NMD 100

Communication & Command Reference Manual
2001-30 Code

Doc No. 8030789/6-E
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1 Introduction

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1.1 Purpose

This document describes the application, session, data link and physical layer of the communication protocol implemented in the NMD.
The protocol is an emulation of the MDDM SD300 01-65 firmware.
The document is intended as a reference for system analysts and developers involved in the task of integrating NMD into dispensing automation products.

1.2 Overview

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1.3 Versions

This document is valid from the following firmware configuration.

CMC	2001-30.06
RVC	2007-02.08 / 2037-01.01
NFC 100	2006-03.16, 2006-03.18 or
NFC 101	2006-04.01 or
NFC 200	2006-05.02 or
	2006-10.01 for NF 300
NCC	2007-02.08

1.4   Definitions and Conventions

1.4.1 Firmware version code

The six digit Firmware Version code, XXXX-YY.ZZ, is explained and changed as follows:

XXXX   =   Program Type. The two last digits indicate the
                    module, hardware compatibility and functionality of
                    the firmware.
                    XXXX= 2001 for NMD Central Machine Controller firmware
                    SD 300 emulation.

YY   =   Version Number. This number changes when new features or
                    major functional changes have been made
                        For example:
                        New format of Command or Reply.
                        Limited function of Command.
                        Not compatible with old hardware or if the program is not
                        compatible because of other major changes.

ZZ   =   Revision Number Changed when the program has been
                    updated or corrected. The release is fully compatible with
                    previous revisions

1.4.2 Conventions in this Manual:

Throughout this manual we will refer to standard ASCII characters enclosing them within brackets, meanwhile their internal hexadecimal value will be represented between inverted commas preceded by letter X.

Example:
The character combination 0A (zero and a letter A)

Hex. Value.....................X'30'X'41'

1.4.3 Vocabulary

ATM	Automatic Teller Machine
BCU	Bundle Carriage Unit
BOU	Bundle Output Unit
CAN	Controller Area Network, a local area network
CCA	Cassette Communication Adapter
CMC	Central Machine Controller
DE	Denomination Extension
FR	Frame
FS	Front Service, referring to cassette service side is on same side as note exit side (front).
FW	Firmware
I/F	Interface
MDDM	Multi Denomination Dispense Mechanism
NC	Note Cassette
NCC	Note Cassette Controller
ND	Note Diverter
Network	The external device where the application for the NMD is executed. The "network" could be a Host, a Terminal controller or a Personal Computer
NFC	Note Feeder Controller + FW included/
NF	Note Feeder
NMD	Notes and Media Dispenser
Note	With "note" is, besides banknote, also referred to other documents as value document etc. that is handled by the modules within the NMD.
NQ	Note Qualifier
NS	Note Stacker
PS	Power Supply
RS	Rear Service, referring to cassette service side is opposite to note exit side (front).
RVC	Reject Vault Controller
SPC	Stack Presenter Controller
SP	Stack Presenter

1.5 MDDM SD300 emulation

The 2001-30.zz firmware is emulating the MDDM 300 firmware 01-65.aa, however there are some differences, which will be explained in this chapter. Observe, only differences are explained.

RESET

This command is fully supported, but the maximum execution time is changed from 20s to 180s. A reset command and power on reset should retract possible notes in the bundle output unit.

DISPENSE

The command is not supported.

DELIVER

This command is fully supported but the execution time is either 20s or180s. Select with Data Item 224.

REJECT

This command is fully supported, but the maximum execution time is changed from 20s to 180s. A reject command will like in MDDM 300 not be accepted with notes in the bundle output unit.

LAST DISPENSER STATUS

The command is not supported

LIFT DOWN

This command is fully supported, but the maximum execution time is changed from 20s to 180s. The command name is changed to CLOSE CASSETTE.

LIFT UP

This command is fully supported. The command name is changed to OPEN CASSETTE.

READ TRACE

The command is supported, but there are two more reject reasons compared with the MDDM 300, Internal Reject and Thin Note.

CHECK THROAT

The command is supported. The command name is changed to CHECK BUNDLE OUTPUT UNIT.

START LOCKTIMER

The command is not supported

ALARM

The command is not supported

CONFIGURE

The command is not supported

READ PROG ID

The command is supported. The response is changed to allow for the new program ID format.

RETRACT

This command is fully supported, but the maximum execution time is changed from 20s to 180s.

SEND SELF TEST DATA

The command is supported, but the response message is completely changed.

SUB DATA TRANS

The command is not supported

DEFINE NOTE SIZE

The command is not supported. READ and WRITE commands introduced will give the possibility to define and read note size.

Z COMMAND

The command is not supported. The equivalent functionality is implemented through READ and WRITE commands.

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2 Physical description

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The purpose of this section is to provide the readers of this manual with the general information about the NMD hardware and its function. It is not a full comprehensive manual of that subject.

Control structure
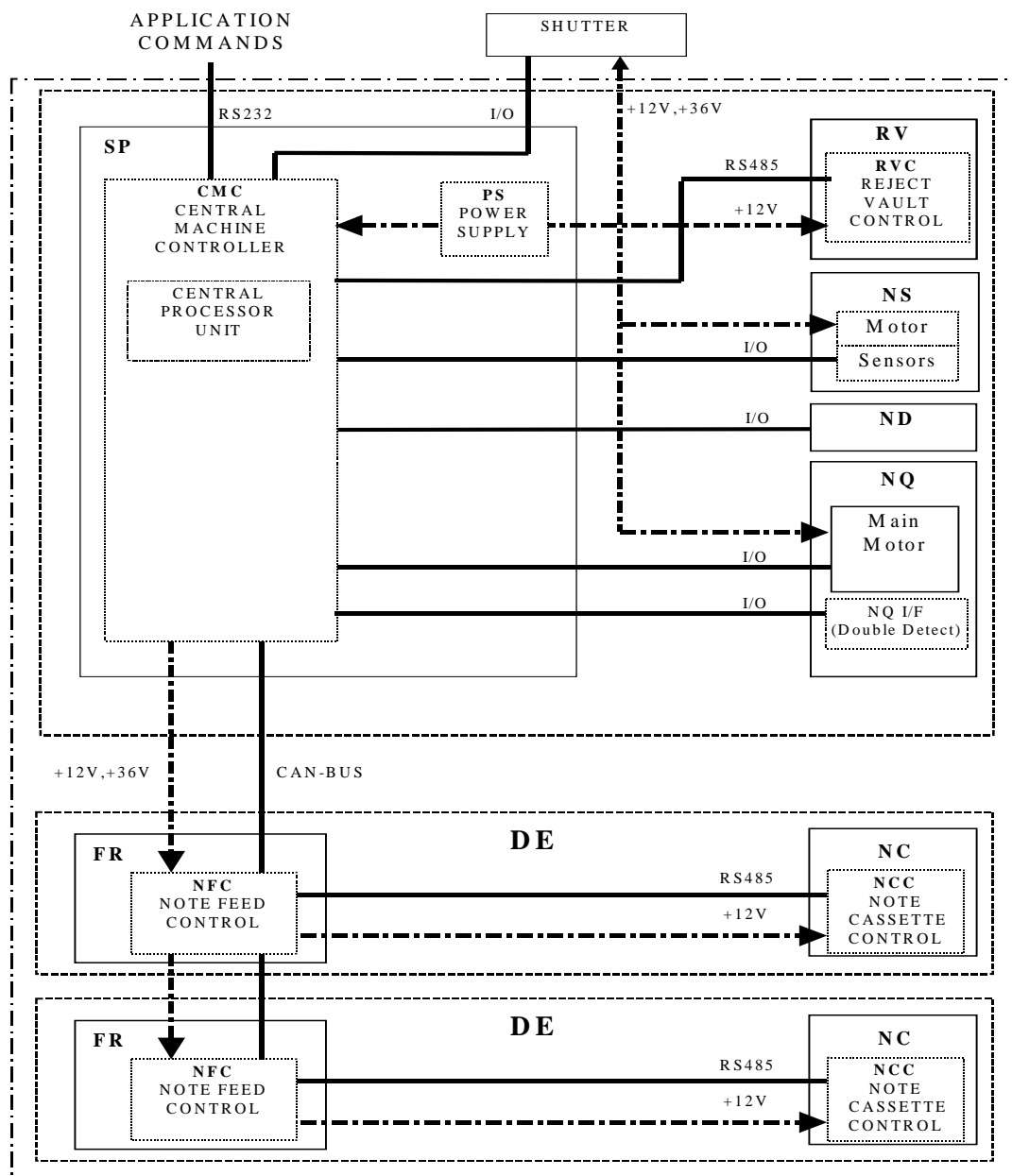
2.1 Description of sensors in the Stacker Presenter

Exit and Empty BOU sensor

BCU

Delivery sensor

2

Reject sensor

1

5

3

4

Detects Hold and Delivery positions

Home sensor
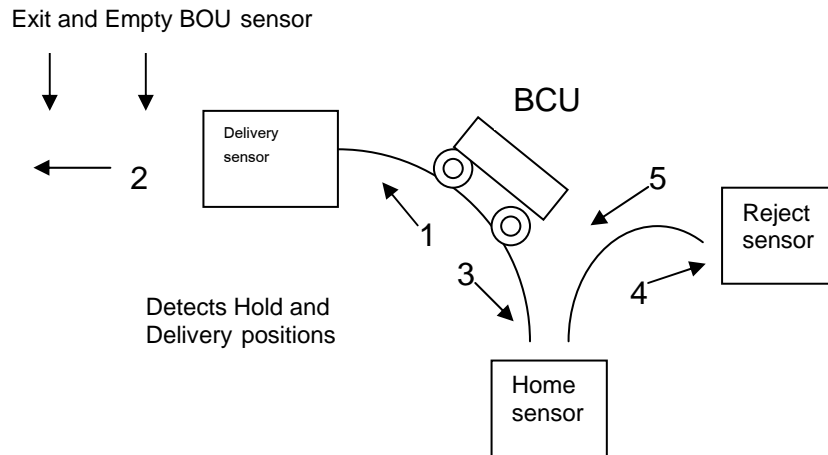
2.1.1 The movement of the BCU

The movement of the BCU could be divided into five different movements

1. From Home position to Hold position. Hold position is when the BCU has reached the Delivery sensor but before expansion. The shutter is not opened in this position.
2. Form Hold position to Delivery position
3. From Delivery position to Home position.
4. From Home position to Reject position.
5. From Reject position to Home position

3 Logical description

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3.1 Dialogue procedures

The NMD Controller is designed to be operated under the control of an external device. We will refer to this device as the NETWORK.
From the logical point of view, the NMD Controller cannot perform any operation without receiving a COMMAND from the Network.

After receiving a COMMAND, the NMD Controller will try to execute it, sending back to the network the adequate STATUS REPLY, regardless of whether the operation has been successfully executed or not.

On the other hand, the NMD will never send any message to the Network, unless it had been previously activated by a command.

The dialogue procedure between the NMD and the Network is always established in PAIRS OF MESSAGES, which must be initiated always from the Network.

Figure 3.1: Dialogue procedure
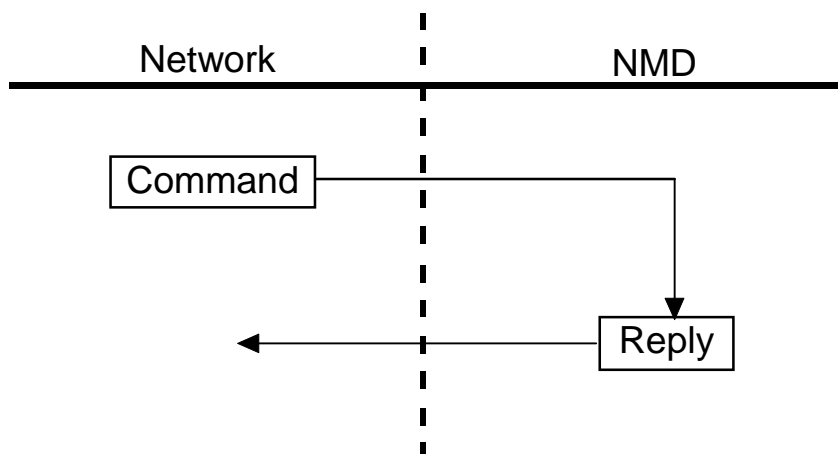
3.2   Commands overview

Possible commands available to handle the system are listed below. However, not all of them are strictly required for common operation at the user site. Each one of the commands is identified by an operation code, 1 byte long, in Hex code.

For everyday normal operation, only 5 commands are strictly required. These are:

X'32' ………. MOVE FORWARD
X'33' ………. DELIVER
X'35' ………. READ CASSETTE-ID.
X'37' ………. CLOSE CASSETTE
X'38' ………. OPEN CASSETTE

Any Application Program to drive the NMD should always begin the "Start-of-day" procedure by sending to the system an "Activation Routine", which basically consists of two commands: the X'38', OPEN CASSETTE, to put the Cassettes in operating position, and then the X'35', READ CASSETTE-ID, to read the Cassette numbers.

X'38' ………. OPEN CASSETTE
X'35' ………. READ CASSETTE-ID

Each transaction will imply sending an order to dispense the notes and deliver it to the tellers, issuing the X'32' MOVE FORWARD and a X'33' DELIVER command.

At the end-of-day procedure, a X'37' CLOSE CASSETTE, command must be sent, in order to unload the Cassettes

3.3 Status reply overview

As stated in paragraph 3.1, the dialogue procedure between the NMD and the network, is established in pairs of messages. That means that each one of the commands issued to the system will send its own REPLY STATUS MESSAGE back to the network.

In general terms, each reply message contains three different types of information:

- *General status code*
- *Hopper status code*
- *Relevant information data*

The *General status code* tells the network what the final result of the transaction has been. It is a 1 byte ASCII character, at the beginning of the reply message.

The *Hopper status code* gives information about the particular situation of each one of the different hoppers. It is also a 1 byte ASCII character, with the same coding as the General Status; so as to make its interpretation easy. Depending on the replying message, the *hopper status*es are located in different positions.

The *information data*, when necessary, gives detailed information as required by the corresponding command, like Cassette *ID-numbers*, number of notes dispensed from each hopper, and so on.

The *status codes* itself, both General and Hopper ones, provide the user with several kinds of information:

- Successful operation.
- Hardware problems.
- Software problems.
- Operation mistakes
- Communication problems.
- Cassette situation.

A detailed description of all the different *status codes* can be found in Section 5 of this manual.

Some status codes can only appear when some of the special options for the NMD are installed.

3.4   Coding of Note Cassette/Reject Vault

Each Feed Cassette is identified by a unique ID-number.

The first time a cassette is used, it must be programmed with its own ID-NUMBER, as explained below. This is normally done at manufacturing.

Throughout this manual we will be making references to the cassettes ID-NUMBERs and also to the Hopper numbers. It's extremely important to clearly understand both concepts. The ID-NUMBER has a 5 digits code.

Because of their electronic identification capability, the note cassettes can be loaded in any Feed Module. As we will see in detail later on, the notes dispense commands refer to the different Feed Modules. Therefore, it will always be necessary to set up a correspondence between each Feeder and the cassette it contains. This is what the Hopper Number is used for.

Each one of the different modules installed in the system; no matter if they are Note Stacker/ Stack Presenter or Note Feeder is defined as a Hopper. Each Hopper will be internally identified by a one-digit code, which will be the Hopper Number. The first Module in the System is always the Stacker Presenter. It will be reported as Hopper Number 0. The following modules are connected in series to the Stacker, and they will be Feeders. The first Feeder connected will be reported as Hopper Number 1, the second Feeder as Hopper Number 2, and so on. Usually, the Feeders are connected in the same order they physically are positioned in the frame, however this is not required.

Hopper 0 will always hold the Reject Vault.

Coding cassettes in the NMD

Insert a Cassette in the Frame. Do not open the Cassette. The NMD mechanism will automatically latch the cassette to the Note Feeder at the first command changing the cassette coding. When cassette coding has been finished a command X'37' Close Cassette has to be issued to unlatch the cassette. The cassette has then to be removed and reinserted in the mechanism before it can be used for normal operation.

Currency/denomination cassette ID and Note size parameters

These parameters can either be set or changed with the CCA 100 or as described here in the NMD-machine with machine level commands Read/Write Data:

WD/9H27 for Currency/Denomination,
WD/9H28 for Cassette Id and
WD/9H29 for Note size.

H is the location (Hopper number):
Stack Presenter SP/Reject Vault = 0, Note Feeder/Note Cassette =1-8.

For more details see Read Data and Write Data in chapter 4.

3.5   Interpretation of CMC200 LEDs

There are three modes in the NMD that are shown by the two LEDs on the CMC 200.

Start-up

Both LEDs are lit up while the CMC200 is starting up.

Machine is operational

One LED is flashing with a frequency at about 1 Hz.

Error detected

When some kind of error is detected in the machine, an internal error code is set and then mapped into an adequate SD300 status code that is sent to the network. To give more detailed information about the error the two LEDs are flashing the internal error-code, which consist of a task number and a code.

The internal error-code sequence is initiated when both LEDs are lit for 1 sec. Then the task number is flashed, starting with the number of tenths on the first LED and then the number of units on the second LED. There after are both LEDs flashed as delimitation and the code is flashed in the same manner as the task number.

The task numbers and codes are described under 'Command X'51'   CHECK NMD STATUS', page60.

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4 Command and reply structure

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4.1 Data transmission

Communication between the NMD and the external network is performed through a standard V.24 port.

As we already have stated, the dialogue procedure is always performed in the same simple way: pairs of COMMAND-REPLY messages. Optionally using the standard V24 timing signals. Detailed information about ASCII character set and signal timing see section 6.

4.1.1 Message format

Commands format

The commands sent from the network to the NMD must conform to the following format:

C   DDD...   LL   E

Where:

C	=	OPERATION CODE	1 or 2 Bytes
D	=	DATA	0-250 Bytes
L	=	LRC	2 Bytes
E	=	EOM	1 Byte

The Operation Code can be any of the codes we already described in paragraph 3.2.

The DATA Field is only required when using Commands:

X'32'	MOVE FORWARD
X'44'	RETRACT
X'47'	SEND SELFTEST DATA
X'52' X'44'	READ DATA
X'57' X'44'	WRITE DATA

The LRC Field, Longitudinal Redundancy Check, is always two bytes long. It is used internally to test the accuracy of the received data. How to calculate it, is explained in paragraph 6.5.

The EOM Field is the End of Message indicator, and ASCII <CR>, hexadecimal X'0D' will be used.

Status reply format

The status reply messages sent back to the network from the NMD, will always conform with the following standard format:

S DDD... LL E

Where:

S	=	STATUS	1 Byte
D	=	DATA	0-250 Bytes
L	=	LRC	2 Bytes
E	=	EOM	1 Byte

The Status Code is 1 Byte ASCII character, which tells the network what the result of the executed transaction has been. This field is the General Status Code described in paragraph 3.3. The particular status of each hopper comes, when relevant, as part of the DATA Field.

The LRC and EOM Fields have the same values, lengths and meanings of those already explained in the preceding paragraph.

More detailed information about the status codes will be given in Section 5 of this manual.

Longitudinal Redundancy Check

In order to verify the accuracy of all transmitted data, both COMMANDS and STATUS REPLY MESSAGES, must include, before the EOM character, the LRC bytes. These two characters are automatically calculated and included by the Controller in the Status Reply Message sent to the network. It is the responsibility of the network to include them in the commands sent to the NMD.

