NEC INNOVADA

Data Sheet

V850Netchip-LAN Module

Document No. U16247EE2V0DS00
Date published: August 2002

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1. Introduction

1.1. Description

The V850Netchip-LAN module is designed to connect any device equipped with a standard serial interface to a LAN and from there to the Internet. It is a complete module on a small printed circuit board that can be socketed onto the host system mother board. It includes full TCP/IP protocol support, enabling host systems to send and receive e-mails, transfer files and serve Web pages to remote systems.

The module is EN60950 certified.

It cane be used in a variety of applications including credit card authorisation terminals, vending machines, utility metering, data acquisition devices, time & attendance terminals, security systems, building-control systems and many other applications.

1.2. Applications

- Credit card authorization terminals
- Utility meters
- Vending machines
- Industrial automation equipment
- Security and access control systems
- HVAC systems
- Embedded applications

1.3. Features

- Serial-to-LAN device server
- Network interface: 10BaseT LAN (10/100BaseT compatible)
- Protocols: ARP, DHCP, IP, ICMP, UDP, TCP, HTTP, SMTP and POP3
- Interface: TTL level serial, with data rates of 300 bps to 115 kbps
- Command-line or AT-command interface for configuration and control
- Flow control: XON/XOFF (software) or RTS/CTS (hardware)
- Single +5 V power supply
- Dimensions: 74.93mm x 55.88mm

1.4. Revision

This Data Sheet describes revision 1.0.4 of the V850Netchip-LAN Module, with the exception that the following commands are not available:

- answer
- autoconnect
- autodisc
- dest
- online

In addition autobaud for AT command mode works over the range of 1200bps to 9600bps only. Furthermore, the autobaud setting will override the configured serial port speed if AT command mode is entered. It is therefore recommended not to use AT command mode in this revision of the V850Netchip-LAN, if serial port speeds above 9600 bps are required.

2. Mechanical Specifications

The V850Netchip-LAN is designed to be attached to a host system motherboard using two connectors: the host interface connector and the phone line interface connector.

The V850Netchip-LAN has pins mounted under each connector for inserting into sockets on the host motherboard. Figures 1 and 2 show outline plan and elevation views of the V850Netchip-LAN.

Figure 1: Outline plan (component side) of V850Netchip-LAN

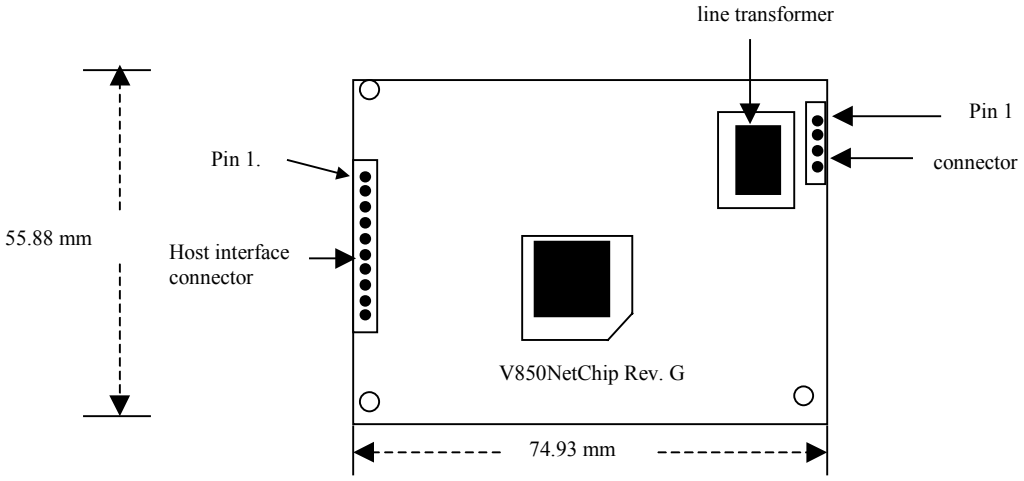
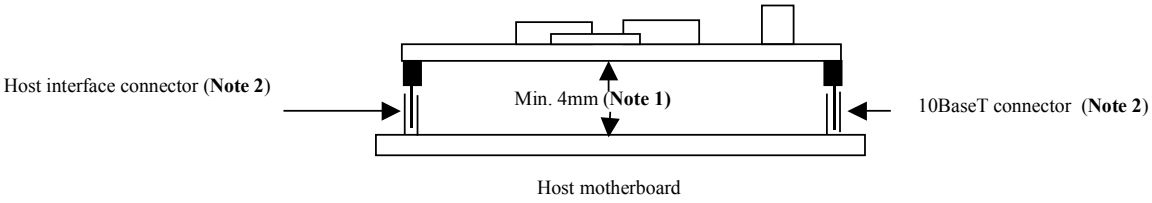


