>	
80h – 8Fh	Audio X-point Acknowledge message, level 0 - 15 (1 - 16).
B0h – BFh	Video X-point Acknowledge message, level 0 - 15 (1 - 16).
D0h – DFh	THOR-CP and Sublime commands.
E0h – EFh	Output locking.

2.3.1 Actions

A router that receives a message, as shown above, on its level (here: level means both address and video/audio level) will execute the routing command timely.

Any control panel that receives such a message on its level will update its indications (LED, GPI output).

Other units will ignore this message.

2.3.2 Reply / Forwarding

A router that responds to the message above will forward the message, if it is not identical to original status. The message will be removed from the NCB if the status is identical to the original status.

A control panel will check if shall forward, or remove the message, according to criteria given in Chapter 2.5.

All units that regard this message as being irrelevant will check the message, before removing it. Criteria for removing messages are given in Chapter 2.5.

2.4 Unknown messages

Any message that confirms to the general 3-byte message, or 2-byte message structure, but which is not recognized by any of the devices in the NCB loop, will be ignored and forwarded, after a check if the message must be removed, according to criteria given in Chapter 2.5.

Messages that do not confirm to the general structure, will be removed regardless, or will be shortened according to the 3-byte / 2-byte structure if they are too long.

2.5 Criteria for removing messages

Because the NCB loop is a closed loop where the messages pass in ring, it is essential that superfluous messages be removed as soon as possible.

The following set of criteria for removing messages is a made, in order to avoid unnecessary traffic on the bus, see also Chapter 1.5;

² The only two-byte message type.

- Routers remove X-point commands that are already executed.
- A status request message is not accepted too short after the previous status request.
- Any unit may remove repeating messages within short time.
- The device that generated the message *X-point Acknowledge*³ removes it when the message has passed the NCB loop.

Further explanation:

A router that receives an X-point command on its level (here: level means both address and video/audio level) that corresponds to its present status will always remove this command, and not forwarding it.

There will not be sent an echo either if it receives such a message directly, via RS-232. The same happens if the message contains an input- or output number that is higher than what is defined for the router, thus an illegal command.

Any router has a built-in timeout for status requests. When the router has sent its status, it will not accept a new status request before a certain time has elapsed. The new status request message is removed if it comes within this timeout. Analogous, if this request is sent directly to the current router, via RS-232, neither any echo, nor any other response will be sent.

This timeout is 1 second for VikinX products.

All units have a buffer for messages in order to check for fast repeating messages. This buffer can only contain 1 single message at a time, and the buffer is emptied after a certain time. This timeout is approximately 100ms. The message-check buffer is only applicable on the NCB, and not on the RS-232 port.

As soon as the buffer is empty the next message that is received by the router will be buffered for the given timeout, before it is forwarded on the NCB. All new messages are compared to this buffered message as long as the timeout is active. If the same message as the one in the buffer is resent within this timeout it will be removed, and not forwarded. The buffer is then emptied, and the process starts as soon as a new message enters the router. If the same message as the one in the buffer is not resent within the given timeout, the buffer is then emptied, and the process starts as soon as a new message enters the router.

2.6 Stand-alone panel via RS-232

The RS-232 port does not have any regular mechanism for removing messages, other than the first two criteria given above, when a control panel is using a direct RS-232 connection to the router (and not the usual NCB connection).

A special case has been developed in order to allow a single control panel be connected to a NCB router loop via a “0-modem” RS-232 cable (Rx/Tx crossed).

The single control panel must not have any NCB connected, in order for this to work.

If an NCB loop were connected to the control panel in addition to the direct RS-232 connection between panel and router(s), messages on the RS-232 port would not generate any echo. If the panel senses a valid message on its NCB port, it goes into normal operation and generates an echo on the RS-232 port. Messages will then jump back and forth between the two NCB loops infinitely, thus blocking the communication.

³ Only applicable to Sublime routers (and Triton routers).

3 VikinX Compact commands

3.1 Audio X-point set

Only for use with audio routers.

Command for setting of audio X-points:

Header: 0x9n

1	0	0	1	Address
---	---	---	---	---------

Byte 2:

0	Output
---	--------

Byte 3:

0	Input
---	-------

Where;

- Address (n) can be 0 – 15, corresponding with level 1 - 16
- Output is the number of the output that shall be controlled, ranging from 00h – 7Fh representing outputs 0 – 127 (= 128 outputs)
- Input is the number of the input that shall be connected to the chosen output, ranging from 00h – 7Fh, representing inputs 0 – 127 (= 128 inputs)

3.2 Video X-point set

Only for use with video routers.