The LRC is a logical algorithm is explained in section 6.5

4.2 Commands overview.

Possible commands available to handle the system are listed below. Each one of the commands is identified by an operation code, 1 byte long, in Hex code. Below follow a list with a full set of commands available and recommended time outs in application program:

OPERATION CODE	MNEMONIC	COMMENTS	MAX TIME TO EXECUTE
X'30'	RESET	Resets the internal status in the CMC and in the Note feeders, and performs a reject sequence to clear the system. Max time selectable with item 239.	20 or 180 sec
X'32'	MOVE FORWARD	Picks up the requested number of notes, moves forward into the Stacker.	180 sec
X'33'	DELIVER	Delivers to the notes, which have been stored in the Stacker by the previous MOVE FORWARD command. Max time selectable with Data Item 224.	20 or 180 sec
X'34'	REJECT	Rejects the notes, in stacker, to the Reject Cassette.	180 sec
X'35'	READ CASS-ID.	Reads the Id of the cassettes that have been inserted into the NMD.	20 sec
X'36'	CHECK DELIVERED NOTES	Reads the number of notes delivered from each feeder	20 sec
X'37'	CLOSE CASSETTE	Close and release the Note Cassettes so that they can be taken out. Max time selectable with item 239.	20 or 180 sec
X'38'	OPEN CASSETTE	Latch and opens the Cassettes to make them operational so that the notes can be picked.	180 sec
X'39'	READ REJECT TRACE	Sends the Reject Trace Area that contain the last 15 reject reasons.	5 sec
X'3A'	CHECK BUNDLE OUTPUT UNIT	Tests if there is any note left in the Bundle output unit.	5 sec
X'41'	READ PROG-ID.	Reads the Program Identification of the firmware version installed in the CMC.	5 sec
X'44'	RETRACT	Retract notes in throat and optionally rejects them.	180 sec
X'47'	SEND SELFTEST DATA	Performs and reports the result of internal self-test.	20 sec
X'4B'	RESEND LAST MESSAGE	Resend last reply message.	5 sec
X'51'	CHECK NMD STATUS	Check the status of the entire NMD	20 sec
X'53'	CHECK STACKED NOTES	Reads the number of stacked notes from each feeder after a MOVE FORWARD command	20 sec
X'52' X'44'	READ DATA	Read Data Item	20 sec
X'57' X'44'	WRITE DATA	Write Data Item	60 sec

4.3   Commands and replies description

In this section is each one of the different commands available for the NMD be described in full detail.

A reference is made to the different status codes, which can appear in each one of the commands. However a full description of those statuses will be given in Section 5 of this Reference Manual.

In this section there will be references to the following two groups of commands:

Movement Commands:

X'30'	RESET
X'32'	MOVE FORWARD
X'33'	DELIVER
X'34'	REJECT
X'37'	CLOSE CASSETTE
X'38'	OPEN CASSETTE
X'44'	RETRACT

Non-Movement Commands:

X'35'	READ CASSETTE-ID
X'36'	CHECK DELIVERED NOTES
X'53'	CHECK STACKED NOTES
X'39'	READ REJECT TRACE
X'3A'	CHECK BUNDLE OUTPUT UNIT
X'41'	READ PROG-ID
X'47'	SEND SELFTEST DATA
X'4B'	RESEND LAST MESSAGE
X'52' X'44'	READ DATA
X'57' X'44'	WRITE DATA

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Command *X'30'* *RESET*

Command Message String:

C LL E

Where: C = Command Code, X'30'.
            L = LRC
            E = EOM Character.

Reply Message String:

S HFNNN HFGGGGG ..... LL E *or* S LL E

Where: S = General Status Code.
            H = Hopper Number.
            F = Hopper Status Code.
            N = Number of notes rejected during the reset sequence.
            G = Cassette ID-Number.
            L = LRC
            E = EOM Character.

Notes: The field HFGGGGG is repeated for each Cassette loaded in the system, except for the Reject Cassette.

The data NNN for HOPPER number X'30' contains the number of notes counted by the Note Qualifier during the reset sequence. Feed Cassette will have HOPPER numbers X'31' - X'38' and the ID-number range from 00001 - 99999.

If S = X'3A' "CASSETTE NOT PROPERLY INSTALLED" or if S = X'3F' "REJECT VAULT NOT PROPERLY INSTALLED" only hoppers with status X'3A' and/or status X'3F' will be reported. The Cassette ID-Number will be set to 00000 since it is not possible to read the cassette number in this situation. Other hoppers with cassettes installed won't be reported until the status is cleared. If only the Reject Vault is inserted X'3A' is not reported as return code.

The second alternative message format (SLLE), will be sent if a LOCK-OUT condition occurs or if status code X'37' TRANSMISSION ERROR, X'38' ILLEGAL COMMAND or X'4E' COMMUNICATION TIMEOUT occurs. (Refer to Section 5).

Command Description:

When a fatal error has occurred (See Section 5), the system will only accept either the X'30' RESET, X'37' CLOSE CASSETTE or Non-Movement commands. Any other command will cause the NMD to send the same fatal status message reply.

The RESET Command is only intended for use after a note jam, lock-out or any other fatal error condition. Therefore, it should be used outside of the normal daily operation, in such a way that it is not easy for the operator to issue it without special supervisor authorisation.

A remaining note in the transport path will be single rejected during the reset. The general status will be Successful Command and the reject reason will be Incorrect Count

Command Time out:

The recommended time out for this command is 180 seconds.
It is possible to select a shorter time-out (20 s) with Item 239.

Status Codes:

Table 5-1 shows a cross-reference of the different status codes.

Command X'32' MOVE FORWARD

Command Message String:

C T HDDD HDDD .... LL E

Where: C = Command Code X'32'.
             T = Not used, must always be X'30'.
             H = Hopper number, X'31' to X'38'
             D = Number of notes to pick up from this hopper. (3 digits).
             L = LRC
             E = EOM Character.

Reply Message String:

S HFNNN HFNNN HFNNN ..... LL E *or* S LL E

Where: S = General Status Code.
             H = Hopper number, X'30' to X'38'.
             F = Hopper Status Code.
             N = Number of notes fed from this hopper, rejects included.
             L = LRC
             E = EOM Character.

Notes: The field HFNNN is repeated for each hopper dispensed from and / or for each hopper having some relevant information. Hopper number zero will always be the first one. For this hopper, the NNN field contains the total number of notes, which have been passed the Note Qualifier including single rejects.

The second alternative message format (SLLE) will be sent if a LOCK-OUT condition is present when the command is received. A LOCK-OUT condition occurring during execution will report with the first alternative message. The short message format will also be sent if status code X'37' TRANSMISSION ERROR, X'38' ILLEGAL COMMAND or X'4E' COMMUNICATION TIMEOUT occurs. (Refer to Section).

No notes will be dispensed on a short answer (S ll e) .

Command Description:

This command picks up the requested number of notes from the specified feed modules, forwarding through the Note Stacker into the Bundle Carriage in the Stack Presenter Unit.

If an error is detected the note is diverted into single reject area in the Reject Vault. If single reject occurs the NMD will try to fulfil the requested number of notes from the actual feeder before starting to feed from the next. The number of times the NMD tries to fulfil the requested notes from each feeder is depending on the requested number, but at least five times.

The Move Forward command can be configured to move the Bundle Carriage Unit with the note bundle to a hold position near the Bundle Output Unit (Item 208) .The default setting is that the Bundle Carriage Unit stays in the stacking position after a successful Move Forward.

To move the notes from the stacking area, use one of the commands X'34' REJECT or X'33' DELIVER.

The reply message includes information about the actual number of notes picked from each Cassette, as well as their particular status. Feed Modules with low-level status not addressed and Feed Modules with 0 note requests will also have its status reported (If item 211 (Status on Non Addressed Feeders) is set to 1). Hopper number 0 data will inform about total number of notes that have been passed the Note Qualifier including single rejects.

Multiple X'32' MOVE FORWARD Command requesting notes will not be executed, and the system will reply with the status code X'38' ILLEGAL COMMAND.
The command can be issued with all note feeders addressed, but with a total of zero notes requested. All feeders addressed will give a response. Addressed non-existing feeders and feeders without cassettes will answer with status X'3A' NOTE CASSETTE NOT PRESENT.

If the same command is repeated but notes are requested from at least one feeder non existing feeders and feeders without opened cassettes will answer with status X'30' SUCCESSFUL COMMAND in the hopper status position.

The default maximum number of notes in a transaction is 100.
(The maximum number of notes in a transaction can be limited with item 104). Requesting more will cause the status X'42' TOO MANY NOTES REQUESTED to be sent to the network.

To be sure that the command response will be sent in the stipulated time a time out has been added. If the time out occurs the transaction will be stopped and the notes in the stacker rejected. The response will be X'36' FAILURE TO FEED.

Command X'32'   MOVE FORWARD

If 'Change over' option is enabled (Item 127 is set to 1) the addressed feeders as well as the feeders used to fulfil the transaction will report there status and number of notes picked from each cassette. The addressed feeders that become empty during the transaction will report X'32' EMPTY CASSETTE as hopper status, but the general status will X'30' SUCCESSFUL COMMAND or X'31' LOW LEVEL if the transaction is fulfilled successfully.

Command Time out:

The recommended time out for this command is 180 seconds.

Status Codes:

Table 5-1 shows a cross reference of the different status codes.

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Command *X'33'   DELIVER*

Command Message String:

C LL E

Where: C = Command Code, X'33'.
         L = LRC
         E = EOM Character.

Reply Message String:

S LL E

Where: S = General Status Code.
         L = LRC
         E = EOM Character.

Command Description:

This command is used to complete an X'32' MOVE FORWARD Command. On receiving it the NMD will move the bundle of notes from the stacking area to the Bundle Output Unit (BOU).

Opening of the Shutter will precede the presentation of notes in the BOU.

If the notes are not removed from the BOU within 1.5 minutes, the NMD controller will start an automatic retract sequence to remove the notes.
The notes will be retracted and dumped in the bundle reject area in the Reject Vault when using default settings. The Shutter will be closed if the removal of the notes were successful. This automatic retract can be disabled by Item 203. The time out may also be set with Item 204.

This command will only be executed when issued following an X'32' MOVE FORWARD command, there must be notes waiting in the Bundle Carriage. If not, the NMD will reply to the network with the status X'38' ILLEGAL COMMAND.

Command Time out:

The recommended time out for this command is 180 seconds.
It is possible to select a shorter time-out (20 s) with Item 224.

Status Codes:

Table 5-1 shows a cross reference of the different status codes.

Command X'34'   REJECT

Command Message String:

C LL E

Where: C = Command Code, X'34'.
         L = LRC
         E = EOM Character.

Reply Message String:

S LL E

Where: S = General Status Code.
         L = LRC
         E = EOM Character.

Command Description:

This command can be used to complete the X'32' MOVE FORWARD command. On receiving it, the NMD will send the bundle of notes, which are waiting, in the stacking area, into the bundle reject area in the Reject Vault.

Command Time out:

The recommended time out for this command is 180 seconds.

Status Codes:

Table 5-1 shows a cross reference of the different status codes.

Command *X'35'   READ CASSETTE ID*

Command Message String:

C LL E

Where: C = Command Code, X'35'.
         L = LRC
         E = EOM Character.

Reply Message String:

S HFGGGGG HFGGGGG .... LL E *or* S LL E

Where: S = General Status Code.
         H = Hopper Number, X'30' TO X'38'
         F = Hopper Status Code
         G = Cassette ID-Number.
         L = LRC
         E = EOM Character.

Notes: The field HFGGGGG is repeated for each Cassette loaded in the system.
The Reject Vault have HOPPER number X'30' and Note Cassettes will have HOPPER
number X'31' - X'38' and the ID-number range is from 00001 - 99999.

If S=X'3A' "CASSETTE NOT PROPERLY INSTALLED" or if S=X'3F' "REJECT
CASSETTE NOT PROPERLY INSTALLED" only hoppers with these status will be
reported. The Cassette number reported will be set to 00000 since it is not possible to
read the cassette numbers in this situation. Other feeders with cassettes installed
cannot be reported until status is cleared. If only the Reject Vault is inserted X'3A' is
not reported as return code.

The second alternative message format (SLLE), will be sent if status code X'37'
TRANSMISSION ERROR, X'38' ILLEGAL COMMAND or X'4E' COMMUNICATION
TIMEOUT occurs.

Command Description:

This command reports the Cassette ID-numbers from all of the Cassettes inserted in the NMD, including the Reject Vault.

The Reply Message will provide the Application Program, with the identification codes of all the Cassettes loaded in the system. Cassette numbers will appear in the natural sequence of the hopper numbers, always beginning with Hopper 0, the Reject Vault. (Further information about Cassette ID-Numbers and HOPPER Numbers; can be found in paragraph 3.4)

This command must be used whenever the Cassettes have been or could have been changed. In order to avoid any possible misunderstanding about the denomination of the notes loaded in each hopper, the NMD does not allow any dispense operation (Command X'32' MOVE FORWARD) unless this command has been issued after the X'38' OPEN CASSETTE Command.

It is not possible to see if the cassettes are opened or not. The answer string is exactly the same for opened cassettes and cassettes that is only inserted in the NMD.

Fatal errors can not occur on this command, only remaining fatal errors that has occurred in a previous command are reported

Command Time out:

The recommended time out for this command is 20 seconds.

Status Codes:

Table 5-1 shows a cross reference of the different status codes.

Command *X'36'   CHECK DELIVERED NOTES*

Command Message String:

C LL E

Where: C = Command Code X'36.
         L = LRC
         E = EOM Character.

Reply Message String:

S HFNNN HFNNN HFNNN ..... LL E *or* S LL E

Where: S = General Status Code.
         H = Hopper number, X'30' to X'38'.
         F = Hopper Status Code.
         N = Number of notes delivered from this hopper.
         L = LRC
         E = EOM Character.

Notes: The field HFNNN is repeated for each hopper dispensed from and / or for each hopper having some relevant information. Hopper number zero will always be the first one. For this hopper, the NNN field contains the total number of notes which have passed the Throat sensor and delivered to the customer The second alternative message format (SLLE), will be sent if status code X'37' TRANSMISSION ERROR, X'38' ILLEGAL COMMAND or X'4E' COMMUNICATION TIMEOUT occurs.. (Refer to Section 5).

Command Description:

This command is used to check the number of notes delivered to the customer through the Bundle Output. The notes are counted in the Note Stacker inlet sensor during Move Forward, but the answer is available after a successful delivery has been performed.

On a power fail the counters for delivered notes are saved in a non-volatile memory.

Command Time out:

The recommended time out for this command is 5 seconds.

Status Codes:

Table 5-1 shows a cross-reference picture of the different status codes.

Command *X'37' CLOSE CASSETTE*

Command Message String:

```
C  LL  E
```

Where: C = Command Code, X'37'.
          L = LRC
          E = EOM Character.

or


```
CHT  LL  E
```

Where: C = Command Code, X'37'.
          H = Hopper number:
                X'30' to X'38', where X'30' is the Reject Vault.
                X'41' will close all cassettes.
          T = Close Type:
                X'31' Close and unlatch the Cassette,
                X'32' Force close and unlatch a Cassette after close failure.
          L = LRC
          E = EOM Character.

Reply Message String:

```
S  LL  E
```

Where: S = General Status Code.
          L = LRC
          E = EOM Character.

Command Description:

This command can either be sent in short form equal to the MDDM SD300 or in long form using Close Type X'31' or Close Type X'32'. When using the short form this command will close and unlatch all cassettes including the Reject Vault.

If no fatal error exists, the NMD starts with a reject sequence in order to clear the transport path from any possible notes staying there. All notes in the stacking area are as well as notes in the bundle output unit then moved to the Reject Vault.

After completion of the reject cycle the cassettes, including the Reject Vault are closed and unlatched one by one.

If there was a remaining fatal error caused by a previous command or if the reject cycle caused a fatal error this command will answer with that fatal error, otherwise it will always answer with status X'30' SUCCESSFUL COMMAND even if it was not possible to close all the cassettes. To get the result of the close sequence it is recommended to send a Read Cassette ID X'35' command after the close command.
Errors will be reported when using the long form (Close type X'31').

When using the long form (Close type X'31') this command will close and unlatch the cassette with the addressed hopper number or all cassettes if hopper number X'41' is used. No reject cycle will take place, except a bundle reject when the Reject Vault is addressed.
It is still possible to feed from other feeders even if the status from close one cassette is X'61' CASSETTE LOCK FAULTY.

When Hopper number "X41" is used all cassettes will be closed without a reset cycle before.

The long form (Close type X'31') can be used for unloading cassettes without putting the NMD out of service.

Close type X'32' is only allowed to release a cassette with shutter locking failure. This cassette should be sent to service organisation.

Command Time out:

The recommended time out for this command is 180 seconds.
It is possible to select a shorter time-out (20 s) with Item 239.

Status Codes:

Table 5-1 shows a cross reference of the different status codes.

Command *X'38' OPEN CASSETTE*

Command Message String:

```
C  LL  E
```

Where: C = Command Code, X'38'.
         L = LRC
         E = EOM Character.

or

CHT LL E

Where: C = Command Code, X'38'.
         H = Hopper number:
                 X'30' to X'38', where X'30' is the Reject Vault
         T = Open Type:
                 X'30' Latch the Cassette to the frame
                 X'31' Latch and Open the Cassette,
         L = LRC
         E = EOM Character.

Reply Message String:

```
S  LL  E
```

Where:
         S = General Status Code.
         L = LRC
         E = EOM Character.

Command Description:

When using the short form this command will latch and open ALL inserted cassettes including the Reject Vault.

When using the Open type X'30' the cassette addressed by Hopper number will be latched to the frame. It will not be possible to feed notes from a cassette, which is latched to the frame. Open type X'30' is not allowed on Reject Vault (hopper number X'30').

When using the Open type X'31' the cassette addressed by Hopper number will be latched and opened. In this case it is possible to feed notes from the cassette.
It is still to feed from other feeders even if the status from open one cassette is X'61' CASSETTE LOCK FAULTY.
This command can be used for loading individual cassettes without taking the NMD out of service.

If no successful reset has been made since POWER UP, it will be performed during the X'38' OPEN CASSETTE command.

After the X'38' OPEN Command, the network must send an X'35' READ Cassette-ID Command, before any dispense operation can be executed.

The NMD Controller logically sets the cassettes, including the Reject Vault to closed state after system power on; this is done regardless of the physical state of the cassettes. Therefore, this command must always be included in the start-of-day procedure.

Command Time out:

The recommended time out for this command is 180 seconds.

Status Codes:

Table 5-1 shows a cross reference of the different status codes.

Command **X'39'   READ REJECT TRACE**

Command Message String:

C LL E

Where: C = Command Code, X'39'.
          L = LRC
          E = EOM Character.

Reply Message String:

S RRRRRRRRRRRRRRR LL E *or* S LL E

Where: S = General Status Code.
          R = LAST 15 REJECT REASONS:
                  X'30' = Pointer or Unused Position.
                  X'31' = Double Note.
                  X'32' = Internal Reject.
                  X'33' = Long Note sensor A.
                  X'34' = Long Note sensor B.
                  X'35' = Short Note.
                  X'36' = Incorrect Count.
                  X'37' = Thin Note.
                  X'38' = Skewed Note.
                  X'39' = Notes Too Close
          L=LRC
          E=EOM Character.

Notes: The second alternative message, format (SLLE) will be sent if status code X'37'
          TRANSMISSION ERROR, X'38' ILLEGAL COMMAND or X'4E' COMMUNICATION
          TIMEOUT occurs.

Command Description:

This command will request the NMD to send back to the Network the contents of the Reject Trace. This is where the NMD Controller keeps a record of the reasons for the last 15 note-rejects.

The trace is updated in a circular way, so that it will always contain the last 15 reject causes. One additional byte, an X'30' is used as a buffer pointer, indicating that the immediately preceding byte corresponds to the last reject. The trace is cleared when the machine is powered on, so that at the beginning of daily operations, it is always 16 zeros (X'30').

The Application Program may use this command for statistical purposes, and also by the technical service engineer to analyse system performance.

The internal reject reasons showed in item 300 and the translation to external reject reason are in the table below.

Reject Code	Internal Reject Name	External Name (MDDM emulation)	Description
01	Learning note	Internal Reject	Reject reason for the rejected notes in the learning sequence. The notes are stacked and a bundle reject is made.
02	More than one note	Double Note	The note was detected as double
03	Too skewed note	Skewed Note	The note was too skewed
04	Too long note at DDA	Long Note sensor A	The note was too long at double detect sensor A.
05	Too long note at DDB	Long Note sensor B	The note was too long at double detect sensor B.
06	Too short note at DDA	Short Note	The note was too short at double detect sensor A.
07	Too short note at DDB	Short Note	The note was too short at double detect sensor B.
08	Too close note	Notes Too Close	The note was too close to previous note.
09	Transaction abort	Incorrect Count.	Note that is rejected on a transaction abort due to a fatal status.
10	Unexpected note	Incorrect Count.	A note is seen in the double detect sensor without having been fed.
11	Note is too thin	Thin Note	The note was detected as thin.
12	Diverter operation failed after reject	Incorrect Count.	It was not possible to turn the diverter from reject to stack
13	Too close in transport	Notes Too Close	An ok note is too close to the following note, Both notes have to be rejected.
14	Too close in diverter	Notes Too Close	An ok note is too close to the following note, Both notes have to be rejected.

