NuDAM®

ND-6520 RS-232/RS-485 Converter

ND-6510 Repeater

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Contents

1. Introduction

1. 1. What is NuDAM ?

NuDAM is a series of data acquisition modules. It provides a total solution of the data acquisition network and control system. You can remote control up to 256 NuDAM modules on a two-wire cable. All you need is to use a host computer, like PC (Personal Computer), with one RS-232 serial port for controlling the whole system. The maximum communication distance is 4000 feet from the host computer.

NuDAM is based on the RS-485 multi-drop network system, each module has an unique address ID. Using simple ASCII command & response protocol through standard RS-485 interface can control all the NuDAM modules in the RS-485 network.

The NuDAM modules provide direct linkage to a wide variety of sensors and perform all signal conditioning, scaling, linearization and conversion. The modules can be used to measure temperature, pressure, flow, voltage, current and numerous types of digital signals.

1. 2. Outstanding Features of NuDAM

- ***Industry standard networking***
  All NuDAM modules use the RS-485 communication protocol for transmitting and receiving at high rates and over long distance.

- ***Two-wire and multi-drop communication***
  A single twisted pair of wires is used to transmit and receive data between modules. Multi-drop capability makes system configuration more flexible and easy set-up of a network.

- ***High transfer speed***
  NuDAM modules provide up to 38.4K bps data / command transfer rate. It can promote system bandwidth.

- ***Simple command / response protocol***
  All communications are performed with printable ASCII characters. This allows the information to be processed with string functions common to the most high-level languages.

- ***Industrial design***
  The screw terminal plug connectors on every NuDAM module ensures simple installation and easy modification. The compact size allows the modules to be mounted on DIN rail, back-panel wall-mount, etc.

- ***Watch-dog supervisory***
  NuDAM contains a watch-dog supervisory circuitry that will automatically reset the module when the system fails. In addition, a user-programmable software timer provides a 'safe' output signal in the event of host computer failure.

- ***High isolation voltage***
  NuDAM provides photo-isolators, which ensure high isolation voltage, between the data acquisition circuits and the communication port. The fatal electric-shock won't go through and damage all the modules on the network.

- ***Noise immunity***
  The Golden NuDAM series provide extra noise immunity capability. An electrode, which is coated inside the ABS case, can reduce electro-magnetic interference (EMI) and noise.

- ***Harsh environmental protection***
  A surface coating covers on the PCB and electronic components of the Golden NuDAM series. It allows superior resistance to harsh environment such as humidity, salt spry and most harsh chemicals.

1. 3. NuDAM-6000 series products overview

The NuDAM-6000 series provides the complete sets of data acquisition modules, including the communication modules, the analog input modules, the analog output modules, and the digital I/O modules.

Communication Module

- NuDAM-6520 : RS-232 to RS-485 converter
- NuDAM-6510 : RS-485 repeater

Analog Input Modules

- NuDAM-6011 : High gain analog input module (with DI/O)
- NuDAM-6012 : Analog Input Module
- NuDAM-6013 : 3 CH RTD Module
- NuDAM-6017 : 8 CH Analog Input Module
- NuDAM-6018 : 8 CH Thermocouple Input Module

Analog Output Modules

- NuDAM-6021 : Single channel analog output

Digital I/O Modules

- NuDAM-6050 : 7 DI channels and 8 DO channels
- NuDAM-6052 : Isolated Digital Input Module
- NuDAM-6060 : Relay Output & Digital Input Module
- NuDAM-6080 : Counter/Frequency Input Module

1. 4. EIA RS-485 Standard

The EIA RS-485 interface is a communication standard developed for multi-dropped systems that can communicate at high rate over long distance. The standard RS-485 can operate at speed up to 10 M bps over cable length up to 4000 feet.

The RS-485 interface can support up to 32 drivers / receivers on the same line. This allows actual networking applications on a parity line system (sometimes called multi-drop).

The RS-485 uses differential transmission on a balance line. Its easy wiring make it popular to use in industrial applications.

1. 5. RS-485 on NuDAM

The NuDAM improves the RS-485 capability for minimizing the user's cost. On each NuDAM module, a half-duplex RS-485 transceiver is used to communicate with other modules. A single twisted pair of wires, which provides standard differential transmission, is used to transmit and receive data between modules. The quarter-unit-load input impedance of each NuDAM receiver allows up to ***128*** NuDAM modules on the same RS-485 bus without using signal repeater.

