

Innovative Technology Limited  [®]

NV4X Bank Note Validator

The Next Generation Smiley[®] Bank Note Validator

Operations Manual

General Description

NV4 Validator - the next generation of Smiley® Bank Note validators

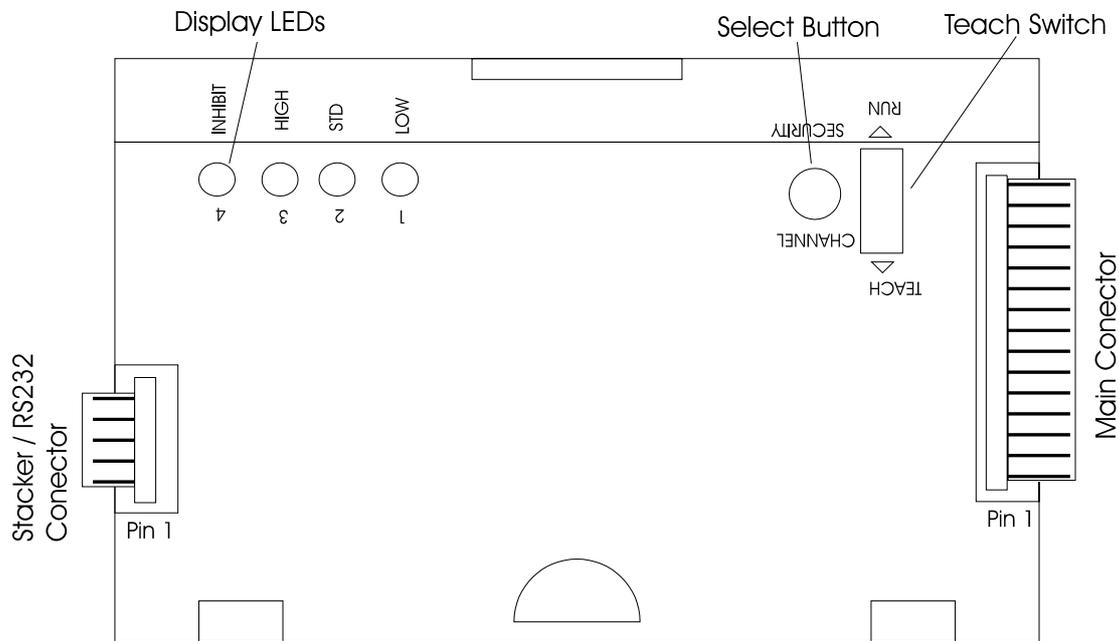


Figure 1 - Top View of NV4 Validator

The NV4 Bank Note Validator is a compact currency tester, suitable for most money machines. It will accept up to four different denominations of notes in the basic output mode, inserted in any orientation with most currencies, and will cope with different designs of banknote having the same value such as are found in the United Kingdom or Spain. It may also be re-configured to offer up to 15 different denominations so that multi currency validation may be done. Please note that this feature is only available using the pulse stream output, the RS232 serial interface or the binary output feature.

The NV4 Validator leaves the factory containing at least one currency data set so that it is ready for immediate installation. If it is desired to change the currency data set this may be done using either the NV4 to NV4 currency copy system or the PC based Currency Management software. The unit may also be programmed using the built in teach facility, without requiring any additional equipment, to cope with new issues of notes or different currencies. New currencies and applications are being tested all the time, so please refer to our web site or contact the factory for information concerning specific currencies if they are not already included on our approved list.

The Validator is of small size and has been designed for easy installation in most machines. The unique “smiling mouth” allows insertion of notes with one hand and simplifies the note handling mechanism. The NV4 however has a flat note exit permitting more note handling options

Interfacing the Validator is very simple, with the choice of parallel open collector outputs, pulse stream output, binary output or a 300bps serial input and output.