Figure 2: Elevation view of short-format V850Netchip-LAN



Notes on Figure 2:

1. At least 4 mm clearance or equivalent insulation must be provided between the V850Netchip-LAN and the host motherboard.
2. The pins for the host interface and phone-line connectors are spaced at 2.54 mm apart.

The V850Netchip-LAN must always be installed within a unit which includes a fire enclosure that meets the safety requirements of EN60950:2000.

NOTE that the RJ-45 connector for attaching to a 10BaseT LAN hub or switch must be mounted on the host system. The V850Netchip-LAN includes a designed-in electrical insulation barrier of 4 mm creepage between the phone line interface circuit and the rest of the V850Netchip-LAN board. The host motherboard should have an equivalent barrier between the RJ-45 connector circuit and other components.

2.1. Host Interface

Table 2.1: Pin description for host serial interface

Pin	I/O	Name	Function
1	I	VCC	Connects to external host power of +5V +/-5%
2	I	-TXD	Serial data output from host DTE
3	O	-RXD	Serial data input to host DTE
4	I	-RTS	Request To Send. -RTS is used to indicate to the modem if it should present data to the DTE on - RXD. –RTS OFF (high) indicates to the modem that it should not transfer data. –RTS ON (low) indicates to the modem that it is ready to accept data for transmission.
5	O	-CTS	Clear To Send. –CTS is used by the modem to indicate whether or not it is ready to transmit data on -TXD. –CTS OFF (high) indicates to the DTE that it should not transfer data. –CTS ON (low) indicates to the DTE that it is ready to accept data for transmission.
6	O	-DSR	Data Set Ready. –DSR indicates the modem status to the DTE.
7	I	-DTR	Data Terminal Ready. An active low on this pin indicates that the host system is ready to communicate with the modem.
8	O	-DCD	Data Carrier Detect. An active low on this pin indicates that the modem has detected a carrier signal.
9	I	-RESET	Device reset. Held high for normal operation, or low for at least 500 ns to reset the device
10	I	GND	Power supply ground

2.2. Line Interface

Table 2.2: Pin description for 10BaseT interface

Pin	I/O	Name	Function
1	O	TX+	TX (positive)
2	O	TX-	TX (negative)
3	I	RX+	RX (positive)
4	I	RX-	RX (negative)

3. Electrical Characteristics

Table 3.1: DC electrical characteristics at 25 o C

Parameter	Conditions	Min	Typical	Max	Units
Vcc supply voltage		4.75	5.00	5.25	V
Vcc supply current - idle	Vcc=5V				
Vcc supply current - active	Vcc=5V				

4. Serial Interface Description

All data transferred to the V850Netchip-LAN has the following characteristics:

- 8-bit data, with no parity and two stop bits
- speed of between 300 bps and 115 kbps, defaulting to 9600 bps
- hardware flow control using RTS/CTS handshaking

The serial interface is in one of three modes:

- command-line mode, as described in section 5 below
- AT command mode, as described in section 6 below
- online mode, where data is transferred using an established TCP/IP connection

5. Command-line Mode

Command-line mode is used to configure the V850Netchip-LAN for TCP/IP operation. Command-line mode is selected by using the ***at!*** command, if the V850Netchip-LAN is currently in AT command mode. Once selected the V850Netchip-LAN remains in command-line mode unless the ***at*** command is selected. Command-line mode is indicated by the following prompt: ***->***
Commands are described below, using the following syntax:
command <parameter> [parameter]
where,
command name of the command
<parameter> mandatory command parameter
[parameter] optional command parameter

All commands and parameters are case sensitive.