The maximum transfer rate of NuDAM is 38.4Kbps which is lower than the maximum speed of the RS-485 standard. The slew-rate limiter on every RS-485 transceiver of NuDAM is very useful for transmitting error-free data, minimizing EMI, and reducing reflections caused by improperly terminated cables.

The NuDAM on a network may not use the same power supply. Therefore, the voltage difference between ground of the modules may exist.

Excessive output current and power dissipation caused by faults or by bus contention are prevented by the current limiter and the thermal shutdown circuitry inside the NuDAM.

1. 6. NuDAM RS-485 Network Configurations

NuDAM-6000 series is designed under RS-485 multi-drop network architecture. Up to 256 NuDAM modules can be controlled in a multi-drop network. The limit of 256 is due to command code. The network can be connected by simple topology (Figure 1-1) or branch topology (Figure 1-2) or free topology (Figure 1-3).

The ND-6520 and ND-6510 are the two basic communication modules to construct a RS-485 network. The ND-6520 is a RS-232 to RS-485 converter. The ND-6520 is used to build a RS-485 port for the host computer by converting standard RS-232 signal into RS-485 signal.

The ND-6510 is the RS-485 signal repeater which is used to extend or to lengthen the network distance. A NuDAM bus can connect up to 256 modules, each segment is up to 128 modules. Whenever the numbers of the modules excess 128, the repeater should be used. In addition, the length of a standard RS-485 bus is up to 4000 feet, the repeater should be used whenever the length of a signal bus is more than 4000 feet.