Command *X'39'* *READ REJECT TRACE*

Reject Code	Internal Reject Name	External Name (MDDM emulation)	Description
15	Diverter operation failed during stack	Incorrect Count.	It was not possible to turn the diverter from stack to reject. A bundle reject is made and all notes are fed again.
16	Learning note, single	Internal Reject	Reject reason for the rejected notes in the learning sequence. The notes are single rejected.
17	Test note	Incorrect Count.	Not used. Only for test purpose.
18	Delayed note	Incorrect Count.	This internal reject reason is used when a note is too late to the Note Qualifier. The reject reason occurs when the timeout exceeds for a note in the NQ. Only used internally for logging reason.
19	Reject all note	Internal Reject	Used when a note is fed and rejected during a Close Cassettes command.
20	Overlapped A	Long Note sensor A	Used for reject reason on the second note on two overlapped notes. The note is detected as one long note on channel A, but two separate notes on channel B.
21	Overlapped B	Long Note sensor B	Used for reject reason on the second note on two overlapped notes. The note is detected as one long note on channel B, but two separate notes on channel A.
22	Unexpected in reject	Incorrect Count.	A note, which has not passed the Note Qualifier, is seen in the reject sensor.
23	Reject note on command	Internal Reject	This reject reason occurs on notes that are fed in a test Move Forward command.
24	Reject in STK	Internal Reject	Used for remaining notes on the transport path when the Reject Vault is full. The notes are stacked in the Note Stacker and a bundle reject is made.

Command Time out:

The recommended time out for this command is 5 seconds.

Status Codes:

Table 5-1 shows a cross reference of the different status codes.

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Command *X'3A'* *CHECK BUNDLE OUTPUT UNIT*

Command Message String:

C LL E

Where: C = Command Code, X'3A'.
              L = LRC
              E = EOM Character.

Reply Message String:

S LL E

Where: S = General Status Code.
              L = LRC
              E = EOM Character.

Command *X'3A'* *CHECK BUNDLE OUTPUT UNIT*

Command Description:

This command shows if there are notes remaining in the Bundle Output Unit BOU.

The Reply Message will answer X'4D' Notes In Bundle Output if the notes are still in the BOU or X'30' Successful Command if there are no notes in the BOU.

Read Data Item 210 to determine if the delivery was successful or if the notes were auto-retracted when the reply of this command changes from status X'4D' to X'30'.
If item 210 reads 1 then an auto-retract has been performed.

Command Time out:

The recommended time out for this command is 5 seconds.

Status Codes:

Table 5-1 shows a cross reference of the different status codes.

Command *X'41' READ PROGRAM-ID*

Command Message String:

C LL E

Where: C = Command Code, X'41'.
         L = LRC
         E = EOM Character.

Reply Message String:

S M NNNNNNNN LL E *or* S LL E

Where: S = General Status Code.
         M = Unit Identifier, always X'44'
         N = Program ID-Number, 8 bytes.
         L = LRC
         E = EOM Character.

Notes: The second alternative message format (SLLE) will be sent if status code X'37' TRANSMISSION ERROR, X'38' ILLEGAL COMMAND or X'4E' COMMUNICATION TIMEOUT occurs.

Command Description:

This command sends back to the network a string containing the Software Identification Number for the CMC. This will be sent in the format of 8 ASCII numeric characters, preceded by the letter D.
To get Program ID from all controllers in the NMD, read Data Item 100.

Command Time out:

The recommended time out for this command is 5 seconds.

Status Codes:

Table 5-1 shows a cross reference of the different status codes.

Command *X'44'   RETRACT*

Command Message String:

C D T LL E

Where: C = Command code X'44'.
          D = Destination of notes:
              X'30', Stacking area
              X'31', Reject Vault
          T = Time out, must be set to X'30.
          L = LRC
          E = EOM character

Reply Message String:

S LL E

Where: S = General Status Code.
          L = LRC
          E = EOM Character.

Command Description:

This command will move the note bundle from the Bundle Output Unit, BOU either to the stacking area in the Stack Presenter or to the bundle reject area in the Reject Vault, depending on the destination parameter D in the command string.

It is only possible to execute a Retract command if a successful deliver command has been performed and the notes still are in the BOU. Otherwise the reply message will be X'38' ILLEGAL COMMAND

The time out parameter T must be set to X'30'.

If the destination parameter D is set to the stacking area and a fatal status occurs the notes are transported to the Reject Vault.

If the notes are removed or obstructed during the RETRACT command the reply message will be X'3C' NO NOTES RETRACTED (see further information in chapter 5.2 X'3C' NO NOTES RETRACTED).

Command Time out:

The recommended time out for this command is 180 seconds.

Status Codes:

Table 5-1 shows a cross reference of the different status codes.

Command *X'47'* *SEND SELFTEST DATA*

Command Message String:

```
C  H  LL  E
```

Where:

        C = Command Code, X'47'.
        H = Hopper number.
        L = LRC bytes.
        E = EOM character.

Reply Message String:

The reply message format depends on which hopper number is specified:

```
H  =  '0'        S   TTTTTTTTTUUUUTUTTTTTTT  LL  E


H  =  '1'-'8'    S   TTTTTTTTTTTTUUUUVVVHHHCCCDDDI  LL  E


H  =  'A'        S   TUUU  CCCDDDIAAAaNNNBBBbNNN.......

                           .....CCCDDDIAAAaNNNBBBbNNN  LL  E
```

or

```
S  LL  E
```

Where:

        S = General Status Code
        A = Double detect sensor A offset
        a = Double detect sensor A gain
        B = Double detect sensor B offset
        b = Double detect sensor B gain
        C = Currency code
        D = Denomination code
        E = Offset calibration sensor A
        F = Offset calibration sensor B
        H = Horizontal size of note
        I = Note type/Issue
        N = Sensor nominal note thicknes value
        T = Sensor test data
        U = Sensor calibration value
        V = Vertical size of note
        L = LRC bytes
        E = EOM Character

Notes: The last alternative message format will be sent if status X'37' TRANSMISSION ERROR, X'38' ILLEGAL COMMAND or X'4E' COMMUNICATION TIMEOUT occurs.

Command Description:

This command is mainly intended for service purpose and not for normal use. When this command is sent to the NMD, the results of the internal self-test are sent back as reply.

Hopper number '0':

When hopper number set to '0' the Stack Presenter, Note Diverter and Reject Vault is addressed in the command the reply message will contain information of the following sensors and switches:

```
S TTTTTTTTTUUUUTUTTTTTTT LL E
```

Lid solenoid status sensor ["0" = Solenoid inactive, "1" = Solenoid active]

Cassette lid/lock sensor ["0" = Lid closed and locked, "1" = Lid not closed]

RV Shutter sensor Stack retract pos. ["0" = Sensor not obstructed "1" = Sensor obstructed]

RV Shutter sensor Stack accept pos. ["0" = Sensor not obstructed "1" = Sensor obstructed]

RV Shutter sensor Single accept pos. ["0" = Sensor not obstructed "1" = Sensor obstructed]

RV Shutter sensor Closed pos. ["0" = Sensor not obstructed "1" = Sensor obstructed]

Reject Vault present sensor ["0" = Cassette not present "1" = Cassette present]

Note Stacker Entry sensor calibration value ["0" ≤ D ≤ "7 "]

Note Stacker Entry sensor ["0" = Sensor not obstructed "1" = Sensor obstructed]

BOU Empty sensor calibration value ["0" ≤ D ≤ "31"]

BOU Exit sensor calibration value ["0" ≤ D ≤ "31 "]

Shutter close sensor ["0" = Shutter not closed "1" = Shutter closed "-"=Sensor not pres]

Shutter open sensor["0" = Shutter not open "1" = Shutter open "-"=Sensor not pres]

Spare ["0" = Sensor not active"1" = Sensor active "2" =Sensor error "-" = Sensor not present]

BCU reject sensor ["0" = BCU not at sensor "1" = BCU at sensor]

BCU home sensor ["0" = BCU not at sensor "1" = BCU at sensor]

BCU Rear service deliver position sensor ["0" = BCU not at sensor "1" = BCU at sensor "-"=sensor notpres.]

BCU Front service deliver position sensor ["0" = BCU not at sensor "1" = BCU at sensor "-"=sensor not pres.]

BOU Empty sensor ["0" = Sensor not obstructed, "1" = Sensor obstructed]

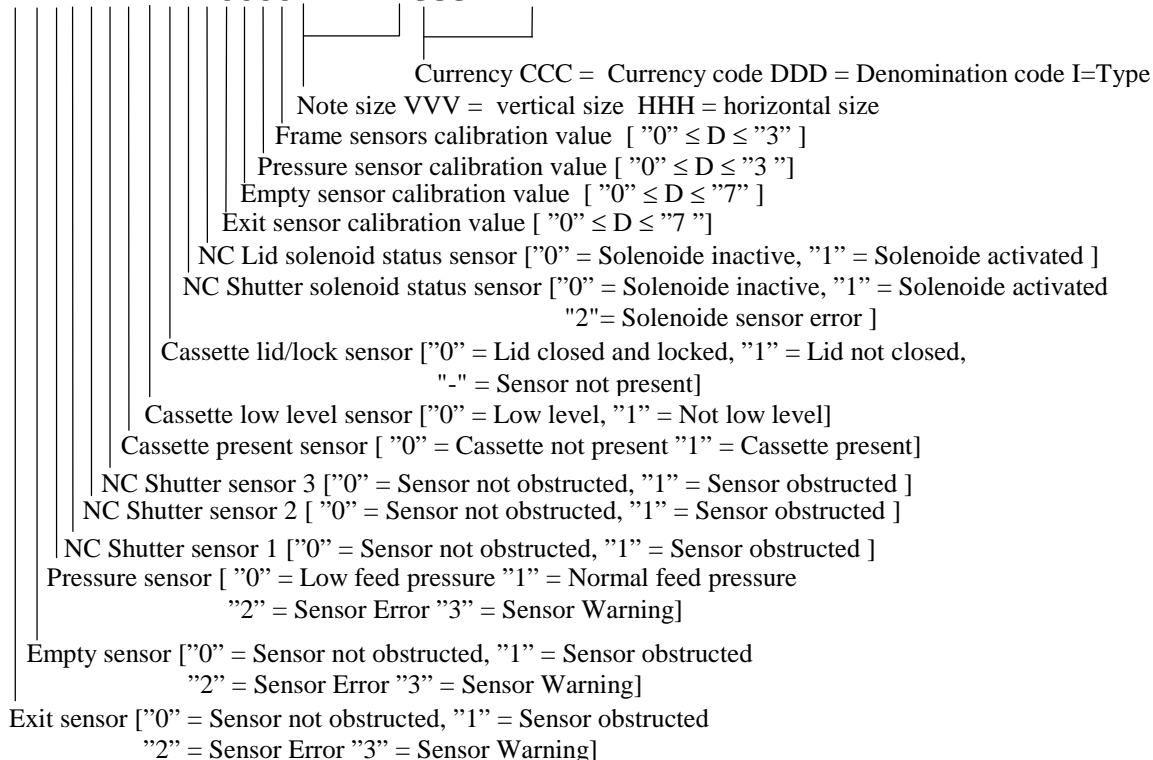BOU Exit sensor ["0" = Sensor not obstructed, "1" = Sensor obstructed]

Command *X'47'   SEND SELFTEST DATA*

Hopper number '1'-'8', standard string:

When hopper number set to 1-8 the Note Feeder and Note Cassette are addressed, the reply message will contain information of the following sensors and switches: The sensors labelled with "T" above will also report status X'5B' if an error associated to the sensor detected. When the NC is not present the positions related to the cassette will be reported as "-".
When Item 214 is set to '0' (standard), the result string will have the following "old" content.

```
S TTTTTTTTTTTUUUUVVVHHHCCCDDDI LL E
```

Currency CCC = Currency code DDD = Denomination code I=Type

Note size VVV = vertical size HHH = horizontal size

Frame sensors calibration value ["0" ≤ D ≤ "3"]

Pressure sensor calibration value ["0" ≤ D ≤ "3 "]

Empty sensor calibration value ["0" ≤ D ≤ "7"]

Exit sensor calibration value ["0" ≤ D ≤ "7 "]

NC Lid solenoid status sensor ["0" = Solenoide inactive, "1" = Solenoide activated]

NC Shutter solenoid status sensor ["0" = Solenoide inactive, "1" = Solenoide activated
"2"= Solenoide sensor error]

Cassette lid/lock sensor ["0" = Lid closed and locked, "1" = Lid not closed,
"-" = Sensor not present]

Cassette low level sensor ["0" = Low level, "1" = Not low level]

Cassette present sensor ["0" = Cassette not present "1" = Cassette present]

NC Shutter sensor 3 ["0" = Sensor not obstructed, "1" = Sensor obstructed]

NC Shutter sensor 2 ["0" = Sensor not obstructed, "1" = Sensor obstructed]

NC Shutter sensor 1 ["0" = Sensor not obstructed, "1" = Sensor obstructed]

Pressure sensor ["0" = Low feed pressure "1" = Normal feed pressure
"2" = Sensor Error "3" = Sensor Warning]

Empty sensor ["0" = Sensor not obstructed, "1" = Sensor obstructed
"2" = Sensor Error "3" = Sensor Warning]

Exit sensor ["0" = Sensor not obstructed, "1" = Sensor obstructed
"2" = Sensor Error "3" = Sensor Warning]

Hopper number '1'-'8', extended string:

When Item 214 is set to '1', the result string will have the following content. *Exit Sensor and Empty sensor have two figures for calibration value. The calibration values for Pressure sensor and Shutter sensors are separated.*
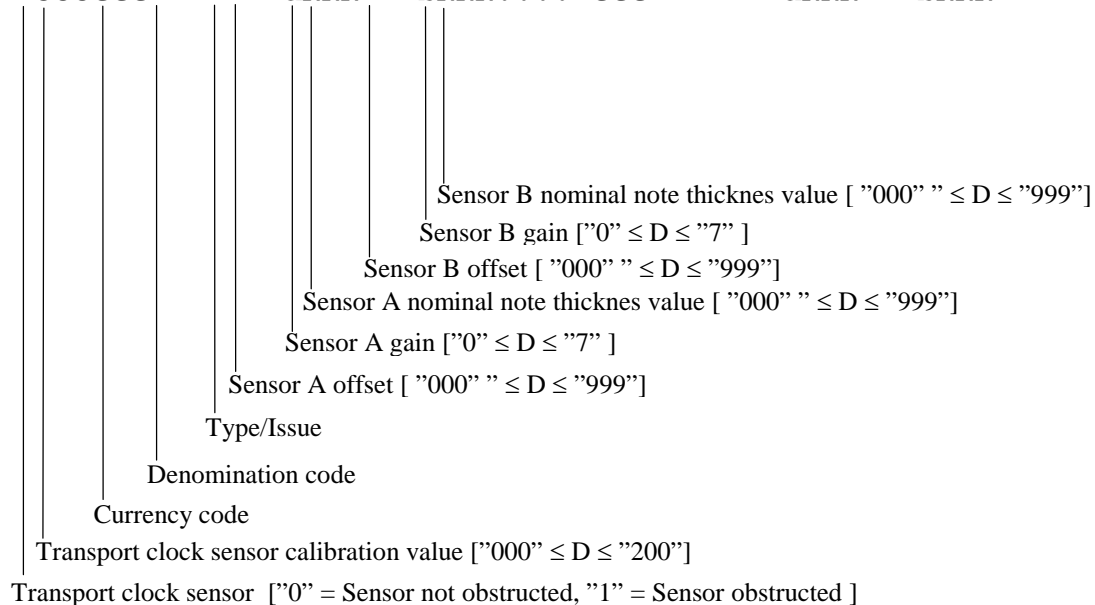
```
S TTTTTTTTTTTUUUUUUVVVHHHCCCDDDI LL E
```


Currency CCC = Currency code DDD = Denomination code I=Type

Note size VVV = vertical size HHH = horizontal size

Frame sensors calibration value ["0" ≤ D ≤ "7"]

Pressure sensor calibration value ["0" ≤ D ≤ "7 "]

Empty sensor calibration value ["0" ≤ D ≤ "15"]

Exit sensor calibration value ["0" ≤ D ≤ "15 "]

NC Lid solenoid status sensor ["0" = Solenoide inactive, "1" = Solenoide activated]

NC Shutter solenoid status sensor ["0" = Solenoide inactive, "1" = Solenoide activated
"2"= Solenoide sensor error]

Cassette lid/lock sensor ["0" = Lid closed and locked, "1" = Lid not closed,
"-" = Sensor not present]

Cassette low level sensor ["0" = Low level, "1" = Not low level]

Cassette present sensor ["0" = Cassette not present "1" = Cassette present]

NC Shutter sensor 3 ["0" = Sensor not obstructed, "1" = Sensor obstructed]

NC Shutter sensor 2 ["0" = Sensor not obstructed, "1" = Sensor obstructed]

NC Shutter sensor 1 ["0" = Sensor not obstructed, "1" = Sensor obstructed]

Pressure sensor ["0" = Low feed pressure "1" = Normal feed pressure
"2" = Sensor Error "3" = Sensor Warning]

Empty sensor ["0" = Sensor not obstructed, "1" = Sensor obstructed
"2" = Sensor Error "3" = Sensor Warning]

Exit sensor ["0" = Sensor not obstructed, "1" = Sensor obstructed
"2" = Sensor Error "3" = Sensor Warning]

Command *X'47'* *SEND SELFTEST DATA*

Hopper number 'A':

When hopper number set to "A" the Note Qualifier Module is addressed, the reply message will contain information of the transport clock sensor and double detect sensors. The note specific data will be repeated for up to 10 latest used currencies and denominations. Unused entries will be reported as "-" (X'2D'):

```
S TUUUCCCDDDIAAAaNNNBBBbNNN.... CCCDDDIAAAaNNNBBBbNNN LL E
```

Sensor B nominal note thicknes value ["000" " ≤ D ≤ "999"]

Sensor B gain ["0" ≤ D ≤ "7"]

Sensor B offset ["000" " ≤ D ≤ "999"]

Sensor A nominal note thicknes value ["000" " ≤ D ≤ "999"]

Sensor A gain ["0" ≤ D ≤ "7"]

Sensor A offset ["000" " ≤ D ≤ "999"]

Type/Issue

Denomination code

Currency code

Transport clock sensor calibration value ["000" ≤ D ≤ "200"]

Transport clock sensor ["0" = Sensor not obstructed, "1" = Sensor obstructed]

Command Time out:

The recommended time out for this command is 20 seconds.

Status Codes:

Table 5-1 shows a cross reference of the different status codes.

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Command *X'4B' RESEND LAST MESSAGE*

Command Message String:

C LL E

Where: C = Command code X'4B'.
         L = LRC Bytes
         E = EOM character.

Reply Message String:

S M...LL E *or* S LL E

Where: S = General Status Code.
         M = Last Response Message.
         L = LRC Bytes.
         E = EOM Character.

Notes: The M-parameter Last Response Message will contain an exact copy of last message sent with the exception that the LRC and EOM characters are removed.

The second alternative message format (SLLE) will be sent if an error exists at the NMD-controller or if the following status occurs.
         X'37' TRANSMISSION ERROR,
         X'38' ILLEGAL COMMAND,
         X'4E' COMMUNICATION TIMEOUT or
         X'65' NO MESSAGE TO RESEND.

Command Description:

This command causes the NMD-controller to resend the last response message sent, excluding the response on this command it self.

Use this command when a communication error is detected in the response message.

If there is no response message to resend, i. e. no command has been executed since power on/hardware reset, the status code X'65' NO MESSAGE TO RESEND will be sent using the second alternative reply message format.

The general status in the reply message shows the validity of the response.

Command Time out:

The recommended time out for this command is 5 seconds.

Status Codes:

Table 5-1 shows a cross reference of the different status codes.

Command *X'51'* *CHECK NMD STATUS*

Command Message String:

C LL E

Where: C = Command Code, X'51'.
           L = LRC
           E = EOM Character.

Reply Message String:

S HFArrGGGGG HFAffGGGGG .... ttqqddssppoovvLL E

or S LL E

Where: S = General Status Code.
           H = Hopper Number, X'30' TO X'38'
           F = Hopper Status Code
           A = Cassette Open Close status
           rr = Internal status for Reject Vault
           ff = Internal status for Feeder
           G = Cassette ID-Number.
           tt = Internal status for Main motor drive
           qq= Internal status for Note Qualifier (Double Detect)
           dd= Internal status for Note Diverter
           ss = Internal status for Note Stacker
           pp= Internal status for Stack Presenter
           oo= Internal status for Note Output (Throat) NMD50
           vv= Internal status for Data Handler(Used for cassette items)
           L = LRC
           E = EOM Character.