The principle of operation is that when a note is presented to the Validator the front optical sensors activates the motor and electronics. As the note is drawn through the Validator it is measured and examined with a broad range of wavelengths of light along its length. The lens assembly enables the Validator to examine the whole of the width of the note on both top and bottom faces, while at the same time making the validation process insensitive to marks commonly found on many banknotes in circulation.

The characteristics of the note are then analysed to see if they fall within the characteristics of any of the notes that the Validator has been taught to recognise, and if so, the note is accepted and the vend signal sent on the appropriate channel. Several techniques are implemented to detect forged notes and prevent the retrieval of notes already accepted. If any irregularities are encountered during the validation process, the note is immediately returned. In the unlikely event that a counterfeit note is found that the Validator will accept, then it may be taught to recognise that note and reject it in future using the channel 5 feature.

General Description

If the validation process matches the note to the data stored in its memory it will be passed through the Validator and into the host machine. The anti-strimming device consists of a mechanical roller that creates the “one way door” mechanical security. The note is reversed back over the top of the roller and out of the validator, following a path along which it is impossible to pull the note back using tape or wire.

Microprocessor technology is used to ensure high acceptance rates for genuine notes, and high sensitivity to forgeries. The unit is also designed so that there are no analogue controls, ensuring a long and stable operating life with no routine maintenance required.

Display Information

The four red LED's on the top of the unit are used to provide a variety of status signals:

Firmware revision code

From software revision 2.50 onwards, when the validator is first switched on, the LED's are used to signal the 3 digit firmware revision number in sequence using a binary coding. A zero is shown by all 4 LED's lighting up. Each digit is shown in turn for about 0.5 sec. E.g. for version 2.51 the sequence is:

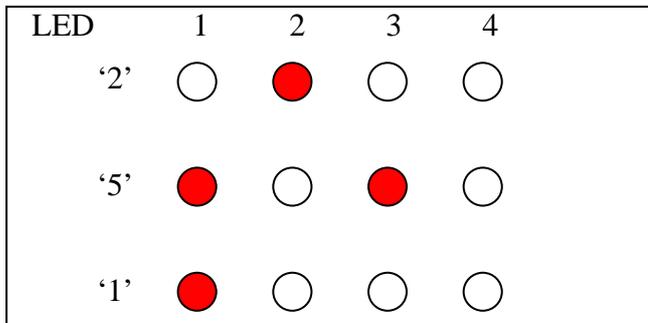


Figure 2 - LED's indicate firmware revision

a full list of number codes is shown in figure 4b

Heartbeat

In normal RUN operation, when the validator is ready to read a note, LED's 2 and 3 flash alternately ("Heartbeat") to signal a "healthy" status. see fig 3a. If the option to permanently add a stacker is set then if the stacker is removed, the LED's 1 & 4 flash alternately. see fig 3b.

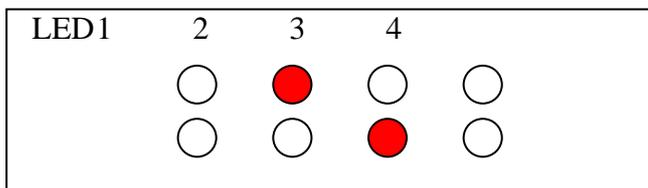


Figure 3a - LED's indicate healthy status

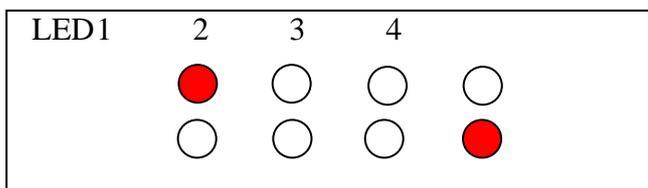


Figure 4b - LED's indicate stacker removed

Other combinations relate to specific functions and are described in later sections. If the validator is started with the Teach/Run switch set to TEACH, then after the revision number display it will go directly into teach mode - see later section.