Command for setting of video X-points:

Header: 0xA_n

1	0	1	0	Address
---	---	---	---	---------

Byte 2:

0	Output
---	--------

Byte 3:

0	Input
---	-------

Where;

- Address (n) can be 0 – 15, corresponding with level 1 - 16
- Output is the number of the output that shall be controlled, ranging from 00h – 7Fh representing outputs 0 – 127 (= 128 outputs)
- Input is the number of the input that shall be connected to the chosen output, ranging from 00h – 7Fh, representing inputs 0 – 127 (= 128 inputs)

3.3 X-point status request

This command is used for status request on both audio and video routers.

Command for status request:

Header: 0xC_n

1	1	0	0	Address
---	---	---	---	---------

Byte 2:

0	No information carried here (normally 00h, but no function associated with it)
---	--

Where;

- Address can be 0 – 15, corresponding with level 1 - 16

The requested router (Audio or Video) will send its X-point status on NCB OUT and RS232. The same command format as for X-point set is used.

3.3.1 Actions

None.

3.3.2 Reply / forwarding

A video- or audio router that receives a message, as shown above, on its level, will reply with its entire X-point status, by means of video- or audio X-point messages from first till last output number. After that, the router will forward the status request message on the NCB. There are exceptions, given in Chapter 2.5.

A control panel will check if shall forward, or remove the message, according to criteria given in Chapter 2.5.

All units that regard this message as being irrelevant will check the message, before removing it. Criteria for removing messages are given in Chapter 2.5.

4 NCB extensions for Sublime routers

The following commands are added to the NCB protocol to support the extra features introduced in the *VikinX Sublime* router range. None of these features are available with *VikinX Compact* routers.

4.1 Commands

4.1.1 Audio X-point acknowledge

Only for use with audio routers.

Command for acknowledge setting of audio X-points:

Header: 0x8n

1	0	0	0	Address
---	---	---	---	---------

Byte 2:

0	Output
---	--------

Byte 3:

0	Input
---	-------

Where;

- Address can be 0 – 15, corresponding with level 1 - 16
- Output is the number of the output that shall be controlled, from 0 – 127 (= output 1 – output 128)
- Input is the number of the input that shall be connected to the chosen output, from 0 – 127

4.1.2 Video X-point acknowledge

Only for use with video routers.

Command for acknowledge setting of video X-points:

Header: 0xBn

1	0	1	1	Address
---	---	---	---	---------

Byte 2:

0	Output
---	--------

Byte 3:

0	Input
---	-------

Where;

- Address can be 0 – 15, corresponding with level 1 - 16
- Output is the number of the output that shall be controlled, from 0 – 127 (= output 1 – output 128)
- Input is the number of the input that shall be connected to the chosen output, from 0 - 127

4.1.3 Output locking

This command is used to lock an output. A locked output cannot be switched to another input.

Command for locking an output:

Header: 0xEn

1	1	1	0	Address
---	---	---	---	---------

Byte 2:

0	Output
---	--------

Byte 3:

0	Ack	Request	A/V	Future use	Lock
---	-----	---------	-----	------------	------

Ack	Request	Message type
0	0	Command
0	1	Request
1	0	Acknowledge / Response
1	1	Undefined

Bit	Usage
Ack	Lock/unlock acknowledge from router
Request	Locking request
A/V	Audio/Video selection; 0 = Video / 1 = Audio
Lock	Locking flag; 0 = unlocked / 1 = locked
Future use	Future use; set to 0.

4.1.4 Router request

This command is used to get information about the routers. The command can be sent with four different data types, one for sending a request and three for sending responses. When a router receives a request, it responds with three commands, one for each response type, and then repeating the command.

A router will not accept more than one request on each level for each 100ms. If a new request is received before this timeout, no responses are transmitted and the command is not repeated. This will prevent requests from looping on the bus.

When a router receives a response that could have been generated by itself, it is not repeated. When it receives a response that couldn't have been generated by itself, it is repeated. This will prevent responses from looping on the bus.

Command for router request:

Header: 0xDF

1	1	0	1	1	1	1	1
---	---	---	---	---	---	---	---

Byte 2:

0	Data type	A/V	Address
---	-----------	-----	---------

Bit	Usage
A/V	Audio/Video selection; 0 = Video / 1 = Audio

Data type:

Value	Type
0	Input
1	Output
2	Format
3	Request

Byte 3, when Data type is *request*:

0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

Byte 3, when Data type is *input*:

0	Highest possible input number (=router size-1)
---	--

Byte 3, when Data type is *output*:

0	Highest possible output number (=router size-1)
---	---

Byte 3, when Data type is *format*:

0	Disconnect	Format
---	------------	--------

Disconnect:

Value	Description
0	The router does not support disconnect
1	The router is using input 127 (128) to disconnect an output

Formats:

Format number	Format description
0	Analogue Video
1	SD-SDI Video
2	HD-SDI Video
3-7	Reserved
8	Analogue Audio
9	AES Audio
10-15	Reserved
16	Ported RS-422 Data router
17	XY-oriented RS-422 Data router
18-63	Reserved