Notes: The field HFAffGGGGG is repeated for all eight possible feeder positions in the system.
The Reject Vault have HOPPER number X'30' and Note Cassettes will have HOPPER number X'31' - X'38' and the ID-number range is from 00001 - 99999.

The second alternative message format (SLLE), will be sent if status code X'37' TRANSMISSION ERROR, X'38' ILLEGAL COMMAND or X'4E' COMMUNICATION TIMEOUT occurs.

Command Description:

This command requests the status of the NMD including Cassette ID-numbers of all the Cassettes inserted in the NMD, even the Reject Vault.

Description of Cassette Open Close Status:

Note Cassette

A	NC Open Close Status	0	No Feeder at position
		1	No Cassette Inserted
		2	Cassette Inserted
		3	Cassette Inserted and Data from Cassette is read
		4	Cassette Locked to Frame
		5	Cassette opened in operation position
		9	Cassette data changed. The cassette needs to be removed and re-inserted.

Reject Vault

A	RV Open Close Status	1	RV not present
		2	RV present but closed
		5	Opened in Single Note Acceptance position
		6	Opened in Bundle Acceptance position
		7	Opened in Bundle Reject position

Description of task numbers used in item 311 and in LED error indication. This is not used in this command:

TaskNO	Task Name	Description
3	TRANSPORT CONTROL	Task that handles the main motor and note transport.
4	FEEDER CONTROL	Task that handles the Note Feeders
5	PRESENTER CONTROL	Task that handles the Stack Presenter including the BCU and BOU.
6	DIVERTER CONTROL	Task that handles the Note Diverter.
7	QUALIFIER CONTROL	Task that handles the Note Qualifier (Double Detect)
8	STACKER CONTROL	Task that handles the Note Stacker
9	THROAT CONTROL	Not Used in NMD 100
10	REJECT CONTROL	Task that handles the Reject Vault and the Note Diverter outlet sensor.
14	DATA CONTROL	Task that handles the Data Items.
20	BCU CONTROL	Task that handles BCU movement.

Command *X'51' CHECK NMD STATUS*

The internal statuses (rr, qq, dd etc) are described below. The internal statuses are also used in item 311 and in LED error indication.

The internal failure codes for the Reject Vault:
(Task number 10)

Code	No	Name of internal Failure	Description
rr	01	REJ_CASS_ALMOST_FULL	The RV is almost full
	02	REJ_CASS_FULL	The RV is full
	03	REJ_NO_CASS_IN_MODULE	There is no RV inserted
	04	REJ_STACK_REJECT_ERROR	There was an error when the RV shutter was moved to the stack reject position
	05	REJ_CLOSE_ERROR	There was an error when closing RV
	06	REJ_SINGLE_ACCEPT_ERROR	There was an error when the RV shutter was moved to the single accept position
	07	REJ_STACK_ACCEPT_ERROR	There was an error when the RV shutter was moved to the stack accept position
	08	REJ_CASS_DATA_ERROR	Checksum error in the RV internal data
	09	REJ_JAM_IN_QUA	A note has jammed between the NQ and the Reject sensor(Located in the diverter)
	10	REJ_NOTE_JAMMED	A note has jammed in the Reject sensor.
	11	REJ_NOTE_IN_STK	A note that was intended to be single rejected was seen in the Note Stacker inlet.
	12	REJ_COM_ERROR	Error in communication with the Reject Vault
	13	REJ_SW_FAILURE	Not Used
	14	REJ_FATAL_SW_FAILURE	Not Used

The internal failure codes for the Note Feeder Task:
(Task number 4)

Code	No	Name of internal Failure	Description
ff	01	FDR_NO_CASS_IN_MODULE	There is no cassette in the actual feeder position
	02	FDR_SERVICE_REQUEST	Service requested on the actual feeder.
	03	FDR_CASS_ALMOST_EMPTY	Low level in the cassette
	04	FDR_EMPTY_DETECTED_ NOT_LOW	Empty has been detected without having low level in the cassette
	05	FDR_EMPTY_DETECTED_ LOW	Empty has been detected with low level in the cassette
	06	FDR_EMPTY_CHANGE_OVER	Empty has been detected, but the feeding continues from another feeder
	07	FDR_CASS_EMPTY	The cassette is marked as empty.
	08	FDR_FEED_ERROR	The feeder has not being able to feed the notes.
	09	FDR_RETRY_NOTE	The feeding is interrupted due to a possible jam between the feeder and the Note Qualifier. A retry is made on this error.
	10	FDR_SENSOR_ERROR	A sensor is broken, or a note is stuck under the exit sensor
	11	FDR_ABORT_ERROR	The feeding is aborted because of the RV single department is getting full.
	12	FDR_RETRY_TRANS	The feeding is aborted, a bundle reject is performed and all notes are fed again.
	13	FDR_CASS_LOCK_ERROR	It was not possible to open or close the cassette
	14	FDR_COM_CLOSE_ERROR	Communication error with the feeder/cassette during Open or Close.
	15	FDR_COM_ERROR	Communication error with the feeder.
	16	FDR_SW_FAILURE	It was not possible to access the feeders from a task. Another task has the access to the feeders.
	17	FDR_FATAL_SW_FAILURE	It was not possible to create mailboxes and queues, the task will not start at all.

Command X'51' CHECK NMD STATUS

The internal failure codes for the main motor transport task:
(Task number 3)

Code	No	Name of internal Failure	Description
tt	01	TRP_MISSING_PULSE	Transport clock pulses are missed, probably due to dust on the transport clock sensor.
	02	TRP_MOTOR_START_ FAILURE	The main motor transport did not reach the stipulated speed within a timeout.
	03	TRP_MOTOR_SPEED_TOO_ LOW	The speed is lower than the speed tolerance, probably due to a jam in the transport path
	04	TRP_MOTOR_SPEED_TOO_ HIGH	The speed is higher than the speed tolerance.
	05	TRP_SW_FAILURE	It was not possible to access the main motor transport from a task. Another task has the access to main motor transport.
	06	TRP_FATAL_SW_FAILURE	It was not possible to create mailboxes and queues, the task will not start at all.

The internal failure codes for the Note Qualifier task, double detect: (Task number 7)

Code	No	Name of internal Failure	Description
qq	01	QUA_CONFIG_DATA_ERROR	An error in the note data table was detected during power on. All notes have to be learned again.
	02	QUA_WRITE_E2_ERROR	An error was detected when writing the note data table to the e2prom.
	03	QUA_TOO_MANY_REJECTS	More than five rejects without any OK notes between.
	04	QUA_JAM_NOTE_ TRANSPORT	A note has left the Note Feeder exit sensor is not seen in the Double detect sensors.
	05	QUA_CHECK_FAILURE	An error was detected, when an ongoing calibration was made on the Double detect sensors. The error is cleared if the next ongoing calibration is successful.
	06	QUA_LEARNING_FAILURE	An error was detected during the learning note sequence.
	07	QUA_DD_FAILURE	An error was detected, when a calibration from a command was made on the Double detect sensors.
	08	QUA_LID_OPENED	The lid in the Note Qualifier is detected as opened.
	09	QUA_SW_FAILURE	It was not possible to access the qualifier a task, or it was not possible to post the note data to the Stacker Control task.
	10	QUA_FATAL_SW_FAILURE	It was not possible to create mailboxes and queues, the task will not start at all.

Command *X'51' CHECK NMD STATUS*

The internal failure codes for the Note Diverter task:
(Task number 6)

Code	No	Name of internal Failure	Description
dd	01	DIV_SENSOR_ERROR	It was not possible to calibrate the Note Diverter sensor. The sensor is located in the note path to the single reject area. The reason for this error could be a broken sensor, or that the sensor is covered with a note.
	02	DIV_SW_FAILURE	It was not possible to post the note data to the Stacker Control task.
	03	DIV_FATAL_SW_FAILURE	Not used

The internal failure codes for the Note Stacker task:
(Task number 8)

Code	No	Name of internal Failure	Description
ss	01	STK_UNEXPECTED_NOTE	An unexpected note was seen in the Note Stacker inlet sensor. The note has not passed the Double detect sensors.
	02	STK_ENABLE_ERROR	It was not possible to enable the Note Stacker.
	03	STK_JAM_IN_QUA	A note has jammed between the Note Qualifier and the Note Stacker inlet sensor
	04	STK_NOTE_JAMMED	A note has jammed under the Note Stacker inlet sensor.
	05	STK_PATH_NOTE_JAMMED	Not used in NMD 100
	06	STK_NOTE_IN_REJ	A note that was intended to be stacked was rejected instead.
	07	STK_MOVEMENT_ERROR	The stacker wheel has not made a proper movement between the notes, or at emptying of the stacker wheels.
	08	STK_SW_FAILURE	Not used
	09	STK_FATAL_SW_FAILURE	It was not possible to create mailboxes and queues, the task will not start at all.

The internal failure codes for the Stack presenter task:
(Task number 5)

Code	No	Name of internal Failure	Description
pp	01	PRS_ILLEGAL_COMMAND	Internal return code from Retract if there are no notes to retract.
	02	PRS_SENSOR_ERROR	The calibration value of the throat sensor or empty grip sensor is too high or two BCU sensors are covered at the same time. A broken or dirty sensor could cause this error.
	03	PRS_MOVEMENT_ERROR	The BCU has not reached the defined position
	04	PRS_HOME_ERROR	An error occurred when moving the BCU to home position after a successful delivery.
	05	PRS_MOVE_TO_HOLD_ ERROR	An error occurred when moving the BCU to hold position, when using move to hold option (see Item 208).
	06	PRS_TO_REJECT_WARNING	An error occurred when moving the BCU to reject position. Retries are made on this warning
	07	PRS_FROM_REJECT_ WARNING	An error occurred when moving the BCU from reject to home position. Retries are made on this warning
	08	PRS_REJECT_ERROR	An error occurred when moving the BCU to reject position, or from reject to home position.
	09	PRS_DELIVERY_ERROR	An error occurred when moving the BCU to hold position, when the movement is initiated by a delivery command. The notes are not reachable by the customer.
	10	PRS_DELIVERY_THROAT_ ERROR	Not used.
	11	PRS_SHUTTER_ERROR	An error occurs when trying to close the shutter. This error could also occur if one of the switches in the shutter is broken or if someone opens the shutter with force.
	12	PRS_SHUTTER_OPEN_ERROR	An error occurs when trying to open the shutter.
	13	PRS_THROAT_ERROR	An error is detected in the throat, and the notes are reachable from the customer.

The internal failure codes for the Stack presenter task: *continued*

Code	No	Name of internal Failure	Description
pp	14	PRS_FOLDED_THROAT_ WARNING	An error is detected in the throat, probably due to folded note. The notes do not leave the inner throat sensor. Deliver will answer with Successful command.
	15	PRS_TRANSPORT_THROAT_WARNING	An error occurred when moving the BCU to delivery position, but the throat sensor is covered and the grip empty sensor is not covered. Deliver will answer with Successful command.
	16	PRS_TRANSPORT_EMPTY_ WARNING	An error occurred when moving the BCU to delivery position, but the throat sensor is covered. Deliver will answer with Successful command.
	17	PRS_HOME_THROAT_ERROR	This error occurs when the customer takes the notes and immediately puts them back into the throat.
	18	PRS_TRANSPORT_THROAT_ ERROR	An error occurred when moving the BCU to delivery position. The error could be caused by a skewed BCU, BCU motor not working or something else that prevents the BCU to go to delivery position.
	19	PRS_NO_NOTES_RETRACTED	There are no notes in the BCU on a retract command.
	20	PRS_INTERNAL_ERROR	There is an internal error in the SPC
	21	PRS_COMMUNICATION_ERROR	Communication error with the SPC or Reject Vault.
	22	PRS_SW_FAILURE	It was not possible to access the presenter from a task. Another task has the access to main motor transport.
	23	PRS_SW_FATAL_FAILURE	It was not possible to create semaphores. The task will not start at all.

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The internal failure codes for the Data Handler:
(Task number 14)

Code	No	Name of internal Failure	Description
Vv	01	DAT_CASS_DATA_ERROR	There was a checksum error in the cassette data area.
	02	DAT_CASS_COMM_ERROR	Communication error with the cassette.
	03	DAT_SW_FAILURE	It was not possible to access the cassettes. Another task has the access to the cassettes.
	04	DAT_FATAL_SW_FAILURE	It was not possible to create semaphores; the task will not start at all.

The internal failure codes for the BCU Handler: *Only in item 311*
(Task number 20)

Code	No	Name of internal Failure	Description
	02	BCU_REDRAW_EVENT	Notes seen in the BOU sensors, when the BCU moves backwards after the notes are taken by the customer
	10	BCU_TRANSPORT_ERROR	Carriage at wrong position or stuck
	11	BCU_ POSITION_ERROR	Carriage position sensors malfunction
	12	BCU_ BOU_ERROR	BOU sensor error
	13	BCU_ RETRACT_ERROR	No notes in carrier on retract

Fatal errors cannot occur on this command; only remaining fatal errors that have occurred in a previous command are reported.

Command Time out:

The recommended time out for this command is 20 seconds.

Status Codes:

Table 5-1 shows a cross reference of the different status codes.

Command *X'53'* *CHECK STACKED NOTES*

Command Message String:

C LL E

Where: C = Command Code X'36.
L = LRC
E = EOM Character.

Reply Message String:

S HFNNN HFNNN HFNNN ..... LL E *or* S LL E

Where: S = General Status Code.
H = Hopper number, X'30' to X'38'.
F = Hopper Status Code.
N = Number of notes stacked from this hopper.
L = LRC
E = EOM Character.

Notes: The field HFNNN is repeated for each hopper dispensed from and / or for each hopper having some relevant information. Hopper number zero will always be the first one. For this hopper, the NNN field contains the total number of notes which have passed the Throat sensor and delivered to the customer The second alternative message format (SLLE), will be sent if status code X'37' TRANSMISSION ERROR, X'38' ILLEGAL COMMAND or X'4E' COMMUNICATION TIMEOUT occurs.. (Refer to Section 5).

Command Description:

This command is used to check the number of notes in the stack presenter after a Move Forward command. The notes are counted in the Note Stacker inlet sensor during Move Forward.

On a power fail the counters for delivered notes are saved in a non-volatile memory.

Command Time out:

The recommended time out for this command is 5 seconds.

Status Codes:

Table 5-1 shows a cross-reference picture of the different status codes.

Command *X'52'X'44'* **READ DATA**

Command Message String:

```
CC  d  nnnn     LL     E

CC  d  nnnn  d  ccc     LL     E

CC  d  nnnn  d  cccmmet  LL     E
```

Where:
C   = Command Code "RD".
d   = Delimiter X'2F' "/".
ccc   = Currency identifier (mandatory for some item numbers, see below)
cccmmet = Currency, denomination and type identifier (mandatory for some items)
nnnn = Item number.
L   = LRC Bytes.
E   = EOM Character.

Reply Message String:

```
S   d  DDD... LL    E      OR            S  LL  E
```

Where:
    S = General Status Code.
    d = Delimiter X'2F' "/".
    D = Data read from requested item
    L = LRC bytes.
    E = EOM Character.

Notes: The second alternative message formats (SLLE) will be sent if an error exists at the NMD-controller or if following status occurs.
X'37' TRANSMISSION ERROR,
X'38' ILLEGAL COMMAND,
X'4E' COMMUNICATION TIMEOUT.

Command Time out:

The recommended time out for this command is 5 seconds.

Status Codes:

Table 5-1 shows a cross reference of the different status codes.

This command is used to read data from the NMD internal data structures. The following section contains a more detailed description of the read data items. The items supported in the NMD SD 300 emulation are:

100	Program ID block
104	Max. notes per bundle
110	Module ID blocks
118	Currency codes
127	Change over method
201	Feed Order
202	Note sizes
203	Auto retract
204	Retract time out
205	Internal parameters
206	Shutter Emulation
207	Software lock flag
208	Move Forward and Hold
209	Throat active flag
210	Auto retract performed
211	Status on Non Addressed Feeders
212	Status on Close
214	Self Test Data option
223	Note Feeder rollers clean flag
224	Deliver Time-out
225	Cassette inserted indicator
227	No Notes between press in HPF mode
228	HPF mode at open cassette
229	Scrub NF Rollers
230	Suspicious Delivery Flag
233	Number of notes between NF scrub
235	Max number of Feed retries
239	Timeout on Reset and Close Cassette
240	Detect Cassette Out on Close
241	Slow Main Motor Start
244	BCU Home Delay

300	Internal reject table
301	Status code table
303	Total notes delivered
304	Total notes rejected
305	Total bundle rejects
308	Total notes single rejected
309	Total notes bundle rejected
311	Module error log
313	BCU overheat counter
314	Number of Delivery time-outs
315	Reject Counters
318	Total notes delivered (high pressure feed)
319	Total bundle rejects (high pressure feed)
320	Total bundles delivered
330	Total notes delivered (Life Time)
331	Total notes rejected (Life Time)
332	Total bundle rejects (Life Time)
333	Total bundles delivered (Life Time)
334	Total retracts (Life Time)
350	NS Entry sensor calibration value
390	Total retracts
395	Enable/Disable Reject Vault
396	Enable/Disable Stack Presenter
397	Module status
398	Configure reject calculation
399	Max notes in single reject compartment
9H27	Currency and Denomination
9H28	Cassette ID
9H29	Note size

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Command *X'57'X'44'* *WRITE DATA*

Command Message String:

```
CC  d  nnnn   LL   E

CC  d  nnnn  d  ccc   LL   E

CC  d  nnnn  d  cccmmet LL   E
```

Where:
C   = Command Code "WD".
d   = Delimiter X'2F' "/".
ccc   = Currency identifier (mandatory for some item numbers, see below)
cccmmet = Currency, denomination and type identifier (mandatory for some items)
nnnn   = Item number.
L   = LRC Bytes.
E   = EOM Character.

Reply Message String:

```
S  LL  E
```

Where:
S   = General Status Code.
L   = LRC bytes.
E   = EOM Character.

Command Time out:

The recommended time out for this command is 5 seconds.

Status Codes:

Table 5-1 shows a cross reference of the different status codes.

This command is used to write data to the NMD internal data structures. The following section contains a more detailed description of the write data items.

104	Max. notes per bundle
110	Module ID blocks
127	Change over method
201	Feed Order
203	Auto retract
204	Retract time out
206	Shutter Emulation
207	Software lock flag
208	Move Forward and Hold
209	Throat active flag
210	Auto retract performed
211	Status on Non Addressed Feeders
212	Status on Close
214	Self Test Data option
217	Clean NS Rollers
218	Clean NF Rollers
223	Note Feeder rollers clean flag
224	Deliver Time-out
225	Cassette inserted indicator
227	No Notes between press in HPF mode
228	HPF mode at open cassette
229	Scrub NF Rollers
230	Suspicious Delivery Flag
233	Number of notes between NF scrub
235	Max number of Feed retries
237	Default machine settings
239	Timeout on Reset and Close Cassette
240	Detect Cassette Out on Close
241	Slow Main Motor Start
244	BCU Home Delay
310	Clear Note statistic counters
311	Clear Module Error Log
313	Clear BCU overheat counter
314	Clear of Delivery time-out counter
350	Clear NS Entry sensor calibration value
392	NQ Note data table initialisation
393	Position BCU
394	Position Shutter
395	Enable/Disable Reject Vault
396	Enable/Disable Stack Presenter
398	Configure reject calculation
399	Max notes in single reject compartment
9H27	Currency and Denomination
9H28	Cassette ID
9H29	Note size

READ/WRITE DATA ITEMS DESCRIPTION

100 Program ID block   R   231   Program versions.
CMCxxxxyyzzSPCxxxxyyzzNF1xxxxyyzz…
NF8xxxxyyzzNC1xxxxyyzz...NC8xxxxyyzzN
SUxxxxyyzzRVCxxxxyyzzPARxxxxyyzz

The version number after "PAR", is the
version of a parameter file, which contains
special currency depending settings.