Note that IP address parameters have the normal “dotted decimal” syntax (e.g. 192.168.16.20). Where an address is specified with an optional port, the port is separated from the address with a “:” or “/” character, as in: 192.168.16.20:1200 for port number 1200 at address 192.168.16.20.

Command	Details
address [local_address network_mask gateway_address]	display or set local address information – example: ***address 192.168.16.200 255.255.255.0 192.168.16.1***
answer [off|always|dtr]	display or set answer mode – see section x.x below for details
at	enter AT-command mode
autoconnect [off|any|cr|dtr|auto]	display or set auto connect mode – see section x.x below for details
autodisc [off|dtr|idle time]	display or set the auto disconnect mode – see section x.x below for details
close	close any currently open TCP connection
dest [ip_address[,port|/port]]	display or set destination address
dmode [off|on]	display or set demonstration mode: see section 9 for details
dhcp [off|on}	display or set DHCP. ***dhcp on*** activates DHCP client from next reset; ***dhcp off*** turns DHCP off from next reset (fixed address configuration required)
help [command]	provide list of available commands or, with optional parameter, describe the use and syntax of the specified command
lan	display LAN interface statistics
online	return to online mode
open <ip_address>[:port]	open a TCP to the specified IP address and port, or if no port is specified, to the telnet port (23) at the specified address
ping <ip_address>	send an ICMP echo request to the specified IP address
reset	soft-reset the V850Netchip-LAN
rev	display the V850Netchip-LAN revision number
save	save all configuration information to non-volatile memory
startup <at|command|none>	set the startup user interface to either ***at*** for AT command mode or ***command*** for command-mode or ***none*** if no active user interface is required
status	display status of TCP connection to serial port; response has syntax ***n*** where n is the TCP connections status: see table below for details.
stty [300|1200|2400|4800|9600|19200|38400|57600|115200]	display or set the serial port data speed; note that new speed is only active from next reset

The following table describes the TCP state as reported by the ***status*** command:

TCP State	
0	TCP is disconnected
1	TCP is establishing a connection
2	TCP connection establishment has failed
3	TCP connection is fully established

6. AT Command Mode

Certain embedded systems are designed to work with standard modems, and thus are designed to work with a modem “AT” command interface. The V850Netchip-LAN may be used with these systems by placing it in AT command mode. In this mode, it emulates a modem by responding to AT commands. Instead of dialling the specified phone number when requested, it establishes a TCP connection to the specified IP address.

Note that most modem AT commands have no relevance to the V850Netchip-LAN, as they are designed to control a modem. The V850Netchip-LAN responds to any unrecognised command with “OK”, without performing the requested action.

Each command line must start with the prefix “AT” and be terminated by a carriage return (ASCII code 16). Table 5-1 lists the result codes and messages. Table 5-2 summarises the AT command set.

Table 6.1. Result codes and Messages

Numeric Code	Text Code	Details
0	OK	Command line executed without errors
1	CONNECT	Connection established
2	RING	Incoming TCP connection detected
3	NO CARRIER	Connection establishment failed
4	ERROR	Invalid command line