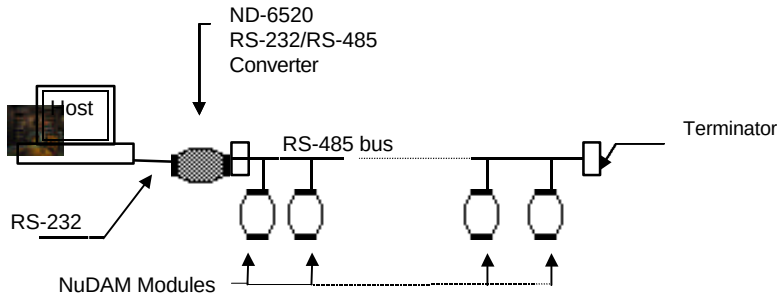


Figure 1-1 Simple Topology

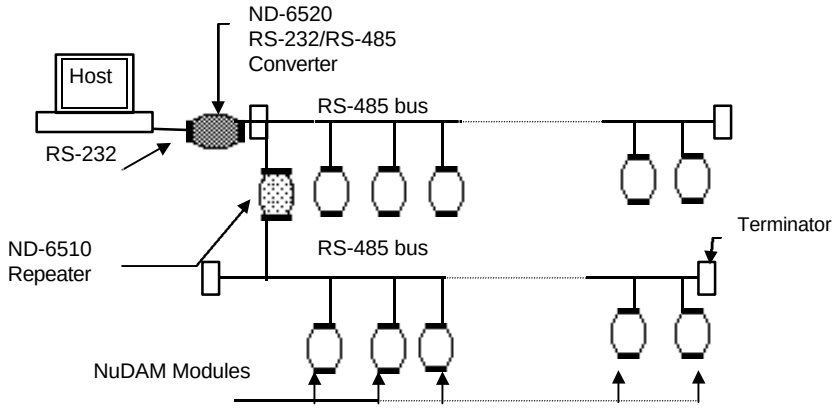


Figure 1-2 Branch Topology

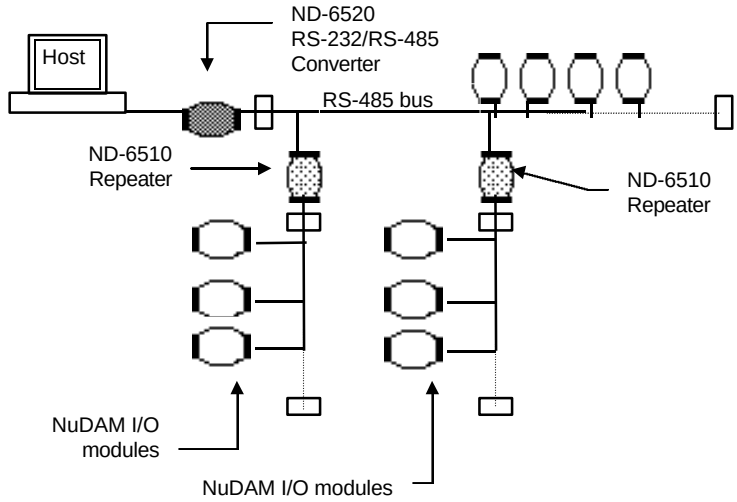


Figure 1-3 Free Topology

1. 7. Constructing a NuDAM Network

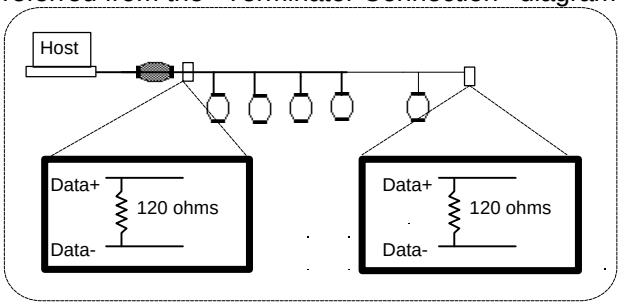
Go through the following steps, the user can construct a NuDAM network easily.

1. Setup a ND-6520.
2. Connect the host computer with the ND-6520.
3. Setup one or more ND-6510 if necessary.
4. Connect the ND-6510 to extend to RS-485 bus if necessary.
5. Install the NuDAM utility software from disk.
6. Initialize the brand-new NuDAM modules.
7. Add the new NuDAM modules into RS-485 network.

Refer to chapter 2 for executing step 1 and 2. Refer to chapter 3 for executing step 3, 4 and for understanding the time to install ND-6510. The knowledge about the software for operating the NuDAM is in chapter 5. For executing the step 6 and step 7, refer to chapter 4.

1. 8. Termination Bus

In order to avoid signal reflections on the bus, each bus segment has to be blanked off at its physical beginning and at its end with the characteristic impedance. An termination resister (Rt) is intalled for this purpose. The Rt value - 120Ω ± 2% is recommended, and the detailed connection of Rt can be referred from the "Terminator Connection" diagram below.



Terminator Connection

1. 9. Shielding

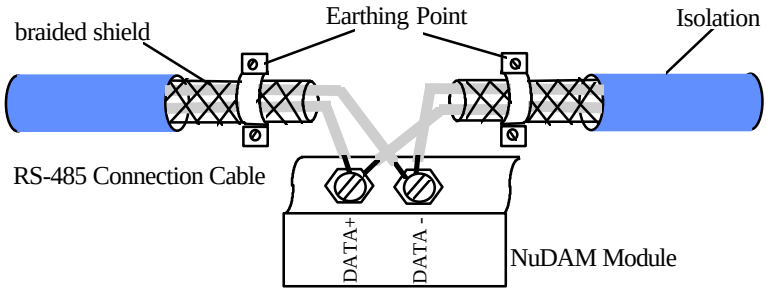
In case of increased interference, a shielded bus cables is recommended to use for wiring between module and modules. In addition, a shielding also should be done for the cable of power supply and for the signal cables.

Some experiences and recommendations are concerning for shield connection.

1. The shield should be connected with protective earthing at each bus connection.

2. The shield should be applied additionally several times along the course of the cable.

3. The Computer should be applied the shield directly to the appliance or to separate shield rails.



1. 10. How to Calculate Checksum Value

Format of NuDAM Commands

(LeadingCode)(Addr)(Command)(Data)**[Checksum]**<CR>

When checksum is enable then **[Checksum]** is needed, it is 2-character.

[Checksum] = ((LeadingCode)+(Addr)+(Command)+(Data)**) MOD 0x100**

Example 1: checksum is **disable**

User Command	$012<CR>
:	
Response	!01400600
:	

Example 2: checksum is **enable**

User Command	$012**B7**<CR>
:	
Response	!01400600**AC**
:	

'$' = 0x24 '0' = 0x30 '1' = 0x31 '2' = 0x30

B7 = (0x24 + 0x30 + 0x31 + 0x32 **) MOD 0x100**

'!' = 0x24 '0' = 0x30 '1' = 0x31 '4' = 0x34
'6' = 0x36

AC = **(** 0x24 + 0x30 + 0x31 + 0x34 + 0x30 + 0x30 + 0x36 + 0x30 + 0x30 **) MOD 0x100**

2. NuDAM-6520

2. 1. Overview

What is NuDAM-6520 ?