Validation / reject codes

When a note is accepted, while the unit is in parallel or pulse mode, a code is presented on the LED's representing the channel in which it was accepted. If the "enable reject code" option is set then, during note validation the heartbeat will be suspended and should the note be rejected then a code is flashed twice representing the reason for rejection, prior to the heartbeat returning.

The codes flashed are as follows in fig 4a

Fig 4a – Reject codes

LED DISPLAY 4 3 2 1	Reject Cause
○ ○ ○ ●	Note rejected due to validation check 1
○ ○ ● ○	Note rejected due to validation check 2
○ ○ ● ●	Note rejected due to validation check 3
○ ● ○ ○	Note rejected due to validation check 4
○ ● ○ ●	Note rejected due to validation check 5
○ ● ● ○	Note inhibited by host machine
○ ● ● ●	Reserved 1
● ○ ○ ○	Rear Roller / Rear Flag Error
● ○ ○ ●	Note validated on more than 1 Channel
● ○ ● ○	Front Sensor detect
● ○ ● ●	Reserved 2
● ● ○ ○	Reserved 3
● ● ○ ●	Slow / Stalled Running
● ● ● ○	Reserved 4
● ● ● ●	Note validated as known fraud

Figure 5b – LED display indication for firmware version numbers

Number	LED DISPLAY			
	1	2	3	4
0	●	●	●	●
1	●	○	○	○
2	○	●	○	○
3	●	●	○	○
4	○	○	●	○
5	●	○	●	○
6	○	●	●	○
7	●	●	●	○
8	○	○	○	●
9	●	○	○	●
10	○	●	○	●
11	●	●	○	●
12	○	○	●	●
13	●	○	●	●
14	○	●	●	●

Environment and Power Requirements

Environment	Minimum	Maximum
Temperature	+3°C	+50°C
Humidity	5%	95% Non condensing

Electrical Supply	Minimum	Maximum	
Supply Voltage (V dc) Absolute Limits	11V	15V	
MDB Supply Voltage	18V	42V	
NOTE: If input voltage falls below 10.5v the NV4 will shut down automatically			
Supply Ripple Voltage	0	0.25V @100Hz	
VCOM (Host logic high)	5V	30V	
Supply Currents			With Stacker HS1 or VS1
Standby		350mA	450mA
Validating		450mA	900mA
Peak (Motor start or stall)		1000mA	1800mA

Interfaces: Hardware Description

Interface Logic levels	Logic Low	Logic High
Inputs	0V < Low < 0.9V	+3.7V < High < (+VCOM+0.5V)
Outputs with 10KΩ pull up	0.4V	pull up voltage of host interface
Maximum Current Sink	50mA per output	

15 Pin Connector

Pin	Name:	Description:
1	Vend 1	Pulse Stream Output Also the serial output pin in Serial Mode Also the pulse stream output in Pulse Stream Mode
2	Vend 2	Not used
3	Vend 3	Not used
4	Vend 4	Not used
5	Inhibit 1	Inhibit channel 1 by holding this pin HIGH. To Enable a channel the inhibit must be held LOW. Also the Serial Input pin in RS232 serial mode
6	Inhibit 2	Inhibit channel 2 by holding this pin HIGH
7	Inhibit 3	Inhibit channel 3 by holding this pin HIGH
8	Inhibit 4	Inhibit channel 4 by holding this pin HIGH
9	Escrow	Not used
10	Alarm	Problem indication Output (optional)
11	Supply Voltage	+12 Volts
12	0V Supply	Ground
13	+VCOM	Not used
14	Parallel /Serial Select	Not used
15	Factory Test Pin	FACTORY USE ONLY - DO NOT CONNECT

5 Pin Connector. For stacker use only. DO NOT power the NV4 validator through the 5 way connector

Pin	Name:	Description:
1	Supply Voltage	+11v to +15v DC
2	0V Supply	
3	Stacker Control	Used to control the stacker
4	Stacker Status RS232 Rx	When stacker is connected, monitors the stacker status. If no stacker is fitted, acts as the serial Input pin in RS232 serial mode
5	RS232 Tx	If no stacker is fitted, acts as the serial Output pin in RS232 serial mode