Table 6.2. AT Command Summary

Command	Function	Default	Parameters/Description
!	Enter command-mode	-	Enters command-line (described in section 4)
A	Accept an incoming connection	-	-
Dn	Dial	-	Dial command. Connect to specified IP address (and optional port number, or port 23 if not specified). Syntax of ***n*** is: nnn.nnn.nnn.nnn/pppp where n and p are decimal digits. Example: 192.168.16.23/17
En	Echo	n=1	**n=0** Disables command echo **n=1** Enables command echo
H	Hangup		Disconnects TCP connection
O	Online mode		Return to online mode
Vn	Result codes format	n=1	**n=0** Result code is displayed as a numeric digit **n=1** Result code is displayed as a text string
Z	Reset		Reset the V850Netchip-LAN (soft reset)

7. TCP Connection Management

As the V850Netchip-LAN is designed to work with a variety of systems, each with their own characteristics, there are several ways in which TCP connections may be managed. In particular there are options that control how:

- a connection is established
- data is forwarded from the serial port to the TCP connection
- a connection is cleared
- incoming connection are handled

Each of these options is now described in detail.

7.1. Establishing a Connection

There are two ways in which a TCP connection may be established:

- manual
- automatic

Each of these is now described.

7.1.1. Manual connection establishment

Manual connection establishment is when the host system explicitly requests a connection, using a command. The command syntax depends on the current V850Netchip-LAN user interface. In command mode, the ***open*** command is used, as in the following example:

open 192.168.16.20:1200

This opens a TCP connection to port 1200 at address 192.168.16.20. A successful connection is indicated by the V850Netchip-LAN displaying the following:

+OK

An unsuccessful connection attempt is indicated by the V850Netchip-LAN displaying the following:

-ERR

Once the TCP connection is established, V850Netchip-LAN is in online mode: any information sent to the V850Netchip-LAN is then forwarded to the remote system over a TCP connection.
Alternatively, if the V850Netchip-LAN is in AT command mode, the ***ATD*** command is used, as in the following example:

ATD192.168.16.200:902

This opens a TCP connection to port 902 at address 192.168.16.200. A successful connection is indicated by the V850Netchip-LAN displaying the following:

CONNECT

An unsuccessful connection attempt is indicated by the V850Netchip-LAN displaying the following:

NO CARRIER

Once the TCP connection is established, V850Netchip-LAN is in online mode: any information sent to the V850Netchip-LAN is then forwarded to the remote system over a TCP connection.

7.1.2. Automatic connection establishment

Certain existing systems may have a serial port but are not designed for working with modems. In this case, the V850Netchip-LAN provides the capability of automatically establishing a connection to a pre-configured address and port. There are certain triggers that may be set, using the ***autoconnect*** command, as follows:

- ***autoconnect off*** turns off autoconnect: all connection establishment is manual (see preceding section)
- ***autoconnect any*** requests the V850Netchip-LAN to establish a TCP connection as soon as it receives any character on its serial port: note that the character is buffered internally, before being forwarded on the connection when it is established
- ***autoconnect cr*** requests the V850Netchip-LAN to establish a TCP connection as soon as it receives a carriage return character on its serial port: note that the character is buffered internally, before being forwarded on the connection when it is established. Any character received before the carriage return is discarded.
- ***autoconnect dtr*** requests the V850Netchip-LAN to establish a TCP connection as soon as DTR is asserted.
- ***autoconnect auto*** requests the V850Netchip-LAN to establish a TCP connection as soon as possible after reset

As soon as a connection is established, the NetChip all data received on the serial port is forwarded on the TCP connection, and all received data on the TCP connection is sent to the serial port.

7.2. Transferring data

Data received by the V850Netchip-LAN on its serial port is buffered before it is forwarded on the TCP connection. This buffering is controlled using configuration parameters, as follows:

[to be specified]

7.3. Closing TCP connections

As with connection establishment, there are two ways in which a TCP connection may be closed:

- manual disconnect
- automatic disconnect

7.3.1. Manual disconnect

Closing TCP connections is done by reverting to command-line or AT mode using one of the following methods:

- by sending on the +++ escape sequence
- by sending in a BREAK signal

Both of these methods result in the V850Netchip-LAN reverting to the appropriate mode.
Once in command-line mode, the connection may be closed using the ***close*** or ***ATH*** commands.