NuDAM-6520 is a RS-232 to RS-485 converter, it converts the RS-232 communications signal to the RS-485 signals. The ND-6520 can be considered as an extension RS-485 series port for the host computer. A standard 9-pins D-type connector is used to connect the host computer and the ND-6520. Hence, the ND-6520 can connect with all kinds the PC, IPC or Notebook PC, which install a standard RS-232 interface.

Features of NuDAM-6520

- RS-485 transceiver
- Easily setup and installation
- Maximum 128 NuDAM on a bus without repeater
- Maximum 256 addressable NuDAM modules
- High transfer speed
- High isolation voltage
- Lower power consumption

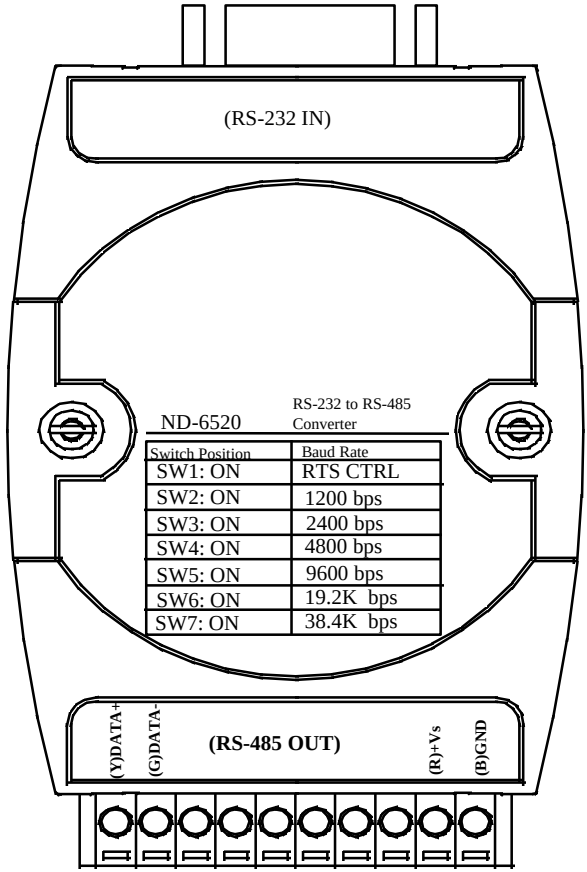
Specifications of NuDAM-6520

✧ **Input**
- Interface : standard RS-232 9 pin D-type connector
- Speed (bps) : 1200, 2400, 4800, 9600, 19.2K, 38.4K, RTS
- Data Format : 8 bits, 9 bits, 10 bits, or 11 bits

✧ **Output**
- Interface : RS-485, differential, 2 half-duplex wires
  RS-422, differential, 4 duplex wires
- Speed (bps) : 1200, 2400, 4800, 9600, 19.2K, 38.4K, RTS
- Max distance : 4000 ft. (1200m)

- **Isolation**
  - Isolation voltage : 3000 V DC
- **Bus**
  - Max Loading : 128 NuDAMs on a bus
  - Max modules : 256 NuDAMs with one ND-6510 repeater
- **Power**
  - Power Supply : +10V to +30V
  - Power Consumption : 1.2 W