104 Max. notes per bundle R/W   3   Maximum number of notes in one bundle.
Legal values: –1 - 100.

110 Module ID blocks   R/W   <208   Commands:
Write ID: *WD/110/<module><id>*
Read ID block: *RD/110/<block>*
Where:
<module> is one of NMD, SPU, NSU,
NTU, NDU, BCU, BOU, TEU,
PSU, CMC, FRn, NFn, NFCn or
POSn (n = 1 to 8).
<block> is one of four blocks:
block 0 = {NMD, SPU, NSU, NTU,
NDU, BCU, BOU, TEU,
PSU, CMC}
block 1 = {FR1, NF1, NFC1 …
… FR4, NF4, NFC4}
block 2 = {FR5, NF5, NFC5 …
… FR8, NF8, NFC8}
block 3 = {POS1 … POS8}
<id> is the module ID number with a
length of 14 characters. The
format may be like <type>
<revision> <field revision>
<serial number>

118 Currency codes   R   8 * 3 Currency codes.
This is a string containing the currency
codes (3 characters) of the defined
currencies. Undefined currencies are
marked as '---'.

127 Change Over Method   R/W   1   If there are two cassettes or more containing
the same denomination this item determines
when to change the dispensing one cassette
to another.
'0': No change over is made (default).
'1': Change over is made on empty cassette.

201 Feed Order	R/W	1	'0': Feed notes in hopper order '1': Feed notes in size order with biggest notes first (for rear service machine). (default) '2':Feed notes in size order with smallest notes first (for front service machine).
202 Note sizes	R	8 *13	Description of all notes sizes. Format: *"cccmmetvvvhhh"*
203 Auto retract	R/W	1	'0': No auto retract (default). '1': Auto retract enabled.
204 Retract time out	R/W	2	This value specifies the retract time-out. Range: –1 - 150 (s.) (default: 90).
205 Internal parameters	R	14	Specifies internal functions of the NMD
206 Shutter Emulation	R/W	1	'0': No Shutter (default) '1': Shutter type 1
207 Software lock flag	R/W	1	Flag can only be set to '1'. Flag will be reset to '0' at power on reset.
208 Move Forward and Hold	R/W	1	'0': BCU will remain in stacking position after successful Move Forward command (default). '1': BCU will move to hold position at a successful Move Forward command. Recommended when using externally controlled shutter. '2': BCU will remain in stacking position, as for value '0'. On the following deliver command no check is made if the Throat sensor or Empty grip sensor are covered during the BCU movement. This function should only be used on NMD without shutter. '4': Same as '0' but with special error handling, i.e. no retries and no bundle reject on Deliver commands that fails due to manipulation of the shutter or throat. This will also cause item 230 'Suspicious Deliver Flag' to be set. '5': Same as '1' but with special error handling, same as in mode '4'.

READ/WRITE DATA ITEMS DESCRIPTION

209	Throat Active Flag	R/W	1	Flag that indicates that the throat sensor has been activated. Reset by writing '0' to it.
210	Auto retract with notes	R/W	1	If a successful auto-retract with notes has been performed this flag is set. Should be read when the reply of the command CHECK BUNDLE OUTPUT UNIT has changed from status X'4D' to X'30'.The statuses for this flag are: '1': An auto-retract with notes has been performed. '0': An auto-retract with no notes or no auto-retract at all. This item indicates if an auto-retract has been successful (i.e. auto-retract with notes) or if the notes was taken before or during the auto-retract
211	Status on Non Addressed Feeders	R/W	1	'0': No status on Non addressed feeders '1': Status on Non addressed feeders or for that have some relevant information (default).
212	Status on Close	R/W	1	'0': No status on Close (default). Close Cassettes command *will not* answer with X'61' Cassette Lock Faulty if the command was not successful. '1': Status on Close. Close Cassettes command *will* answer with X'61' Cassette Lock Faulty if the command was not successful.
214	Send Self Test Data option	R/W	1	'0': Send Self Test Data for Note Feeders (G1-G8) will answer as in FW 2001-03.26 (default). '1': Send Self Test Data for Note Feeders (G1-G8) will with more relevant information. The answer string is longer.
217	Clean NS Rollers	W	1	'1': Drives to transport in 500mm/s in 20 seconds. Used for cleaning of the Note Stacker prism.
218	Clean NF Rollers	W	1	Used for cleaning and scrubbing the Note Feeder rollers. '1': NF1 (NQ Feeder) '2': NF2 etc.
223	NF Rollers Clean flag	R/W	1	'0': No automatic cleaning of NF Rollers '1': NF Rollers cleaned at every Close Cassette command

224	Deliver Time-out	R/W	1	The presented note bundle is drawn back on time-out. '0': 180 sec. (default) '1': 20 sec. (NMD 100 value)
225	Cassette inserted indicator	R/W	1	'0': No indicator of Cassette properly inserted '1': Sound indicator enabled. Flipping the diverter four times makes the sound. The cassettes has to be out of the NMD at least 5 seconds before it is inserted again.
227	Notes between press at open cassette	R/W	3	Specifies the number of fed notes between moving the packer plate in HPF mode. Default is 40 notes.
228	High pressure mode at open	R/W	1	'0': No HPF mode at open cassette.(default) '1': HPF mode at open cassette.
229	Scrub NF Rollers	W	1	Used for cleaning and scrubbing the CRR rollers. Makes a lock cassette before scrubbing the CRR rollers and reopens it again '1': NF1 (NQ Feeder) '2': NF2 etc.
230	Suspicious Delivery Flag	R/W	1	Flag indicating a unsuccessful Deliver command that failed due to manipulation of the shutter or throat. It will also be set by a Retract command or an Auto-Retract. Reset by writing '0'.
233	Number of notes between NF scrub	R/W	4	Specifies how often the automatic NF-roller scrubbing will be done. The scrubbing is made on a Close Cassette command when the specified number of notes is fed (default: 2000 notes). If this item is set to '0' no scrub is done if not Item 223 is set to '1'.
235	Max number of Feed retries	R/W	1	Number of feed-error retries before Failure to Feed is reported is possible to set between 1 to 5 (default:5).
237	Default Machine settings	W	1	WD/237/1 sets all machine settings to default. A power off power on has to be made before the default machine settings are actual.

READ/WRITE DATA ITEMS DESCRIPTION

239 Timeout on Reset and R/W   1   The commands Reset and Close Cassettes
Close Cassette   gives an answer within this time. When this
                                       item is set to '1' a reset cycle is performed
                                       on power on.

                                       '0': 180 sec. (default)
                                       '1': 20 sec.

240 Detect Cassette Out on R/W   1   Detects if the cassette is pulled out during
Close   close before it is locked. The result of Close
                                       Cassette will then be a new error code 0X70
                                       Cassette Out on Close.
                                       '0' : Disabled (default).
                                       '1' : Enabled.

241 Optimised Main Motor R/W   1   Optimised main motor start to prevent main
Start   motor failure.
                                       '0' : Standard motor start (default)
                                       '1' : Slow motor start.
                                       An NMD with 5 or more feeders will
                                       automatically use the optimised main motor
                                       start

244 BCU Home Delay   R/W   1   Delay for the BCU before it moves to home
                                       position after the notes has been taken
                                       Possible to set between 0 and 5 seconds.
                                       Default is 0 seconds delay.

300	Internal reject table	R	24*6	This table specifies the number of times each reject reason has occurred. This item contains 24 entries Format: *RRnnn…* RR: Reject Reason code nnn: Number of occurrence of each reject reason. This item can be called with *cccmmet* parameter, to get the reject reason counters for one denomination. Reject reason counters for the last ten denominations is stored.
301	Status code table	R	40*5	This table specifies the number of times each status code has occurred. This item contains 40 entries. Status X'30' is not logged. Format: *SSnnn…* SS: Status code nnn: Number of occurrence of the status code
303	Total notes delivered	R	10	Total number of notes delivered.
304	Total notes rejected	R	10	Total number of notes rejected.
305	Total bundle rejects	R	10	Total number of bundle rejects
308	Total notes single rejected	R	10	Total number of notes rejected with single rejects.
309	Total notes bundle rejected	R	10	Total number of notes rejected with bundle rejects.
310	Clear Note statistic counters	W	1	'0': Clear the contents of item 300,301,303,304,305,308,309,318,319, 320 and 390.

READ/WRITE DATA ITEMS DESCRIPTION

311	Module Error Log	R/W	8*28	Command Message String: TTEELLLL… Where:

311   Module Error Log   R/W   8*28   Command Message String:
TTEELLLL…
Where:
     T = Task Number
     E = Module Error Code
     L = Module Line Number
The Module Error log has four levels
Which make it possible to log the last 112 internal errors.
To see all errors this item must be called with a parameter.

'0' : The last 28 internal errors
'1' : Error 29 – 56
'2' : Error 57 – 84
'3' : Error 85 – 112
'L' : Up to 28 errors since last reading
No parameter gives the last 28 errors.

Write data with parameter '0' clear the contents of item 311.

313   BCU overheat counter   R/W   5/1   Counts up every time the BCU get stuck on its way to the wanted destination. This may be due to a position sensor malfunction, or the path selector or the BCU not working properly.
Read: a five-digit string displays the counter value.
Write: '0' clears the counter.

314   Delivery time-out counter   R/W   5/1   Counts every time delivery time-out occurs. Write: '0' clears the counter.

315   Reject and Retract Counters   R   Command Message String
/sss/bbb/rrr/ccc/nnn/ttt/
Where:
S = No notes in Single Reject
B = No note in Bundle Reject
R = No retracted notes.
C = Calc no notes in Bundle Reject
N = No bundles in Bundle Reject
T = No retracts.

318   Total notes delivered (high perform. feed)   R   10   Total notes delivered when notes are fed in 'high performance feed' mode

319   Total notes rejected (high perform. feed)   R   10   Total notes rejected when notes are fed in 'high performance feed' mode

320   Total number of transactions bundles   R   10   Total number of transactions bundles completed.

330	Total notes delivered (Life Long)	R	10	Total number of notes delivered.
331	Total notes rejected (Life Long)	R	10	Total number of notes rejected.
332	Total bundle rejects (Life Long)	R	10	Total number of bundle rejects
333	Total number of transactions bundles (Life Long)	R	10	Total number of transactions bundles completed.
334	Total number retracts (Life Long)	R	10	Total number of retracts.

READ/WRITE DATA ITEMS DESCRIPTION

350	NS Entry sensor calibration value	R/W	3/1	Read: value in percent 000 - 100. Write: '0' to clear the value.
390	Total number retracts	R	10	Total number of retracts.
392	NQ Note data table initialisation	W	1	'0': Clears the NQ Note data table.
393	Position BCU	W	1	Moves the Bundle Carriage unit to requested position. NOTE! This is a regarded as a test command without the normal error handling. '0': Home position '1': Reject position '2': Hold position
394	Position Shutter	W	1	Move the Shutter to requested position. '0': Open Shutter '1': Close Shutter
395	Enable/Disable Reject Vault	R/W	1	'0' : Disable Reject Vault '1': Enable Reject Vault (Default)
396	Enable/Disable Stack Presenter	R/W	1	'0' : Disable Stack Presenter '1': Enable Stack Presenter (Default)
397	Module Status	R	12*9	Specifies status of modules. TTT/EE/LLLL/ Where: TTT = task EE = module error code LLLL = module line number
398	Configure reject calculation	R/W	2	Specifies correction value for bundle reject calculation. Legal values: 1 - 20 (Default=15)
399	Max notes in single reject compartment	R/W	3	Specifies the maximum number of notes in the single reject compartment Legal values: 1 - 200 (Default=50) **Warning**: A high value could cause jam in the single reject inlet of the Reject Vault.

The cassette table consists of data related to each cassette present in the NMD.

All cassette data table item numbers are written on the following format:
9H_nn_

> Where: 9 specifies the data table.
> H specifies the position of the cassette, where 0=Reject vault, 1=Cassette in first Feeder and 8=Cassette in last Feeder.
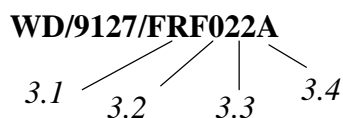> _nn_ specifies the Item.

Changing currency and denomination

Use the command **WD/9H27/cccmmet**.

3.1	**ccc** =	Currency code according to DIN 30784 and ISO 4217. When a note not included in ISO 4217 is used the currency code should be set to **?xx,** where **xx** is a De La Rue recommended code for the specific note.
3.2	**mm**e=	Is the denomination where **mm** is the mantissa, the mantissa should coded with as low value as possible, i.e. the exponent should be as high as possible, the most significant digit should be "0" for all currencies not needing two digits to describe the value.
3.3	mm**e** =	Where **e** is the number of trailing zeros
3.4	**t** =	Is the Variant/Issue, **t** is a letter code where "A" is the first Issue/Variant in circulation, "B" the second and so on. If the variant is not needed or not used the code should be set to "_".

Ex. The cassette is inserted in NF1, the note to be used is a 200 French Franc of the first issue/variant. The command is:
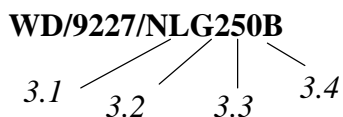
WD/9127/FRF022A

   3.1   *3.2*   *3.3*   *3.4*

A Dutch 25 Gelder note of issue/variant B in NF2 gives in the same way the Command:

WD/9227/NLG250B

   3.1   *3.2*   *3.3*   *3.4*

Note: It is very important to code the cassette according to this description because the NMD use this for adjust the Note Feeders and Double Detect parameters.

READ/WRITE DATA ITEMS DESCRIPTION

Changing the Cassette ID

Use the command WD/9H28/XXXXXXXX

XXXXXXXX   The three most significant digits are recommended to be coded with 000 when used in mechanisms emulating a MDDM

XXX**XXXXX**   The five least significant digits are the five-digit number reported in the response to the Reset and Read Cassette ID commands. The coding of these five digits is totally transparent to the dispensing mechanism.

Note!
If the mechanism is used with an Application program written for the MDDM/SD300 it's recommended that this eight digits is used in the following way :

<u>000</u><u>**10052**</u>

Not used always 000

Denomination code

Cassette Identification

Use digits 0 to 5 for denomination coding with the lowest digit for the lowest denomination. Reserve code 6 for the reject vault.

It's strongly recommended that if a new application is written that this parameter is used as pure cassette identification enabling future expansion to a full 8-digit identifier.

READ/WRITE DATA ITEMS DESCRIPTION

Changing Note size (Note width and length)

Use command **WD/9H29/vvvhhh**

vvvhhh = Vertical size of note (width) in mm
vvv**hhh** = Horizontal size of note (length) in mm
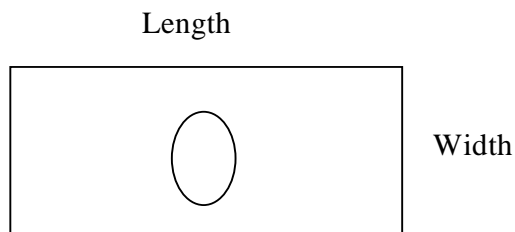
Verifying cassette coding

All coding can be read out by using command Read Data. **RD/9H27**, **RD/9H28** and **RD/9H29**. As with Write the variable H addresses the location in the mechanism.
The reply string will have the format S/YYY…Y where S is the general status code and YYY…Y is the actual setting with the same format as Write Data.

Ex. Read currency and denomination in NF4 the note is a 10 000 Italian Lira of third variant/issue:

Command: **RD/9427**
Reply: **0/ITL015C**

General   Currency Denomination Variant C
status   code   10 000
code

Length

Width

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5 STATUS HANDLING

5

5.1 Introduction

This Section describes in detail each individual status code sent back to the network by the NMD.

Each one of the Status Codes, will be provided with following information:
Status Code.
Mnemonic name.
Status Description.
Applicable Commands.
Recommended Actions.
Recommended Operator Message.

Table 5-1 shows all the possible Status Codes, with the Mnemonic Names used throughout this Section, and their different types, which will be described in the following paragraph.

Status	Code	Ch	Reset X'30' 0	Move Forward X'32' 2	Deliver X'33' 3	Reject X'34' 4	Read Cassette Id. X'35' 5	Close Cassette X'37' 7	Opens Cassette X'38' 8	Read Trace X'39' 9	Check Bundle Output Unit X'3A' :	Read Prog Id X'41' A	Retract X'44' D	Send Self Test Data X'47' G	Resend Message X'4B' K	Check NMD Status X'51' Q	Read Data X'52'/X'44'	Write Data X'57'/X'44'
Successful Command.	X'30'	0	A	A	B	B	A	B	B	B	B	B	B	B	B	A	B	B
Low Level.	X'31'	1	A	A			A									A		
Empty Cassette.	X'32'	2	A	A			A									A		
Machine not Opened.	X'33'	3			B	B	B						B					
Rejected Notes.	X'34'	4		B														
Diverter Failure	X'35'	5	B	B	B	B	B	B	B				B			B		
Failure to Feed.	X'36'	6		A														
Transmission Error.	X'37'	7	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Illeg Com. or Com. Seq.	X'38'	8	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Jam in Note Qualifier	X'39'	9	B	B	B	B	B	B	B				B			B		
NC Not Pres or Prop Ins.	X'3A'	:		A			A							A			B	B
No Notes Retracted.	X'3C'	<											B					
RV Not Pres or Prop Ins.	X'3F'	?	A	A		B	A	B	B				B			A		
Delivery Failure.	X'40'	@	B	B	B	B	B	B	B				B			B		
Reject Failure.	X'41'	A	B	B	B	B	B	B	B				B			B		
Too Many Notes Req.	X'42'	B		B														
Jam in Note Feeder Transport	X'43'	C	B	B	B	B	B	B	B				B			B		
Reject Vault Almost Full.	X'44'	D	A	A			A	A	B				B			A		
Cassette Internal Failure	X'45'	E	A				A		B							A	B	B
Main Motor Failure.	X'46'	F	B	B	B	B	B	B	B				B			B		
Rejected Cheque	X'47'	G		A														
Note Qualifier Faulty	X'49'	I	B	B	B	B	B	B	B				B			B		
NF exit sensor failure	X'4A'	J	A	A			A							A		A		
Shutter Failure	X'4B'	K	B	B	B	B	B	B	B				B			B		
Notes in Bundle Output Unit	X'4D'	M		B	B	B					B							
Communications Time-out.	X'4E'	N	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B
Cassette not Identified.	X'50'	P		B	B	B							B					
Reject Vault Full.	X'51'	Q	B	B	B	B	B		B				B			B		
Error in Throat.	X'57'	W	B	B	B	B	B	B	B				B			B		
Sensor Err or Sensor Cover.	X'5B'	[	B	B	B	B			B				B	B		B		
NMD Internal Failure	X'60'	'	B	B	B	B	B	B	B				B			B	B	B
Cassette Lock Faulty	X'61'	a					A		B							A		
Error in Note Stacking Area	X'62'	b	B	B	B	B	B	B	B				B			B		
Module Need Service	X'63'	c	A	A			A		B							A		
No Message To Resend.	X'65'	e													B			
Cassette out Error	X'70'	p	A	A	B	B	A	B	B				B		B	A		

Table 5-1

Notes: A = This Status can appear as General Status and as Hopper Status.

B = This Status appears only as General Status.

Table 5-1 shows all the possible Status Codes, with the Mnemonic Names used throughout this Section, and their different types, which will be described in the following paragraph.

* Only when item 240 is set to '1'.

Status codes

Tabell 5-2

MNEMONIC NAME	TYPE	HEX	ASCII
Successful Command	W	X'30'	0
Low Level	W	X'31'	1
Empty Cassette	O	X'32'	2
Machine not Opened	O	X'33'	3
Rejected Notes	W	X'34'	4
Diverter Failure	F	X'35'	5
Failure to Feed	R	X'36'	6
Transmission Error	S	X'37'	7
Illegal Command or Command Sequence	S	X'38'	8
Jam in Note Qualifier	F	X'39'	9
Feed Cassette Not Present or Properly Installed	O	X'3A'	:
No Notes Retracted	W	X'3C'	<
Reject Vault Not Present or Properly Installed	O	X'3F'	?
Delivery Failure	F	X'40'	@
Reject Failure	F	X'41'	A
Too Many Notes Requested	O	X'42'	B
Jam in Note Feeder Transport	F	X'43'	C
Reject Vault Almost Full	W	X'44'	D
Cassette Internal Failure	R	X'45'	E
Main Motor Failure	F	X'46'	F
Rejected Cheque	W	X'47'	G
Note Qualifier Faulty	F	X'49'	I
Note Feeder exit sensor failure	R	X'4A'	J
Shutter Failure	F	X'4B'	K
Notes in Bundle Output Unit	O	X'4D'	M
Communications Time-out	S	X'4E'	N
Cassette not Identified	S	X'50'	P
Reject Vault Full	O	X'51'	Q
Error in Throat	F	X'57'	W
Sensor Error or Sensor Covered	R	X'5B'	[
NMD Internal Failure	F	X'60'	'
Cassette Lock Faulty	F	X'61'	a
Error in Note Stacking Area	F	X'62'	b
Module Need Service	W	X'63'	c
No Message To Resend	W	X'65'	e
Cassette out on Close	F	X'70	p

5.2   Status types

The different Status Codes sent back to the network in the Reply Message are classified into five different groups, depending on the priority level of the reported situation.