Interfaces: Protocols

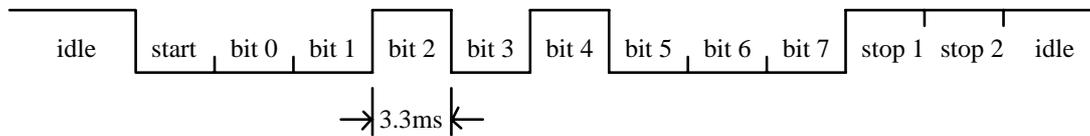
1: RS232TTL Input and Output

Existing Smiley® NV2 users may already be using the serial output facility in conjunction with the parallel inputs. This system is supported by the NV4 Validator and now has some further characters. However the NV4 now also supports serial input control as well. The NV4 also offers true RS232 input and output via the five pin Stacker connector.

Please contact the factory for details of firmware and currency programming protocols.

Typical Serial Output: Transmission of the value 20 (decimal), Note not recognised

Vend 1(Pin 1)



300 baud Serial Output Only Mode. Pin 14 connected to 0V only

Data format: 1 start bit
8 data bits
2 stop bits.
300 baud.

Transmitted codes:

MESSAGE	DECIMAL VALUE
Accept on C1	1
Accept on C2	2
Accept on C3	3
Accept on C4	4
Accept on C5	5
Accept on C6	6
Accept on C7	7
Accept on C8	8
Accept on C9	9
Accept on C10	10
Accept on C11	11
Accept on C12	12
Accept on C13	13
Accept on C14	14
Accept on C15	15
Accept on C16	16
Note Not Recognised	20
Mechanism running slow	30
Strimming attempted	40
Channel 5 Note Rejected (fraud channel)	50
STACKER Full or Jammed	60
Abort During Escrow	70
Note may have been taken to clear jam	80

300 baud Serial input/output Mode.

This mode can be entered by selecting serial mode (pin 14 connected to 0V) and connecting the vend 4 output to the inhibit 4 input before the power is turned on.

The Validator echoes each valid command it receives. Note that the host does not have to echo messages back to the validator. The output codes indicated in '300 baud serial output mode' are supported with the following extensions.

Transmitted codes:

MESSAGE	DECIMAL VALUE
Validator Busy	120
Validator Not Busy	121
Command Error	255

Recognised Receive Codes:

MESSAGE	DECIMAL VALUE
Inhibit C1	131
Inhibit C2	132
Inhibit C3	133
Inhibit C4	134
Inhibit C5	135
Inhibit C6	136
Inhibit C7	137
Inhibit C8	138
MESSAGE	DECIMAL VALUE
Inhibit C9	139
Inhibit C10	140
Inhibit C11	141
Inhibit C12	142
Inhibit C13	143
Inhibit C14	144
Inhibit C15	145
Inhibit C16	146
Uninhibit C1	151
Uninhibit C2	152
Uninhibit C3	153
Uninhibit C4	154
Uninhibit C5	155
Uninhibit C6	156
Uninhibit C7	157
Uninhibit C8	158
Uninhibit C9	159
Uninhibit C10	160
Uninhibit C11	161
Uninhibit C12	162
Uninhibit C13	163
Uninhibit C14	164
Uninhibit C15	165
Uninhibit C16	166
Enable serial escrow mode	170
Disable serial escrow mode	171
Accept Escrow	172
Reject Escrow	173
Status	182
Enable all	184
Disable all	185

Example protocols are shown in the tables below:

Event	Validator		Host
Note entered into validator Note Accepted Channel 3	Validator Busy Validator Ready Accept on Channel 2	120 → 121 → 2 →	
Note entered into validator Note not recognised Validator has returned note	Validator Busy Validator Ready Note not recognised Validator Ready	120 → 121 → 20 → 121 →	
Software Inhibit Channel ↓	Inhibit C4 Channel 4 Inhibited	← 134 134 →	Inhibit C4
Software Enable Channel ↓	Uninhibit C4 Channel 4 Inhibited	← 154 154 →	Uninhibit C4
Status Report 3 byte status message	Inhibit status Channels 1-8 Inhibit status Channels 9-16 Escrow On (=1) / Off (=0)	← 182 byte 1 → byte 2 → byte 3 →	Status Request
Turn on Escrow Mode	Escrow Mode Enabled	← 170 170 →	Enable Escrow Mode
Note accept in Escrow Mode Note entered into validator Note Accepted Channel 3	Validator Busy Validator Ready Accept on Channel 2 Accept Escrow Accept on Channel 2	120 → 121 → 2 → ← 172 172 → 2 →	Accept Note in Escrow

2: Pulse Stream Output (U.S. Standard)

For retrofitting to older coin based machines, the NV4 can be set to give a stream of pulses via the vend 1 output. Firstly the pulse stream system must be toggled on using the special menu functions (see later section on Special Menu). Then the number of pulses per channel may be programmed in using the teach process. This is done as follows:

Manual Pulse Speed Switching

1. While the unit is powered up slide the teach switch to the teach position.
2. Use the channel button to make your selection.
3. LED 1 = No Pulse; LED 2 = 50 msec pulse; LED 3 – 100 msec pulse
4. Slide the teach switch back to run.

Manual Pulse Per Dollar Selection

1. While the unit is powered up hold down the channel button and slide the teach switch to the teach position.
2. Release the channel button.
3. LED 1 = 1 pulse per dollar; LED 1, 2, 3, 4 = 4 pulses per dollar
4. Use the channel button to make your selection.
5. Slide the teach switch back to the run position.

Note: Any other pulse rates or pulse speeds require the DA1 software kit to change.

3: Binary Output

In the event that the machine needs more than 4 notes to be recognised, but the host machine cannot take advantage of the serial communication methods then the NV4 can be set to give a binary pattern output on the four parallel output pins. Refer to the special menu option setting to use this feature.

If the NV4 is set to 15 channel mode it will issue the vend signals as a binary pattern on the parallel outputs for 100 milliseconds. In this way a maximum of 15 different notes can be accepted and controlled.

4: SSP - Smiley® Serial Protocol.

SSP is a secure serial interface and the preferred method of connecting the NV4 to a host machine. SSP is supported from firmware version 2.50 (older validators can be upgraded to support SSP). SSP is an expandable open protocol that can be configured in a multi drop mode to allow many devices to be connected to the same serial interface on the host. Many of the frauds and communication problems associated with conventional parallel and serial interfaces are overcome in SSP.

For a specification of the SSP Protocol please contact Innovative Technology Ltd directly.

Cloning

The NV4X Validator may be upgraded in two ways:

1. Use the NV4 Currency Manager Software, which is supplied with a range of currencies. To use this system you will require a PC running Windows 95/98™, Pentium™ 75MHz or faster with a serial port, and a 12volt dc power supply to power the validator. (© Microsoft and Intel). A list of currently supported currencies is maintained on our web site, and new releases can be downloaded from there. Further details are available from Innovative Technology Ltd.
2. NV4 Master/Slave copying - a currency set can be transmitted from one NV4 onto another.

NV4 - NV4 Copy:

Overview

The facility exists for using an NV4 Bank Note Validator to copy its contents to another NV4 connected to it. The 'Master' validator will upgrade the slave's firmware if necessary and copy the currency data completely.

Requirements

-An NV4X unit with the new software already installed.

And

-An NV4X cloning kit.

Or

-The two cables on the following two pages.