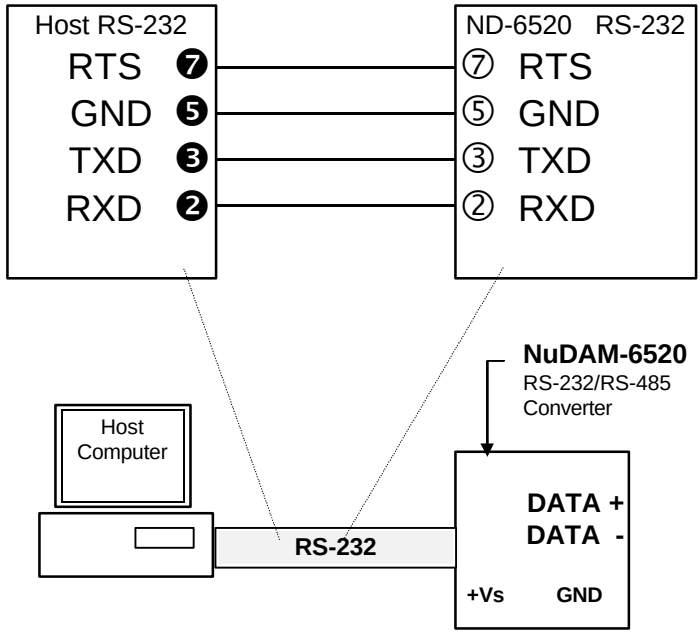
A Look at NuDAM-6520 & Pin Assignment



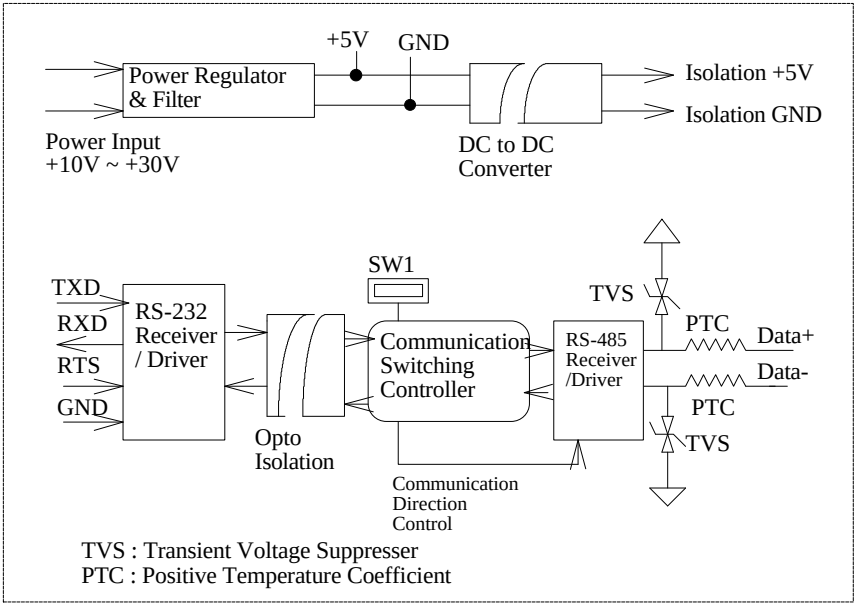
Pin Definitions

Pin #	Signal Name	Description
1	(Y)DATA+	RS-485 transmission line, positive
2	(G)DATA-	RS-485 transmission line, negative
9	(R)+VS	NuDAM power supply, +10V~+30V
10	(B)GND	NuDAM ground
--	RS-232 IN	9-pin RS-232 connector

Connection Between Host and ND-6520



Functional Block Diagram



2. 2. Setup

Objective of Setup

In normal condition, it is not necessary to setup the NuDAM-6520. The default configuration of this communication module is 9600 bps and data format of 8 data bits with 1 start bit, 1 stop bit, and no parity check. Note that the data format is reserved to be compatible with other brand's communication port, it should not be modified if only NuDAM is used in a system. The baud rate can be configured according user's requirement.

Setup Equipments

Only screw driver is used to open the case. Software, power supply, and wiring are not necessary.

Setup Procedure

Only hardware switch setting can be setup in NuDAM-6520. The user can set the speed of the series interface (RS-232 and RS-485), and the series data format. The speed and the data format on the whole RS-485 network must be identity otherwise the communication will be not correct.

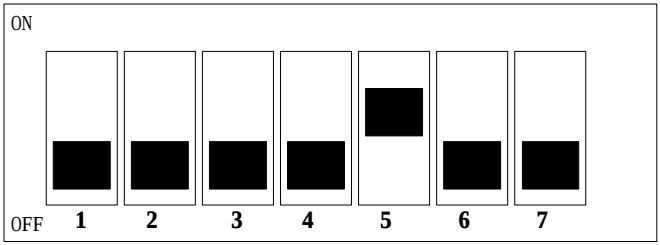
To setup the ND-6520, use the screw driver to open the case, then change the switch setting. The new setting is available after power on. The case must be put back and locked carefully. Note that do not scratch the surface of the circuit while setting up, otherwise the surface coating or even the circuits will be damaged.