Each one of these groups will imply a different action for the Application Program handling them. The five groups, and the status included under each one of them, are:

5.2.1 WARNING Status (Type W)

This status codes give the operator some information about the system, which does not require any immediate action. The requested command has been completed.

The statuses of type W are:
X'30'	=	Successful Command
X'31'	=	Low Level
X'34'	=	Rejected Notes
X'3C'	=	No Notes Retracted
X'44'	=	Reject Vault Almost Full
X'47'	=	Rejected Cheque
X'63'	=	Module Need Service
X'6A'	=	No Data Available

5.2.2 SOFT RECOVERABLE Status (Type S)

All this status codes informs the Application Program that the associated command has not been executed. However, there is not any hardware failure in the machine, so that it in most cases would be possible to send the last command again, and if the same status remains, check the Application Program and/or check the communication line.

X'37'	=	Transmission Error
X'38'	=	Illegal Command or Command Sequence
X'4E'	=	Communications Time-out
X'50'	=	Cassette not Identified

5.2.3 OPERATOR RECOVERABLE Status (Type O)

Like the status codes of the preceding group, these ones also imply that the associated command has not been executed. There could be different reasons, but all of them could be easily solved by an operator action, like refill empty Cassettes or sending OPEN CASSETTE command.

X'32'	=	Empty Cassette
X'33'	=	Machine not Opened
X'3A'	=	Note Cassette Not Present or Properly Installed
X'3F'	=	Reject Vault Not Present or Properly Installed
X'42'	=	Too Many Notes Requested
X'4D'	=	Notes in Bundle Output Unit
X'51'	=	Reject Vault Full

5.2.4 RETRIABLE FATAL Status (Type R)

The status codes included in this group are rather serious, as they probably will imply a hardware failure. The associated command is not executed at all, but could be tried again. If the status code is repeated after this second try, the system should be taken out of service.

X'36'	=	Failure to Feed
X'45'	=	Cassette Internal Failure
X'4A'	=	Feeder Sensor Fail.
X'5B'	=	Sensor Error or Sensor Covered
X'65'	=	No Message To Resend

5.2.5 FATAL Status (Type F)

The status codes defined as Fatal imply a serious problem. The associated command has not been completed and the execution was terminated at the stage where the fatal problem was detected. The NMD will respond to all movement commands with the same fatal error status until appropriate action has been taken. Please refer to description of each fatal status to which appropriate action has to been taken.

The FATAL Statuses are divided into two severity types and the action to be taken depends on which type the received status belongs to.

1) The application may send an X'30' RESET command to recover from the problem. If the Status appears again the system must be put out of service, until a Field Service Engineer has revised it.

The Statuses of this type are:

X'40'	=	Delivery Failure
X'41'	=	Reject Failure
X'43'	=	Jam in Note Feeder Transport
X'46'	=	Main Motor Failure
X'49'	=	Note Qualifier Faulty
X'4B'	=	Shutter Failure
X'60'	=	NMD Internal Failure
X'61'	=	Cassette Lock Faulty

2) The NMD must be put out of service, until a Field Service Engineer has revised it.

The Statuses of this type are:

X'35'	=	Diverter Failure
X'39'	=	Jam in Note Qualifier
X'57'	=	Error in Throat
X'62'	=	Error in Note Stacking Area

5.2.6 Lock out conditions

Under certain circumstances, the system sets itself in the LOCK OUT condition. When this happens, all the Reply Messages of movement commands are sent in the short format, containing only the General Status byte, until the LOCK OUT condition is cleared. Meanwhile, only very few commands are accepted by the system.

There can be different reasons that put the machine into the LOCK OUT state. Each one of the LOCK OUT conditions are explained below with the ways of recovery and also the commands which are not accepted during this LOCK OUT condition.

Machine not Opened

When the lifts have been run to loading position, after a power-up or hardware reset, the LOCK OUT condition is set.
Issuing the command X '38' OPEN CASSETTE clears the condition.

The following commands are not accepted during the LOCK OUT condition:

    X'32'   MOVE FORWARD
    X'33'   DELIVER
    X'34'   REJECT
    X'44'   RETRACT

Cassettes not identified

When the lifts have been run to operating position or if any cassette has been changed, the LOCK OUT condition is set.
Issuing the command X '35' READ CASSETTE-ID clears the condition.

The following commands are not accepted during the LOCK OUT condition:

    X'32'   MOVE FORWARD
    X'33   DELIVER
    X'34'   REJECT
    X'44'   RETRACT

Reject Vault full

When the limit for number of rejected notes has been exceeded for one or both of the two reject compartments in the Reject Vault, the system stays in LOCK OUT condition until the Reject Vault is unloaded and emptied. The only movement commands accepted are:

    X'37'   CLOSE CASSETTE

Note!
The normal reject cycle performed at CLOSE CASSETTE will not be executed when this lock out condition is present, only a Stack Reject will occur empty the Bundle Carriage Unit.

Fatal jam

All the status codes defined as fatal will cause this LOCK OUT condition. In this situation, the only movement commands acceptable are:

    X'30'   RESET
    X'37'   CLOSE CASSETTE

5.3   Status description

Included in the following pages, is a detailed description of each one of the different status codes, which can appear in the Reply Messages from the NMD Controller to the Network.

Each status can be easily identified by its mnemonic name, and also by its ASCII code. The different statuses are described in the natural sequence of their hexadecimal values.

Status Description:

This status is sent to the Network, when the command has been successfully executed.

Applicable Commands:

See table 5-1

Recommended Actions:

No action is required.

Operator Message:

There is no recommended message for this status.

Status Description:

This status is sent to the network when the number of notes in one or more Cassettes is below a pre set level. This means that the low-level sensor in the Note Cassette has been activated. Roughly, this happens when the number of notes left in the cassette represents a note pile of less than 20-30 mm.
Low Level can also be sent to the network on a Move Forward command from a not addressed position with Empty Cassette status.

Applicable Commands:

See table 5-1

Recommended Actions:

The Cassettes should be removed and filled using the normal procedure. The refilling could be delayed for several transaction since this status is a first warning that the cassette is becoming empty and the Cassette still contains notes for several transactions. But actions should be taken to refill the cassette as soon as possible.

This message could also direct the Application Program to use alternate Cassettes in the following transactions.

Operator Message:

The recommended message that the Application Program should send to the operator is:

31-W LOW LEVEL IN CASSETTE NNNNN

Status Description:

This status is generated when a Cassette is empty during a dispense operation. The notes picked up until this condition arises are sent to the Stack reject area in the Reject Vault, and the transaction is aborted. For compatibility reasons Empty cassette are only reported when notes is requested from the cassette being empty, Empty cassettes not requested in the Move Forward command will have there hopper status set to Low Level. On the commands Reset and Read cassette ID X'35' cassettes with empty condition will reply with X'32' EMPTY CASSETTE in the Reply Message for the cassettes being empty.

If Change Over Method is used (item 127 set to 1), X'32' EMPTY CASSETTE will be reported as hopper status on the cassettes that becomes empty during the transaction, but the overall status will be X'31' LOW LEVEL or X'34' REJECTED NOTES if the transaction is successfully performed.

Applicable Commands:

See table 5-1

Recommended Actions:

The empty Cassette should be removed and refilled using the normal loading procedures. The status could also be used to trigger the Application Program to begin using alternate note Cassettes in the following transactions.

Operator Message:

The recommended message that the Application Program should send to the operator is:

32-O CASSETTE NUMBER NNNNN IS EMPTY

MACHINE NOT OPENED   Status *X'33'*
Type O

Status Description:

This status code arises when the cassettes, including the Reject Vault are not opened and any movement command different from OPEN CASSETTE, RESET and CLOSE CASSETTE are sent to the system.

It is also possible that this status is sent to the network, even if the lifts are in the up position. This will occur if the machine is switched off and on during normal daily operation. This is to indicate that the power has been off.

Applicable Commands:

See table 5-1

Recommended Actions:

Send the commands OPEN CASSETTE and READ Cassette-ID.

Operator Message:

The recommended message that the Application Program should send to the operator is:

33-O MACHINE NOT OPENED

Status Description:

This status indicates that notes have been rejected during the transaction before the requested amount is stored in the bundle.

The Reply Message informs of the total number of notes fed from each module, including those rejected. Hopper number 0 field, will detail the total number of notes counted in the Note Qualifier, both delivered and rejected.

Rejection counters in the Application Program can be updated by subtracting the total number of notes requested from the total number of notes counted in the Note Qualifier. However, it must be kept in mind that this figure might be not exact, because rejected notes can be anything from two notes stuck together to a sheet of paper.

Applicable Commands:

See table 5-1

Recommended Actions:

Being a warning message, the only action required is to provide the Application Program with the proper subroutines to keep control of the number of rejected notes. The reject trace area should be read and the latest reject reason is stored by the application in a maintenance log file.

Operator Message:

The recommended message that the Application Program should send to the operator is:

34-W CAUTION: NOTES REJECTED

NOTE DIVERTER FAILURE   Status *X'35'*
Type F

Status Description:

This status indicates that the system has recognised a note that was intended to be single rejected in the Note Stacker inlet, or a note that was intended to be stacked in the Note Diverter sensor for single reject. The most likely reason is either a mechanical or an electrical failure in the Note Diverter. Therefore it is qualified as Fatal Error.

Applicable Commands:

See table 5-1

Recommended Actions:

The content of the machine has to be verified, all transaction must be suspended, and the system must be set out of service until revised by a Field Service Engineer. However, to empty the machine from notes a CLOSE CASSETTE command could be sent and the cassettes could be removed.

Operator Message:

The recommended message that the Application Program should send to the operator is:

35-F NOTE DIVERTER FAILURE. **CALL SERVICE ENGINEER**

Status Description:

This status appears when the system fails to dispense the requested amount of notes.

Applicable Commands:

See table 5-1

Recommended Actions:

There could be different reasons to report this status. One reason is that the Note Feeder fails to feed notes; another is that there are too many single rejected notes in the transaction. However, it is not a Fatal Status, so that the Application Program could try *one* more time. If the situation still remains the same, put the hopper position out of service, continue to feed notes from remaining positions and call for a Field Service Engineer.

Operator Message:

The recommended message that the Application Program should send to the operator is:

36-R FAILURE TO FEED. **CONTINUE OPERATION FROM REMAINING FEEDER POSITIONS **

TRANSMISSION ERROR Status *X'37'*
Type S

Status Description:

This status occurs when the message received by the NMD has a wrong LRC character or a parity error. Therefore, the cause of the problem must be either some error in the Application Program Subroutines dealing with LRC calculation or a problem in the communication line.
See also chapter 6.

Applicable Commands:

See table 5-1

Recommended Actions:

The Application Program could try to send the command, again because the problem might have arisen because of a random noise in the line.

Operator Message:

The recommended message that the Application Program should send to the operator is:

37-S TRANSMISSION ERROR

ILLEGAL COMMAND OR COMMAND SEQUENCE Status *X'38'*

Status Description:

This error appears when the logical sequence of the commands sent to the NMD is not the one expected by the NMD. This can happen if two MOVE FORWARD commands are sent one after the other, or if DELIVER is sent without any previous MOVE FORWARD. The failure can also appear if an unknown command is sent to the NMD, or if a command with wrong parameters is sent to the NMD.

Applicable Commands:

See table 5-1

Recommended Actions:

Please check the application.

Operator Message:

The recommended message that the Application Program should send to the operator is:

38-S ILLEGAL COMMAND.

JAM IN NOTE QUALIFIER   Status *X'39'*
Type F

Status Description:

This status indicates that a note is detected in the Note Qualifier but not seen in the Note Stacker inlet sensor or Note Diverter sensor, probably due to a jam in the transport between the Note Qualifier and Note Diverter.

Applicable Commands:

See table 5-1

Recommended Actions:

The content of the machine has to be verified, all transaction must be suspended, and the system must be set out of service until revised by a Field Service Engineer. However, to empty the machine from notes a CLOSE CASSETTE command could be sent and the cassettes could be removed.

Operator Message:

The recommended message that the Application Program should send to the operator is:

39-F JAM IN NOTE QUALIFIER   **CALL SERVICE ENGINEER**

FEED CASSETTE NOT PRESENT OR OPENED Status *X'3A'*

Status Description:

This status appears when requesting notes from a cassette, which either is not present, or it is not opened. It can also occur if the Command addresses a non-existing feed module. The status can also appear if data has been written to the cassette with item 9Hnn. This status also appears as Hopper Status.

Applicable Commands:

See table 5-1

Recommended Actions:

The operator should insert and open the cassette, read cassette numbers and resume transactions. If data has been written to the cassette it has to be removed and inserted again before it is opened.

Operator Message:

The recommended message that the Application Program should send to the operator is:

3A-O INSERT CASSETTE NNNNN AND START UP AGAIN

NO NOTES RETRACTED Status *X'3C'*
Type W

Status Description:

.

This status code can appear only after a RETRACT command. The status is set when no notes were retracted due to an empty Bundle Carriage Unit, BCU. The BOU Exit sensor and the BOU Empty sensor perform this check.
If a fatal status code occurs during a retract sequence (i.e. when a Retract command has been given) and a "No Notes Retracted" status code occurs at the same time, the later status code should have the higher priority but the fatal status code should be presented on the following commands until the appropriate action has been taken

Applicable Commands:

See table 5-1

Recommended Actions:

This status indicates that the notes have been removed and no special action has been taken except the normal transaction logging.

Operator Message:

The recommended message that the Application Program should send to the operator is:

3C-W NO NOTES RETRACTED

REJECT VAULT NOT PRESENT OR OPENED Status *X'3F'*

Type O

Status Description:

Whenever a movement command is received, the system checks that the Reject Vault is properly loaded in the machine. If not, this status code is sent, and the transaction is ignored. Only exception is the movement command CLOSE CASSETTE, which will be done without the reject cycle.

Applicable Commands:

See table 5-1

Recommended Actions:

The operator should insert the Reject Vault properly, open the Reject Vault, read the cassette numbers and resume daily transactions.

Operator Message:

The recommended message that the Application Program should send to the operator is:

3F-O INSERT REJECT VAULT

DELIVERY FAILURE Status *X'40'*
Type F

Status Description:

This status is generated by the NMD when the Bundle Carriage fails to move the notes from the home position to the Bundle Output Unit, BOU, see 2.1. When this status is set the notes have not reached the delivery opening.

Delivery Failure can only appear when Move Forward and Hold option is disabled with item 208.

The failure might be caused by some serious hardware problem in the Stack Presenter; therefore it is defined as fatal, and will cause a LOCK OUT condition.

Applicable Commands:

See table 5-1

Recommended Actions:

The NMD must be put out of service, until a Field Service Engineer has revised it.

Operator Message:

The recommended message that the Application Program should send to the operator is:

40-F DELIVERY FAILURE **CALL SERVICE ENGINEER**

Status Description:

This status appears in the following situations.

- When a note that was supposed to be single rejected appears in the Note Stacking sensor during a transaction.
- When the Bundle Carriage not reaches the right position when moving to reject position or back to home position, see 2.1.
- When it is not possible to move the shutter in the Reject Vault to the right position.

It is a fatal error. The command is not executed.

Applicable Commands:

See table 5-1

Recommended Actions:

The application program should send a RESET command. If the response on the RESET command indicates successful execution, operation can be resumed from the point where the problem occurred. If the problem returns or if the RESET command was unsuccessful the NMD must be put out of service until revised by a Field Service Engineer.

Operator Message:

The recommended message that the Application Program should send to the operator is:

41-F REJECT FAILURE. **CALL SERVICE ENGINEER**

Note: The text ****CALL SERVICE ENGINEER**** should not be reported before the recovery procedure has failed.

TOO MANY NOTES REQUESTED Status *X'42'*
Type O

Status Description:

This status appears when a transaction with too many notes is requested. Maximum number of notes is default 100, but can be redefined with item 104. The transaction is not executed, and the status code is sent back to the network.

Applicable Commands:

See table 5-1

Recommended Actions:

The operator should repeat the transaction, asking for a smaller number of notes.

It is recommended that the Application program is checked, while this status indicates that the number of notes requested is higher than the maximum number of notes defined in item 104.

Operator Message:

The recommended message that the Application Program should send to the operator is:

42-O MORE THAN NNN NOTES REQUESTED

Status Description:

This status is sent when a note is fed from the feeder, but not reached the Note Qualifier in time. The failure could appear if a jam occurs between the feeder and the Note Qualifier, or if the note is not detected in the Note Qualifier.

Applicable Commands:

See table 5-1

Recommended Actions:

The application program should send a RESET command. If the response on the RESET command indicates successful execution, operation can be resumed from the point where the problem occurred. If the problem returns or if the RESET command was unsuccessful the system must be put out of service until revised by a Field Service Engineer.

Operator Message:

The recommended message that the Application Program should send to the operator is:

43-F JAM IN NOTE TRANSPORT. **CALL SERVICE ENGINEER**

Note: The text ****CALL SERVICE ENGINEER**** should not be reported before the recovery procedure has failed.

REJECT VAULT ALMOST FULL Status *X'44'*
Type W

Status Description:

This status is sent, both as General and as Hopper status, when the internal reject counter for bundle reject or when the counter for single rejects reach the limit for almost full.

The algorithm for the counter C of BUNDLE rejects is
$C = (((100-m)*n)/100)+m$.
Where
n = actual number of notes in the bundle
m = a number between 0-20 to adjust the calculation
m is set with Information Item 398
The status REJECT VAULT ALMOST FULL is sent when the Counter C exceeds 187.

The counter for SINGLE reject is incremented by one for each single rejected note. The default limit for almost full in single reject area is 37.
The limit for REJECT VAULT FULL can be set between 1 and 200 with item 399. In that case the limit for REJECT VAULT ALMOST FULL is 75% of the limit for REJECT VAULT FULL.
Ex. If item 399 is set to 100, REJECT VAULT ALMOST FULL occurs when the counter for single rejects exceeds 75.

Applicable Commands:

See table 5-1

Recommended Actions:

The Reject Vault should be emptied as soon as possible to avoid a LOCK OUT condition when the internal counter for bundle rejects is above 250 notes, or the counter for single reject is above 50. The Reject Vault must be emptied with power on.

Operator Message:

The recommended message that the Application Program should send to the operator is:

44-W REJECT VAULT MUST BE EMPTIED

Status Description:

This status is sent if there is a checksum error in the data stored in the Note Cassette.

Applicable Commands:

See table 5-1

Recommended Actions:

Put Cassette out of service.

Operator Message:

The recommended message that the Application Program should send to the operator is:

43-R CASSETTE INTERNAL FAILURE

MAIN MOTOR FAILURE Status *X'46'*
Type F

Status Description:

This status occurs when main motor has not reached the normal speed in time, or if there are several missing pulses from the transport clock wheel in one transaction. As with any other fatal error, this status code generates a LOCK OUT condition, and the command is not executed.

Applicable Commands:

See table 5-1

Recommended Actions:

The application program should send a RESET command. If the response of the RESET command indicates successful execution operation can be resumed from the point where the problem occurred. If the problem returns or if the RESET command was unsuccessful the system must be put out of service until revised by a Field Service Engineer.

Operator Message:

The recommended message that the Application Program should send to the operator is:

46-F MAIN MOTOR FAILURE ** CALL SERVICE ENGINEER**

Note: The text ****CALL SERVICE ENGINEER**** should not be reported before the recovery procedure has failed.

Status Description:

This status indicates that a note has been rejected during the transaction before the requested amount is stored in the bundle.
The status is used unique for Note Cassettes coded with denomination code '**?xx**'.