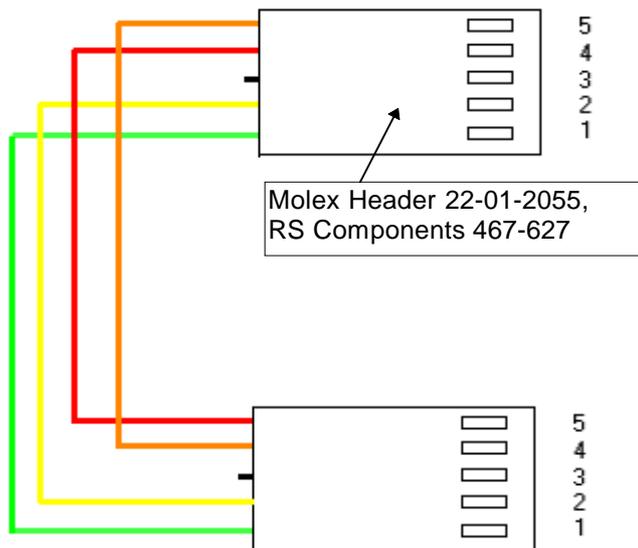


Figure 6 - Pin connections for NV4 Copy Connector

Start-up configuration

In order for the master validator to start in Copy Mode, the NV4 units should be set up as follows:

- The master and slave NV4s are set to 'TEACH'
- The Master and Slave NV4s are connected together using the NV4 copy cable as above.
- On the 15 pin connector on the Master NV4, pins 15 and 14 are held low and +12v input is connected to pin 11 and 0v to pin 12. (Do not apply the power until all the connections are made)