7.3.2. Automatic disconnect

Automatic disconnect may be set using the ***autodisc*** command, as follows:

- ***autodisc off*** turns off autodisconnect: all connection closure is manual (see preceding section).
- ***autodisc dtr*** requests the V850Netchip-LAN to close a TCP connection as soon a TCP connection as soon as DTR is de-asserted.
- ***autodisc time <time_in_seconds>*** requests the V850Netchip-LAN to close a TCP connection if the specified number of seconds elapses with no data sent in either direction.

7.4. Incomming connections

The V850NetChip-LAN supports two incomming connections:

- TCP port 23 (i.e. telnet port) enables remote management of the V850Netchip-LAN by providing the same command-line interface as described in section 5 above
- TCP port 3001 connects the serial port to a remote application

8. CTRL Module Protocol

The CTRL module allows a V850Netchip-LAN device to be remotely controlled and monitored over TCP/IP. This is designed primarily to allow Java applets to control the device for demonstration purposes. This document describes how the protocol currently implements this.

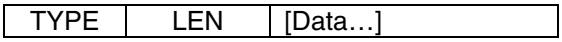
8.1. Protocol Operation

The CTRL module accepts incoming TCP/IP connections on IP port number 26. It does not support UDP because most browser Java environments do not allow applets to receive on UDP sockets for security reasons (because a UDP socket may receive from any remote address). Port 26 has been arbitrarily chosen for development.

The CTRL module accepts incoming an incoming TCP connection from a remote client. Only one connection may be established at a time. The general model used is that the client submits command messages and receives confirmation messages in response. CTRL may also send indication messages to the client. No responses are sent by the client in reply to indications.

Once the incoming connection is established, CTRL waits for the client to send commands to it. All CTRL messages (commands, confirmations and indications) consist of a two-byte header followed by data as shown in figure 1.

Figure 3: CTRL message format



The TYPE field specifies the message type, the LEN field specifies the length of the following data. An error in the format of any received message causes CTRL to abort the connection.

The following commands are currently specified:

Command	Value
CMD_IO_VALUE_MON	0x01
CMD_IO_STATE_GET	0x02
CMD_IO_STATE_SET	0x03
CMD_IO_VALUE_SET	0x04
CMD_DISPLAY_SET	0x05

A confirmation message for a received command has its TYPE field set to the command value bitwise-ORed with 0x80 (e.g. 0x83 is a confirmation message for a CMD_IO_STATE_SET command).

The operation of each of these commands (and indications associated with each) are described below.

8.2. CMD_IO_VALUE_MON

Command type: 0x01. Confirm type: 0x81. Indication type: 0x10.

This command requests the CTRL module to monitor a specified analogue input channel on the V850Netchip device. The LEN field has a value of 1 and is followed by one byte of data identifying the channel to monitor. Channel numbers start at 0. The max allowed channel number is currently 7.

CTRL sends a CMD_IO_VALUE_MON_CONF message (TYPE 0x81) in reply. The LEN field has a value of 1 followed by a one-byte result code. A result of 0 means the request has been accepted, a result of 1 means that an error has occurred.

Shortly after a command has been accepted, CTRL sends a CMD_IO_VALUE_IND (TYPE 0x10) message to the client. This message has a LEN value of 2 followed by 2 bytes of data : a one-byte channel number and one byte of data indicating the current channel level. The value range for the channel level is currently 0x00 – 0x7F (i.e. 7-bit resolution). The level value is stored in the message MSB first.

CTRL continues to sample the channel level once a second. Each time a change in the level is detected, a new CMD_IO_VALUE_IND message is sent to the client. There is currently no message defined to stop the monitoring of a channel.

8.3. CMD_IO_STATE_GET

Command type: 0x02. Confirmation type: 0x82. Indication type: None.

This command requests CTRL to return the state of a specified digital input/output on the V850Netchip device. The LEN field has a value of 1 and is followed by a one-byte value specifying the port number. Port numbers start at 0 and currently have a max value of 7.