The Reply Message informs of the total number of notes fed from each module, including those rejected. Hopper number 0 field, will detail the total number of notes counted in the Note Qualifier, both delivered and rejected.

Reject counters in the Application Program can be updated by subtracting the total number of notes requested from the total number of notes counted in the Note Qualifier. However, it must be kept in mind that this figure might be not exact, because rejected notes can be anything from two notes stuck together to a sheet of paper.

Applicable Commands:

See table 5-1

Recommended Actions:

Being a warning message, the only action required is to provide the Application Program with the proper subroutines to keep control of the number of rejected notes. The reject trace area should be read and the latest reject reason should be stored by the application in a maintenance log file.

Operator Message:

The recommended message that the Application Program should send to the operator is:

47-W REJECTED CHEQUE. TRANSACTION CANCELLED

NOTE QUALIFIER FAULTY Status *X'49'*
Type F

Status Description:

This status is sent back to the network from the NMD, when it is not possible to calibrate the double detects sensors in the Note Qualifier, or when it is not possible to adjust the gain value when learning a new note. Being a fatal error, the transaction is not completed, and a LOCK OUT condition is generated.

Applicable Commands:

See table 5-1

Recommended Actions:

The application program should send a RESET command. If the response on the RESET command indicates successful execution, operation can be resumed from the point where the problem occurred. If the problem returns or if the RESET command was unsuccessful the system must be put out of service until revised by a Field Service Engineer.

Operator Message:

The recommended message that the Application Program should send to the operator is:

49-F NOTE QUALIFIER FAULTY **CALL SERVICE ENGINEER**

Note: The text ****CALL SERVICE ENGINEER**** should not be reported before the recovery procedure has failed.

Status Description:

This status appears when a sensor error occurs in the Note Feeder, or when a note is stuck in the Note Feeder exit sensor. This error is qualified as Retriable because even if it is rather serious, the system can still be used if no notes are going to be required from that module.

Applicable Commands:

See table 5-1

Recommended Actions:

The Application Program can make a retry with the same command as used when the problem occurred. If the problem still remains, the Application Program must internally mark the particular Hopper as faulty to avoid using it until a Field Service Engineer has resolved the problem.

Operator Message:

The recommended message that the Application Program should send to the operator is:

4A-R NOTE FEEDER SENSOR FAIL **CALL SERVICE ENGINEER**

SHUTTER FAILURE Status *X'4B'*

Type F

Status Description:

This status appears if the NMD fails to operate the shutter when required. This error can only occur when shutter is activated with item 206.

Applicable Commands:

See table 5-1

Recommended Actions:

The application program should send a RESET command. If the response on the RESET command indicates successful execution, operation can be resumed from the point where the problem occurred. If the problem returns or if the RESET command was unsuccessful the NMD must be put out of service until revised by a Field Service Engineer.

Operator Message:

The recommended message that the Application Program should send to the operator is:

4B-F SHUTTER FAILURE **CALL SERVICE ENGINEER**

Note: The text ****CALL SERVICE ENGINEER**** should not be reported before the recovery procedure has failed.

Status Description:

An attempt to feed or dispense notes when a bundle is still in the BOU will cause this error to be sent back as a reply and the command will not be executed.

This status is also used as a throat status in the command CHECK BUNDLE OUTPUT UNIT.

This status will also be reported if a command X'34' REJECT is requested when there is notes in the BOU.

Applicable Commands:

See table 5-1

Recommended Actions:

If a bundle is blocking the throat opening, the bundle must be removed. Check if notes have been removed, using the command CHECK BUNDLE OUTPUT UNIT, and then repeat the original command.

Operator Message:

The recommended message that the Application Program should send to the operator is:

4D-O NOTES IN BUNDLE OUTPUT UNIT. TRANSACTION CANCELLED

COMMUNICATION TIME-OUT Status *X'4E'*
Type S

Status Description:

This error status is reported when the transmission of each one of the characters in the command string, is not completed within the time restriction imposed by the electrical interface used. See chapter 6.

Applicable Commands:

See table 5-1

Recommended Actions:

The most likely cause for this problem must be the setting up of the electrical signals in the interface, or some mistake in the Application Program, which is delaying the transmission of the characters in the command string.

In both cases, the system must be put out of service, and a full revision of the installation and Application Program should be required.

Operator Message:

The recommended message that the Application Program should send to the operator is:

4E-S COMMUNICATION TIME-OUT. REVISE INSTALLATION

Status Description:

This status is reported when a movement command is ordered without one preceding READ CASSETTE ID command after the cassettes, including the Reject Vault have been opened.

Applicable Commands:

See table 5-1

Recommended Actions:

Either the operator or the Application Program itself should send the READ CASSETTE-ID Command to recover from the LOCK OUT condition.

Operator Message:

The recommended message that the Application Program should send to the operator is:

50-S CASSETTES NUMBERS MUST BE READ NOW

REJECT VAULT FULL Status *X'51'*
Type O

Status Description:

This status is generated when the internal counter for bundle reject exceeds 250, or when the counter for single rejects exceeds 50. See description of REJECT VAULT ALMOST FULL.

It must be kept in mind that this status, even if it is not a fatal one, will cause a LOCK OUT condition, which will not be removed until the Reject Vault has been emptied. The internal counter of rejected notes is stored non-volatile during power down and restored at power up. This lead to that the Reject Vault must be removed, emptied and inserted with power on to get a proper handling of the internal reject counter.

Please refer to status X'44' REJECT VAULT ALMOST FULL for information about the way the internal reject counters is updated.

Applicable Commands:

See table 5-1

Recommended Actions:

The operator must empty and reinsert the Reject Vault before normal operation can be resumed.

Operator Message:

The recommended message that the Application Program should send to the operator is:

51-O EMPTY AND REINSERT REJECT VAULT

Status Description:

This status is reported by the NMD when an error occurs in the delivery transport path. The error code is set both during Delivery and Retract/Reject cycles when a note transport problem occurs with notes in the Bundle Output Unit and the notes are reachable by the customer.

The following situations are the most likely reasons for the return code Error in Throat.

- The exit sensor is not covered after the movement.
- The BCU doesn't move from the hold position.

See 2.1.

Applicable Commands:

See table 5-1

Recommended Actions:

The content of the machine has to be verified, all transaction must be suspended, and the system must be set out of service until revised by a Field Service Engineer. However, to empty the machine from notes a CLOSE CASSETTE command could be sent and the cassettes could be removed.

Operator Message:

The recommended message that the Application Program should send to the operator is:

57-F ERROR IN THROAT **CALL SERVICE ENGINEER**

SENSOR ERROR OR SENSOR COVERED Status *X'5B'*
Type R

Status Description:

This status is used when a sensor in the Stacker Presenter, Note Diverter or Note Stacker does not work properly during an internal self-test preceding the movement commands.

Applicable Commands:

See table 5-1

Recommended Actions:

When this status is given as reply, the application could make a retry on the command to see if the error still remains. If the error still remains the machine should be revised by a technical service engineer. One probable reason for the sensor failure is that the sensor is dirty. Another reason is that either notes or some mechanical part covers the sensor, and in this case this status does not necessarily mean that the sensor is faulty. To check which sensor is dirty or covered command X'47' Send Selftest Data can be used.

Operator Message:

The recommended message that the Application Program should send to the operator is:

5B-R ERROR IN SENSOR **CALL SERVICE ENGINEER**

Status Description:

This status is reported when an internal error occurs in the NMD. The most likely reason for this is internal communication problems in the NMD.

Applicable Commands:

See table 5-1

Recommended Actions:

The application program should send a RESET command. If the response to the RESET command indicates successful execution, operation can be resumed from the point where the problem occurred. If the problem returns or if the RESET command was unsuccessful the system must be put out of service until revised by a Field Service Engineer.

Operator Message:

The recommended message that the Application Program should send to the operator is:

60-F NMD INTERNAL FAILURE **CALL SERVICE ENGINEER**

Note: The text **CALL SERVICE ENGINEER** should not be reported before the recovery procedure has failed.

CASSETTE LOCK FAULTY Status *X'61'*
Type F

Status Description:

This status is reported by the NMD at the 'OPEN CASSETTE' command, when it fails open the Note Cassette. It is also reported at 'CLOSE CASSETTE' command if the close type 1 is used. (See description of 'CLOSE CASSETTE'). The failure can also occur when using the normal 'CLOSE CASSETTE' command, but it is not reported in that case.

The Note Cassette(s) causing the problem is/are located by issuing a READ CASSETTE-ID directly after the first occurrence of this status. The cassette causing the problem will have hopper status set to X'61' CASSETTE LOCK FAULTY, this status will also be reported as main status.

Applicable Commands:

See table 5-1

Recommended Actions:

Check the notes loaded in the cassette and if necessary reload the cassette. If the problem still remains after reloading the cassette, replace the cassette and submit the faulty one for Field Service Engineer.

Operator Message:

The recommended message that the Application Program should send to the operator is:

61-F CASSETTE FAULTY OR IMPROPERLY LOADED

Status Description:

This status appears in following situations.

- When the note is stuck in the Note Stacker inlet sensor.
- When the Note Stacker wheel is not turning.
- When the bundle carriage can not reach the home position after the bundle has been taken.

When item 208 is set to 1 (Move Forward and Hold enabled) the status can also appear when it is not possible to move the bundle carriage to hold position, see 2.1.

Applicable Commands:

See table 5-1

Recommended Actions:

The content of the machine has to be verified, all transaction must be suspended, and the system must be set out of service until revised by a Field Service Engineer. However, to empty the machine from notes a CLOSE CASSETTE command could be sent and the cassettes could be removed.

Operator Message:

The recommended message that the Application Program should send to the operator is:

62-F ERROR IN STACKING AREA ** CALL SERVICE ENGINEER**

MODULE NEED SERVICE Status *X'63'*
Type W

Status Description:

This status is reported by the NMD when calibration values for at least on sensor in the specific Note Feeder exceeds the warning level

Applicable Commands:

See table 5-1

Recommended Actions:

Check the sensor calibration values with 'SEND SELF TEST DATA' command. If the calibration value on one or more sensors is too high maintenance should be made.

Operator Message:

The recommended message that the Application Program should send to the operator is:

63-W MODULE NEED SERVICE

Status Description:

This status appears at the 'RESEND LAST MESSAGE' command when there is no command previously executed and consequently no response message to resend. This status indicates that a power loss/firmware restart has occurred at the NMD controller and no information could be retrieved.

Applicable Commands:

See table 5-1

Recommended Actions:

If the Network has sent one of the command 'DELIVER' and this status occurs after receiving command 'RESEND LAST MESSAGE', special actions must be taken. First a command 'CHECK BUNDLE OUTPUT UNIT' should be used to verify if the Deliver was completed. If the notes are detected in the bundle output unit the operation could continue. If the response on the 'CHECK BUNDLE OUTPUT UNIT' command indicates no notes in throat it's recommended that the system is taken out of service. The content of the Reject Vault should then be inspected to determine if the transaction was completed or not.

Operator Message:

There is no special recommended message for this status, as the message to send to the operator depends on the command given prior to the 'RESEND LAST MESSAGE'.

CASSETTE OUT ON CLOSE Status *X'70'*
Type F

Status Description:

This status appears when the cassette is pulled out by force during Close Cassettes.
The Cassette in this case is not locked.

The status can only appear when Item 240 is set to '1'. in following situations.

Applicable Commands:

See table 5-1

Recommended Actions:

The content of the machine has to be verified, all transaction must be suspended, and the system must be set out of service until revised by a Field Service Engineer. However, to empty the machine from notes a CLOSE CASSETTE command could be sent and the cassettes could be removed.

Operator Message:

The recommended message that the Application Program should send to the operator is:

70-F CASSETTE OUT ON CLOSE ** CALL SERVICE ENGINEER**

6 *STANDARD INTERFACE*

6

The NMD Controller Board CMC is equipped with two communication ports, one for the normal application command /reply communication J5 and a second allocated for manufacturing testing J7.

6.1 *Electrical and mechanical characteristics*

In the following text the logical state "ON" is referred to as active and the logical state "OFF" as inactive.

All interface signals meets the electrical specification of CCITT recommendation V.24 and EIA RS-232-C in asynchronous mode, with 1 Start bit, 7 Data bits and 2 Stop bits,

Signals:	Data Signals		Logical "1" : below -3 V
			Logical "0" : above +3 V
	Control Signals	"OFF"	= logical "0" : below -3 V
		"ON"	= logical "1" : above +3 V

Voltages are in reference to signal ground.

The ports have their connectors located on the NMD Central Machine Controller board. The connectors are 5 pin male AMP CT-type.

6.2 *Baud-rate and parity*

Communication with the NMD takes place at a fixed baud rate of 9600 with even parity.

6.3 *Interface signals*

The following signals are defined in the NMD application command port J5:

Circuit		PIN	IN/OUT	Signal name
CCITT	EIA			
103	BA	1	OUT	TxD Transmit Data
104	BB	2	IN	RxD Receive Data
105	CA	3	OUT	RTS Request to Send
106	CB	4	IN	CTS Clear to Send
102	AB	5	-	SG Signal Ground

6.4 *Character coding*

The NMD uses ISO 646 character coding

	0	1	2	3	4	5	6	7
0	NUL	DLE	SP	0	@	P	'	p
1	SOH	DC1	!	1	A	Q	a	q
2	STX	DC2	”	2	B	R	b	r
3	ETX	DC3	#	3	C	S	c	s
4	EOT	DC4	$	4	D	T	d	t
5	ENQ	NAK	%	5	E	U	e	u
6	ACK	SYN	&	6	F	V	f	v
7	BEL	ETB	´	7	G	W	g	w
8	BS	CAN	(	8	H	X	h	x
9	HT	EM	)	9	I	Y	i	y
A	LF	SUB	*	:	J	Z	j	z
B	VT	ESC	+	;	K	[	k	{
C	FF	FS	,	<	L	\	l	|
D	CR	GS	-	=	M	]	m	}
E	SO	RS	.	>	N	^	n	~
F	SI		/	US	O	_	o	

Table 6.01.(1): Standard ASCII code set

6.5 LRC calculation

Example: If the message string, before the LRC calculation is: A B C D
Each graphic symbol being a byte of the message string. Then, the following operations should be performed:

- Calculate the "exclusive or" of all the characters in the string:
$V = (A) .XOR. (B) .XOR. (C) .XOR. (D)$

- Divide the hexadecimal value calculated above by hexadecimal 10 , and truncate the result:
$Y = V / X'10'$

- Calculate the "logical and" between the result of the first operation and the hexadecimal (0F):
$Z = V.AND.X'0F'$

- Add hexadecimal (30) to the last two values. This will give us the two LRC bytes, L_1 and L_2:

- $L_1 = Y.OR.X'30'$

$L_2 = Z.OR.X'30'$

The complete message string without the EOM character, will be:
A B C D L_1 L_2 NOTE:".XOR."=LOGICAL EXCLUSIVE OR. ".AND.=LOGICAL AND ".OR."=LOGICAL OR

Example: A Move Forward command with 5-notes from hopper 2 "202005"

Calculating the exclusive or V= $X'32'$ .XOR. $X'30'$ .XOR. $X'32'$ .XOR. $X'30'$ .XOR. $X'30'$ .XOR. $X'35'$ = $X'05'$

Divide by X'10:

$Y = INT (X'05' / X'10') = X'00'$

Calculate "logical and".V.AND.X'0F'

$Z = X'05'.AND.X'0F' = X'05'$

Add hexadecimal 30 to Y and Z

$L_1 = X'30'.OR.X'00 = X'30'$
$L_2 = X'30'.OR.X'05' = X'35'$

This will give the complete string

X'31' X'30' X'32' X'30' X'30' X'35' X'30' X'35' X'0D'
or expressed as a literal string

"20200505<CR>"

Pseudo code; LRC calculation

a Set a byte variable to zero. SUM := 0x00
b XOR all bytes in the command string FOR i := 1 to end-of-string
with SUM (NOT including EOM). SUM := SUM XOR CMD[i]
c Integer divide SUM with 0x10 and
OR it with 0x30 to get LRC1. LRC1:= (SUM DIV 0x10) OR0x30
d AND SUM with 0x0F and OR it
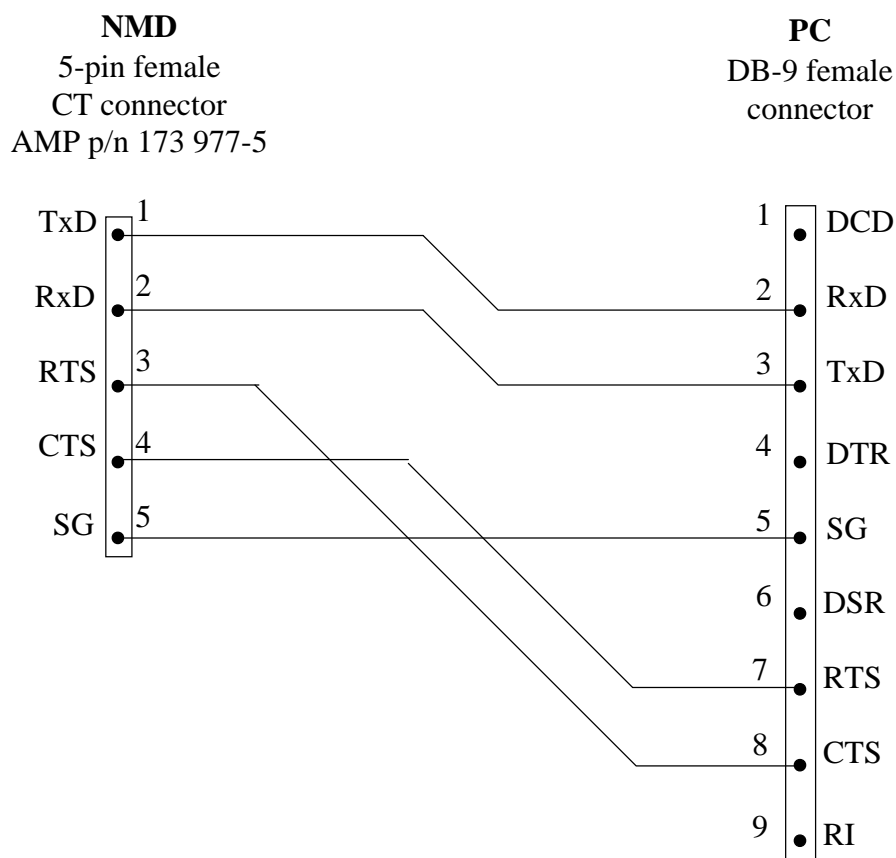with 0x30 to get LRC2. LRC2 := (SUM AND 0x0F) OR 0x30

6.6 Control signals and cables

There are two different possibilities to communicate with the NMD, with or without "handshaking".

6.6.1 Communication with handshake

In normal situations, when handshaking is required, the control signals are used in the following way:

CTS	"ON" condition indicates that the connected device wants to communicate with the NMD. The CTS signal must be held "ON" when the command is transmitted to the NMD as well as when the NMD sends the reply string.
	The CTS signal can be used to delay characters in the response message up to 1 sec.
	The CTS must be set "OFF" within 1 sec. after that RTS has been set "OFF" by the NMD.
RTS	"ON" condition will be applied by the NMD as a response to detecting the CTS "ON". The connected device must not transmit any data to the NMD until RTS is "ON". The RTS signal will stay "ON" until the NMD has transmitted the response message.

NMD
5-pin female
CT connector
AMP p/n 173 977-5

PC
DB-9 female
connector

NMD	pin		PC pin	
TxD	1		1	DCD
RxD	2		2	RxD
RTS	3		3	TxD
CTS	4		4	DTR
SG	5		5	SG
			6	DSR
			7	RTS
			8	CTS
			9	RI

Normal situation

In the normal situation, the Network raises the RTS line, which indicates that it wants to send a message to the NMD. In response the NMD raises the CTS line within 10 ms, indicating it is ready to receive the first character.

The Network sends the message terminated by an EOM Character, the Network may after sending the EOM Character put the RTS line "OFF". When the message is received by the NMD, it is passed onwards to the actual handler in the NMD code. When the message has been processed and the NMD is ready to send a response the RTS line must be "ON". The Network may now delay the transmission by setting the RTS line "OFF", and re-enable transmission by setting the RTS line "ON" again. The transmission must not be delayed by more than 1 second each time the RTS is turned "OFF".

The NMD will terminate the message with an EOM Character. At this point a complete exchange has been performed. The Network now has a choice of two actions.