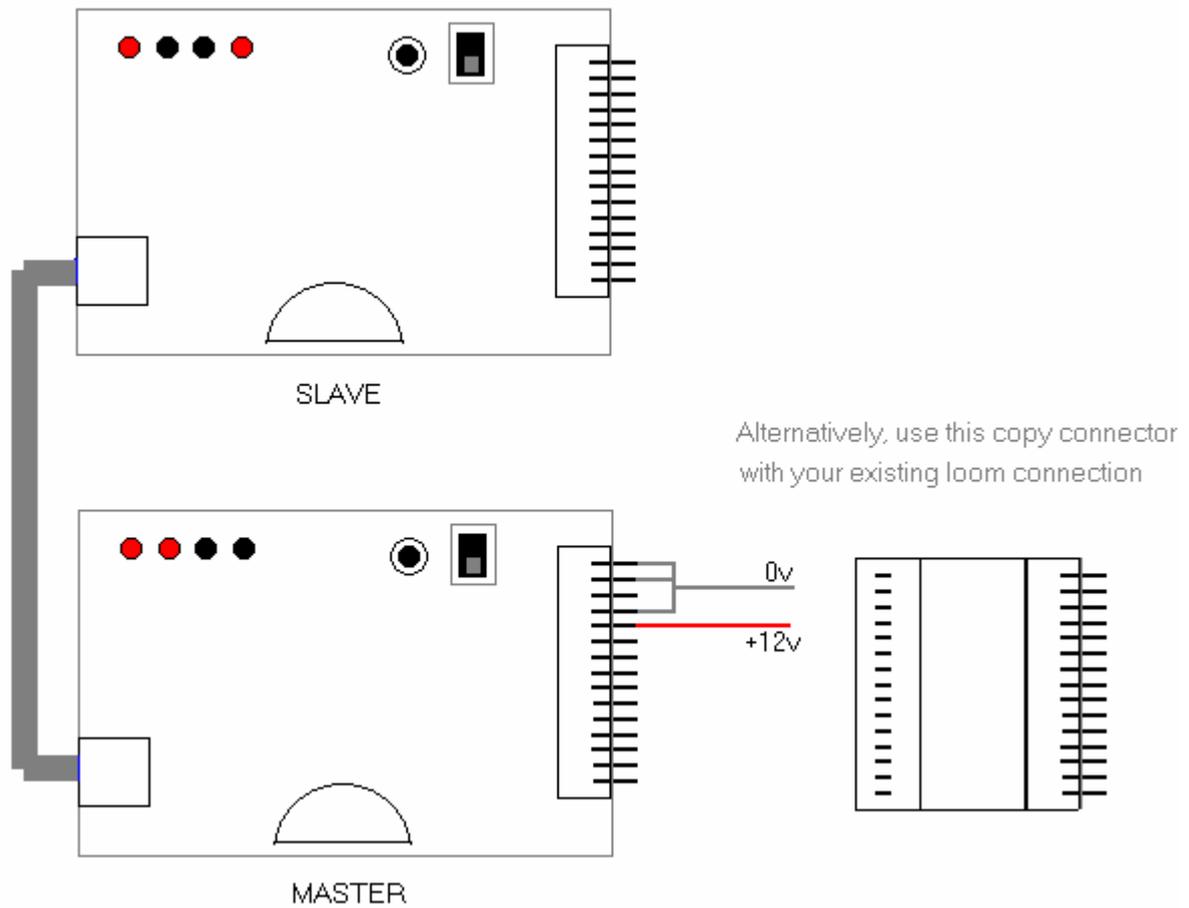


Figure 7 - Connecting Master and Slave NV4 units to copy a currency set

- If you are using the NV4 copy connector you can simply connect your existing 15 way plug to the master NV4 with this piece in-between.

Copying Procedure

LED1	2	3	4	
Slave	●	○	○	●
Master	○	○	●	●

Figure 8 - LED's indicate Ready to Copy

Apply the power and the NV4 units should now start-up with the led indicators as shown above (Master - LED's 3 & 4 , Slave - LED's 1 & 4). This indicates that the two validators are ready to start the copy process.

When the NV4 Units are started and are showing the correct indicator LED's, click the channel select button on the Master NV4 UNIT to initiate the copy process.

The Master NV4 UNIT will now look at the firmware version of the Slave and will upgrade the Firmware if it (the Master) has a higher version than the Slave.

If the Master is a different board issue number than the slave (a 1 to a 2 or vice versa) then

Led 3 on the Master will flash and no further operation can be allowed. In this case you require a Master that is the same board issue number as the Slave.

If the Master has a lower firmware issue number than the Slave, Led 2 will flash on the Master and again no further operation will be allowed.

Calibration and Routine Maintenance

If the Master cannot communicate with the Slave (due to a hardware or connection problem) then Led 4 will flash on the Master and the copy operation will stop.

LED	1	2	3	4
Firmware upgrade proceeding		●	○	○
Master firmware is lower issue	○		●	○
Master and slave are different board issues	○	○	●	○
Communications Error	○	○	○	●

Figure 9 - LED's firmware downloading or error condition

If the firmware versions are the same the copy process will now go directly to the currency copying mode.

Firmware Upgrade

If this process has been activated then Led 1 on the master will flash for a period then pause then flash again for a second period. This represents the transferring of the two blocks of Firmware data.

WARNING ! YOU MUST ENSURE THAT THIS PART OF THE COPY PROCESS IS NOT INTERRUPTED OR THE SLAVE NV4 UNIT MAY NO LONGER FUNCTION!

At the end of the firmware transfer, LED's 2 & 3 will be lit on the Master and on the Slave. The Slave will undergo a restart process. The Master will wait until the restart of the Slave has completed and then start the currency transfer.

LED1	2	3	4
Slave	●	○	●
Master	●	○	●

Figure 10 - LED's indicate currency downloading

Currency Transfer.

LED's 1 and 4 on both NV4 Units will flash on and off while the transfer is taking place, if an error occurs during this process, led 1 on the master will flash on its own and the process can be restarted to try again. At the end of the Currency transfer, LED's 3 & 4 will be illuminated on both validators to show that a successful transfer has taken place.

LED1	2	3	4
Slave	○	○	●
Master	○	○	●

Figure 11 - LED's indicate end of copy process

Calibration and Routine Maintenance

The NV4 Validator has been designed to minimise any performance variation over time. Much of this is achieved by careful hardware and software design. However, depending upon the environment the NV4 may at some time require cleaning or even re-calibration.