If the port number in the command is valid, CTRL retrieves the port state and sends a CMD_IO_STATE_GET_CONF message (TYPE 0x82) in reply. This has a LEN value of 2 followed by two bytes of data: a one-byte port number and a one-byte state value. A state value of 0 means the port is off, 1 means the port is on.

An invalid port number is taken as a message format error and causes the TCP connection to be closed.

8.4. CMD_IO_STATE_SET

Command type: 0x03. Confirmation type: 0x83. Indication type: None.

This command requests CTRL to set the state of a specified port. The LEN field has a value of 2 followed by two bytes of data: a one-byte port number and a one-byte value specifying the requested state. A value of 0 for the state means turn the port off, 1 means turn it on.

If the specified port number is valid, the port state is changed and CTRL sends a CMD_IO_STATE_SET_CONF message (type 0x83) in reply. This has the same format as the corresponding command: a LEN value of 2 followed by the port number and the specified state.

An invalid port number in the command is taken as a message format error and causes the TCP connection to be closed.

8.5. CMD_IO_VALUE_SET

Command type: 0x04. Confirmation type: 0x84. Indication type: None.

This command requests CTRL to set the value of the specified analog output port on the V850Netchip device. The LEN field has a value of 2 and is followed by a one-byte value specifying the port number, and one byte with the value to which to set the port (between 0 and 0x7f). The only valid port number is currently 0.

If the specified port number is valid, CTRL sets the port value to that specified. and sends a CTRL_CNF_RELAY_STATE_GET message (TYPE 0x84) in reply. This has a LEN value of 2 followed by two bytes of data: a one-byte relay number and a one-byte value giving value of the port.

An invalid port number in the command message is taken as a message format error and causes the TCP connection to be closed.

8.6. CMD_DISPLAY_SET

Command type: 0x05. Confirmation type: None. Indication type: None.

This command requests CTRL to set display the specified text on the V850Netchip LCD display. The LEN field has a value of 32 followed by 32 bytes of ASCII data to display. The display field is two lines of 16 characters. Therefore, the message contains the complete display for the NetChip.

There is no confirmation message.

8.7. Closing the CTRL Connection

The client may close the TCP connection to the CTRL module at any time. No messages are defined for terminating the connection at the protocol level.

9. V850Netchip Demonstration Hardware

The section outlines the correspondence between the port values exchanged on the TCP/IP connection, as specified in the preceding section, and the actual hardware to which they refer.

9.1. Analog Input Ports

These ports are monitored using the CMD_IO_VALUE_MON command, and the values are reported using the CMD_IO_VALUE_IND message, as described in section 2.2 above. The port numbers are connected as follows:

Port	Connected to
0	Temperature sensor
1	Light level sensor
2	(not used)
3	Potentiometer (i.e. “volume” type control)
4	Switch 1
5	Switch 2
6	Switch 3
7	Switch 4

9.2. Digital Output Ports

These state of these ports is retrieved using the CMD_IO_STATE_GET command, and may be set using the CMD_IO_STATE_SET message, as described in section 2.3 and 2.4 above. The port numbers are connected as follows:

Port	Connected to
0	Relay 1 (i.e. switch 1)
1	Relay 2 (i.e. switch 2)
2	LED 1
3	LED 2
4	spare (1) – externally connected device
5	spare (2) – externally connected device
6	spare (3) – externally connected device
7	spare (4) – externally connected device

9.3. Analog Output Ports

These value of these ports is set using the CMD_IO_VALUE_SET command, as described in section 2.5 above. The port numbers are connected as follows:

Port	Connected to
0	LED (variable brightness)

9.4. LCD Display

There is a LCD alpha-numeric display of two lines of 16 characters. The text to display on this is set using the CMD_DISPLAY_SET command, as described in section 2.6 above. The message contains the complete text to display, so that the complete display is refreshed for each message.