It may drop DCD, which terminates the connection and causes the NMD to drop RTS and resume idle mode.
It may send a new message within 1 second, in which case this is treated in the same manner as the previous.

Delaying transmission

The Network may delay transmitted characters from the NMD by taking RTS to "OFF" condition. The NMD will stop transmission within 2 characters time after that the RTS is set to "OFF" condition.

Maximum delay is 1 second. If exceeded, the error handling described in paragraph "Transmit time out / Delay time out" below is carried out.

6.6.2 Error conditions

After error detection and handling has taken place as described below, the NMD will always await a new transmission (command) from the connecting device.

Receive time out of incoming data

A 1s timer is started when the NMD responses to the handshake and sets CTS signal to "ON". This timer is restarted each time a complete character is received, and is stopped upon receiving an EOM Character.
If a time out occurs, the following error handling takes place:
The NMD transmits error message X'4E' COMMUNICATION TIME OUT and then sets CTS to "OFF" condition.
The NMD will not support any further communication on this channel until the Network sets to RTS "OFF" condition.

If the RTS is at "OFF" condition when the NMD is ready to send the error message, the NMD will wait 1 second for RTS "ON" and then set the CTS to "OFF" condition, not sending the error message.

Input buffer overflow and receive error

If the 254 character input buffer is exceeded or a character receive error is detected, such as Parity, Framing or LRC error, the following error handling takes place:

The NMD transmits error message X'37' TRANSMISSION ERROR and then sets CTS to "OFF" condition.

If the RTS is at "OFF" condition when the NMD is ready to send the error message, the NMD will wait 1 second for RTS "ON" and then set the RTS to "OFF" condition, not sending the error message.

Transmit time out / Delay time out

When the NMD is ready to send the response message the RTS line must be "ON" within 1 second. During transmission the RTS line from the Network is used to inhibit the NMD if the Network cannot receive data in the rate it is sent to it. When the Network lowers the RTS, the NMD stops transmission within 2 characters. The RTS must be raised within 1 second or a transmission time out is triggered. Thus for each character to be sent, the RTS must be raised within 1 second, and when it is lowered, transmission is stopped.

The first character of the response will not be sent before 50 ms have elapsed since reception of EOM of the command.
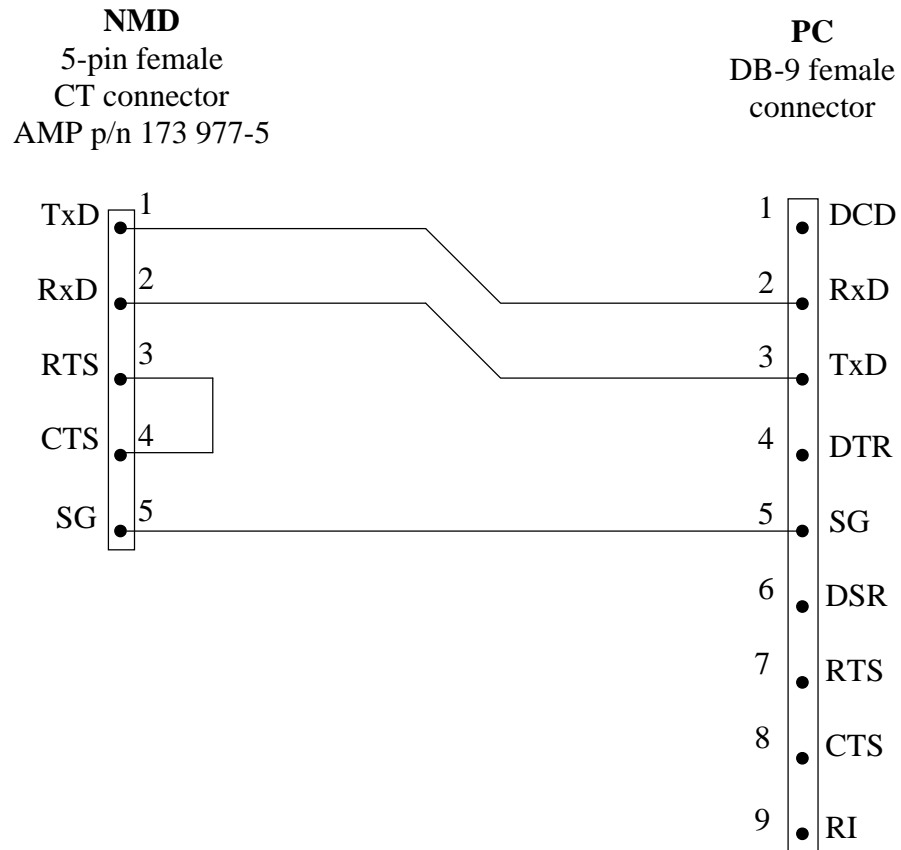
If a transmission time out exception is raised, this causes the NMD to lower the CTS signal. The Network must now lower the RTS line before this channel can be used again. There is no time out waiting for the Network to lower the RTS line.

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6.6.3 *Communication without handshake*

Under special conditions, when "handshaking" is not desired, the control signals may be used in the following way:

CTS	Wired to RTS. The NMD Machine controller will at power on reset determin if this pin is connected directly to RTS to deside if communication without hanshake is requested.
RTS	Will be set permanently "ON" after detection of it being wired to CTS

NMD
5-pin female
CT connector
AMP p/n 173 977-5

PC
DB-9 female
connector

```
TxD   1 ─────────────────╮       1   DCD
RxD   2 ──────────────╮   │       2   RxD
                      │   │
RTS   3 ─┐            │   ╰────   3   TxD
CTS   4 ─┘            ╰────────   4   DTR
SG    5 ─────────────────────    5   SG
                                 6   DSR
                                 7   RTS
                                 8   CTS
                                 9   RI
```

The Network sends the message terminated by an EOM. When the NMD Controller receives the message, it is passed onwards to the actual handler in the NMD code. When the message has been processed the NMD Controller send the response.

It should be notified that the NMD is not ready to receive a new message until the EOM character in the response has been transmitted from the NMD.
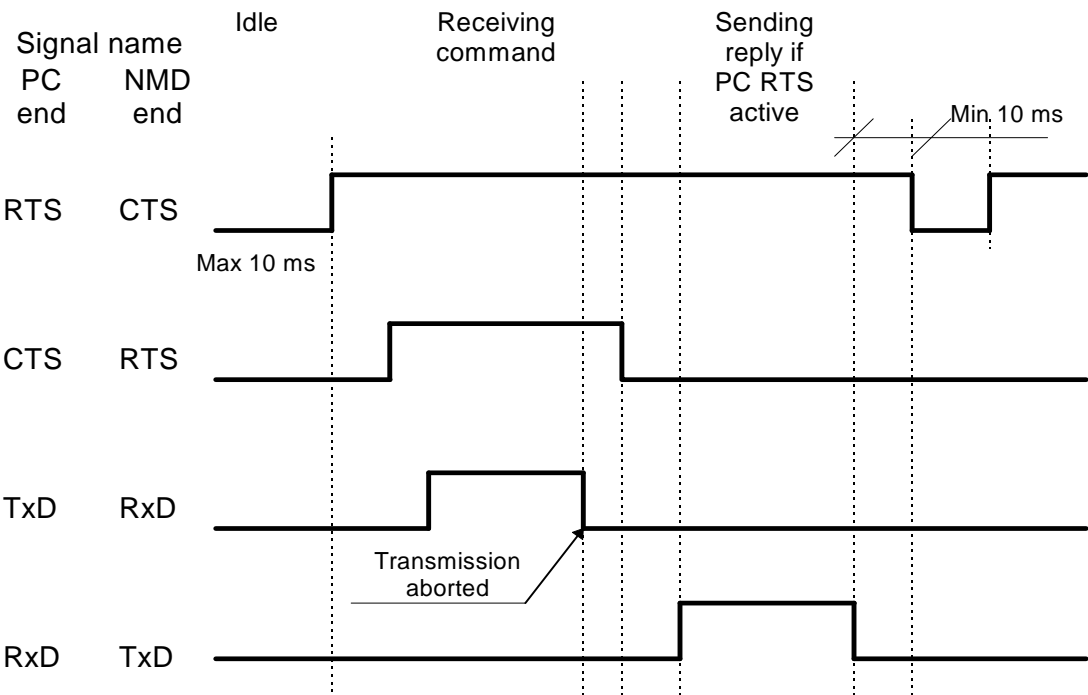
6.7 Signal timing

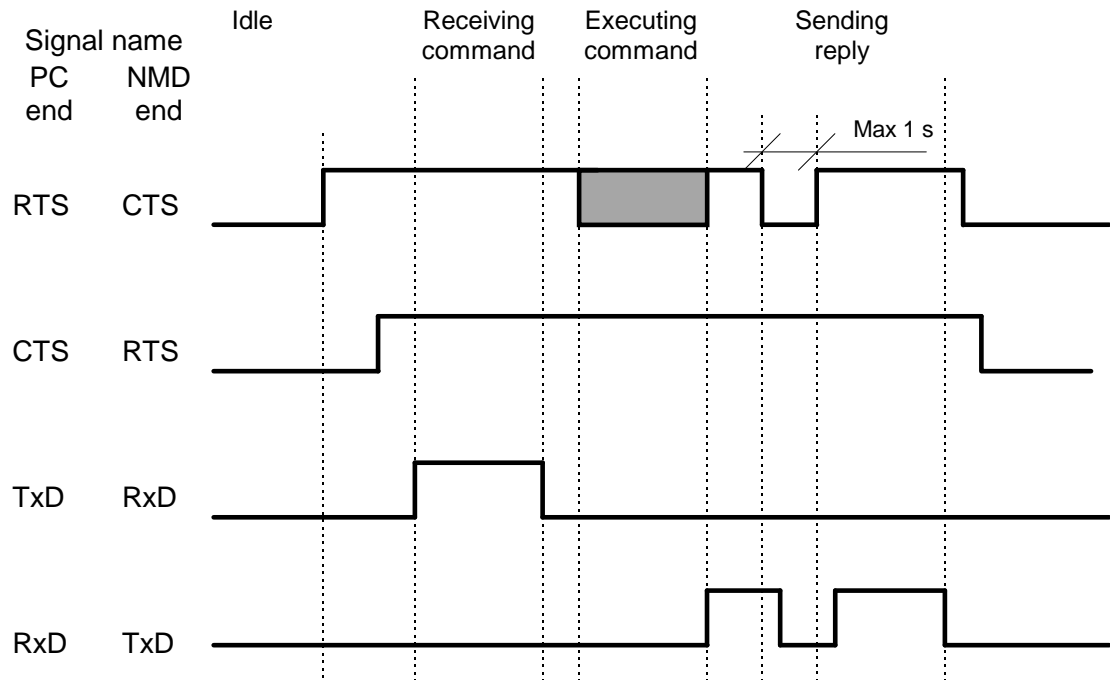In the following pages some examples are shown of the timing of control signals in different situations.

Example: Normal situation.
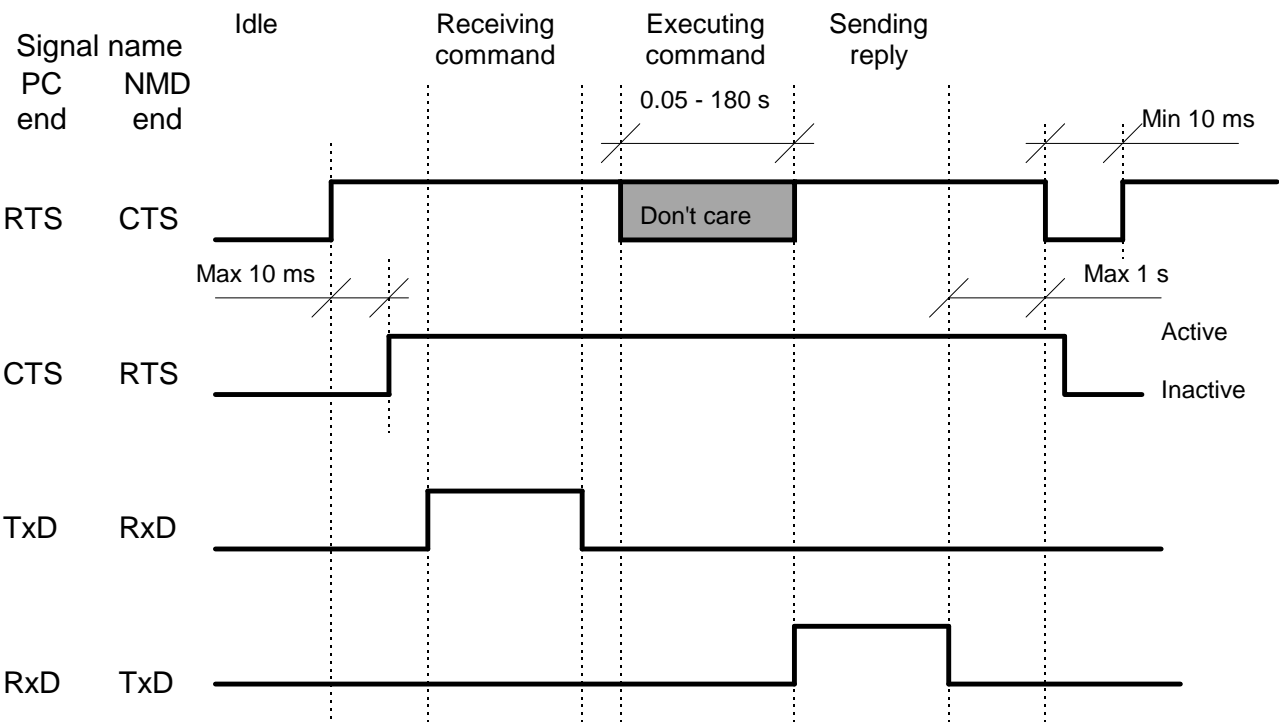
Example: Receive time-out or Buffer overflow.

Example: Transmission delay.

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7   SHUTTER INTERFACE

7

7.1 Overview

The Shutter electrical interface consists of an 8-pin connector on the CMC200.

The shutter is controlled through two low-level logical signals "Open Shutter" and "Close Shutter".

The Shutter position is reported through two logical signals "Shutter Open" and "Shutter Closed". The sensor position signals is active low, a low state on both position sensors concurrently should be interpreted as a sensor error.

7.2 Connector

8-pin AMP CT-type or compatible.

7.3 Timing
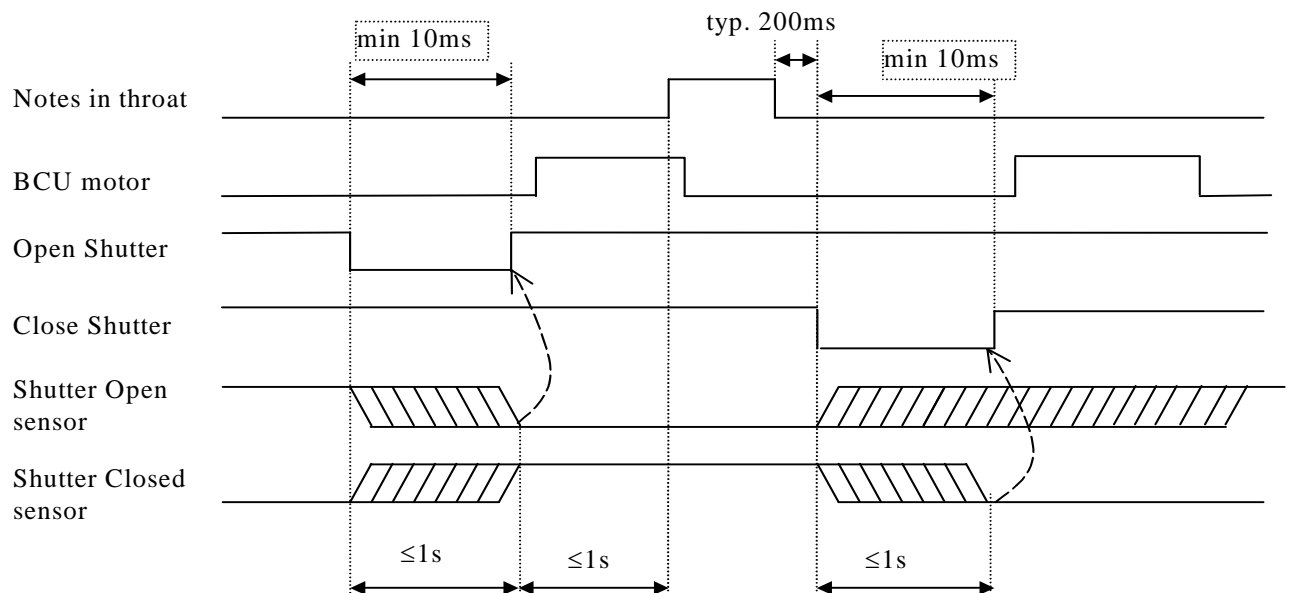
7.4 Pin definition

Pin no	Dir.	Signal name	Description	Logical def.	Test condition		Min	Nom	Max	Unit
1	OUT	Open Shutter	Open collector output, controlling the position of the shutter	Low = Open shutter	I_{OL}=2.5mA I_{Omax}=25mA	V_{OL}			0.5 2.5	V
				High = Inactive	V_{OH}=12V V_O=16V	I_{OH}			25	μA
2	OUT	Close Shutter	Open collector output, controlling the position of the shutter	Low = Close shutter	I_{OL}=2.5mA I_{Omax}=25mA	V_{OL}			0.5 2.5	V
				High =Inactive	V_{OH}=12V V_O=16V	I_{OH}			25	μA
3	IN	Shutter Open	Signal from "Shutter open" position sensor	Low = Shutter open	U_1=5.0V	V_{T+}	3.4	3.1		V
					U_1=5.0V	V_{T-}		2.2	2.0	V
					U_1=5.0V V_{IH}= V_{T+nom}	I_{IH}		-0.2		mA
			Internal pull-up 4.7k to +5V		U_1=5.0V V_{IL}= V_{T-nom}	I_{IL}		-0.3		mA
						V_I	-0.3		U_1+0.3	V
4	IN	Shutter Closed	Signal from "Shutter closed" position sensor	Low = Shutter closed	U_1=5.0V	V_{T+}	3.4	3.1		V
					U_1=5.0V	V_{T-}		2.2	2.0	V
					U_1=5.0V V_{IH}= V_{T+nom}	I_{IH}		-0.2		mA
			Internal pull-up 4.7k to +5V		U_1=5.0V V_{IL}= V_{T-nom}	I_{IL}		-0.3		mA
						V_I	-0.3		U_1+0.3	V
5		0V	Common							
6	OUT	+ 12V	Supply voltage			I_O			500	mA
7		0V	Common							
8	OUT	+ 36V	Supply voltage			I_O			500	mA

All measurements shall be done relative to GND

V_{OH} Output HIGH voltage - The minimum voltage at an output terminal for the specified output current I_{OH}.

V_{OL} Output LOW voltage - The maximum voltage at an output terminal sinking the maximum specified load current I_{OL}.

V_{IH} Input HIGH voltage - The range of input voltages that represents a logic HIGH.

V_{IL} Input LOW voltage - The range of input voltages that represents a logic LOW.

V_{T+} Positive-going threshold voltage - The input voltage of a variable threshold input that is interpreted as a V_{IH} as the input rises from below V_{T-}.

V_{T-} Negative-going threshold voltage - The input voltage of a variable threshold input that is interpreted as a V_{IL} as the input transition falls from above V_{T+}.

V_O Output HIGH voltage. The maximum voltage that may be applied at a turned off open collector or open drain output.

V_I The maximum voltage that may be applied at an input.

V_{OUT} The voltage specified at an output at a specified current.

I_{OH} Output HIGH current - The leakage current flowing into a turned off open collector output with a specified HIGH output voltage applied. For outputs with a pull-up circuit, the I_{OH} is the current flowing out of an output which is in the HIGH state. *

I_{OL} Output LOW current - The current flowing into an output which is in the LOW state. *

I_{IH} Input HIGH current - The current flowing into an input when a specified HIGH voltage is applied. *

I_{IL} Input LOW current - The current flowing into an input when a specified LOW voltage is applied. *

I_O The maximum current flowing in/out of an output. *

I_A Current range for distinguishing double notes. *

I   The current flowing in/out of an output. *

$I_{SHORT CIRCUIT}$ The maximum current that may flow in/out of a short circuited output. *

* Current out of a terminal is given a negative value.