Cleaning:

Press down the red half circle on the top of the Validator to release it from the front bezel. The note path may now be exposed for cleaning. Wipe the surfaces with a soft lint free cloth that has been dampened with a water and detergent solution (such as a household washing up liquid) NEVER use a solvent based cleaner such as alcohol, petrol, methylated spirits, white spirit, or PCB cleaner. This will result in permanent damage to the validator. Take particular care with the lenses. If a lens has become badly scratched do not attempt to polish it as this may damage the optical properties. Near the front of the unit you will see two small slits in the upper path. these may be cleaned out with a soft toothpick. However, be careful not to push the toothpick inside the Validator. Cleaning instructions are also shown on the drawing GA107 which applies to both the NV4 and NV5.

Calibration:

The NV4 has an in-built calibration system. To re-calibrate an NV4 the unit must first be powered OFF and fitted to its front bezel. It must also be removed from any stacker it is fitted to. Now insert a piece of white paper into the curved entrance until it hits the drive wheels (letter quality, ideally 100 gram, white matt linen - approximately 150mm x 80mm. Do not use ordinary photo copier paper). The paper must occupy the entire curved entrance. Now hold down the select button and while you are holding it down turn on the power supply.

Release the button when the motor starts. The white paper will be drawn into the validator, and held for several seconds while the lenses are calibrated. It will then be pulled through the main body, then back over the rear roller, before eventually exiting over the top of the roller. Remove the white paper. After a short period the front bezel will be illuminated and the NV4 is now re-calibrated.

If the display bulb is flashing on and off continuously, the NV4 needs to be recalibrated. Insert the calibration paper as described above and press the select button momentarily. The Validator will then re-calibrate itself

For NV5 initialisation can be achieved by pressing the select switch as the Firmware revision code is being displayed on the four LEDs as the validator is powered up.

Support Tools

The following support tools are available for use with the NV4 Bank Note Validator:

1. PC Currency Manager Software.
2. PC Hardware Diagnostics Software.
3. Downloads from the Innovative Technology Ltd website: **www.innovative-technology.co.uk**

1. PC Currency Programming Software.

The NV4 Currency Manager software offers the following functions:

- teach the NV4 Validator by downloading pre-prepared currency data via the serial communications link. The firmware will also be updated to the version compatible with the currency set to ensure maximum security.
- Check the firmware version and currency set already loaded on an NV4 unit
- Adjust the channel and pulse configuration on a pre-programmed NV4 to your own requirements
- download a new version of firmware onto the NV4
- upload the currency data in an NV4 and save to file

The software will run on an IBM compatible Personal Computer with Pentium™ processor or equivalent and requires a test box and security dongle (part number NP4KIT) which must be fitted to the PC parallel port. This program runs under the Windows 95/98™ operating system, and requires one free serial port to connect to the NV4. (© Microsoft and Intel).

2. PC Hardware Diagnostics Software.

In order to assist with the repair and testing of NV4, a diagnostic software package is available which allows the various functions of the validator to be individually operated remotely from a PC using a serial link.

The software will run on an IBM compatible Personal Computer with Pentium™ processor or equivalent. This program runs under the Windows 95/98™ operating system, and requires one free serial port to connect to the NV4 using the NP4 Test box and dongle (© Microsoft and Intel)

3. Internet Website support.

The Innovative Technology Ltd website provides the means to download new and updated currency sets and new versions of firmware for the NV4. Visit **www.innovative-technology.co.uk** for further details. Technical bulletins are also made available. If you have an NP4 test box and dongle all software and currency files are free to use. Note the files are password protected to prevent abuse. Periodically the passwords are changed. Please contact Innovative Technology for password updates.

4. Email Support.

If the data you require is not available over the internet Innovative Technology supports an email system to help customers with unusual requirements. The address is sales@innovative-technology.co.uk or aai@comcastwork.net