Default Setting

- 9600 baud rate
- 10 bits series data format : one start bit, eight data bits, one stop bit, no parity check

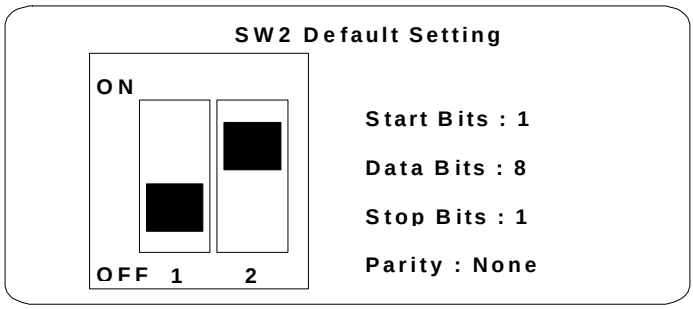
SW1 Setting

SW1 Default Setting (9600 bps)



1	2	3	4	5	6	7	Baud Rate
ON	OFF	OFF	OFF	OFF	OFF	OFF	RTS Control
OFF	**ON**	OFF	OFF	OFF	OFF	OFF	1200 bps
OFF	OFF	**ON**	OFF	OFF	OFF	OFF	2400 bps
OFF	OFF	OFF	**ON**	OFF	OFF	OFF	4800 bps
OFF	OFF	OFF	OFF	**ON**	OFF	OFF	9600 bps
OFF	OFF	OFF	OFF	OFF	**ON**	OFF	19200 bps
OFF	OFF	OFF	OFF	OFF	OFF	**ON**	38400 bps

SW2 Setting



*** Do not changed this default setting. ***

2. 3. Installation

Software Utility

Software is not necessary for this module.

Equipments for Installation

A host computer with RS-232 port
RS-232 cable (9 pin)
Power supply (+10V~+30V)
Wires (shielded and grounded is recommended)

Installation Procedure

1. Make sure the host computer is power off.
2. Use RS-232 cable to connect NuDAM-6520 with host computer.
3. Wire the power supply to NuDAM. Note that the power supply should meet the specification.
4. Wire other NuDAMs.

Application Wiring

The Figure 2-1 shows the application wiring of NuDAM-6520.

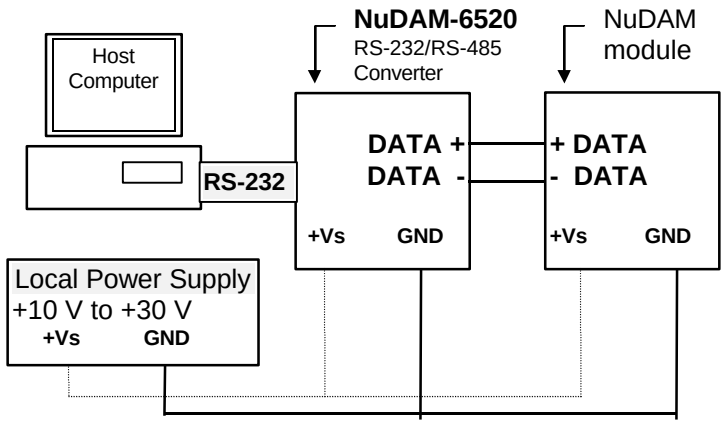


Figure 2-1 Application wiring of NuDAM-6520

2. 4. Programming

The NuDAM-6520 is a communication module, it is not necessary to be programmed.

3. NuDAM-6510

3. 1. Overview

What is NuDAM-6510 ?

The ND-6510 is the RS-485 signal repeater which is used to extend or to lengthen the network distance. A NuDAM bus can connect up to 128 modules. The repeater should be used when the numbers of the modules excess 128. In addition, the repeater should also be used when the length of a signal bus is more than 4000 feet.

Features of NuDAM-6510

- RS-485 signal transceiver & repeater
- Bi-directions signal transmission for both RS-485 ports
- Automatic transmission direction control
- Easily setup and installation
- Maximum 128 NuDAM on a bus
- Maximum 256 addressable NuDAM modules
- High transfer speed
- Lower power consumption

Specifications of NuDAM-6510

✧ **Input / Output**
- Interface : RS-485, differential 2 half-duplex wires
  RS-422, differential, 4 duplex wires
- Speed (bps) : 1200, 2400, 4800, 9600, 19.2K, 38.4K
- Data Format : 8 bits, 9 bits, 10 bits, or 11 bits
- Max distance : 4000 ft. (1200m)

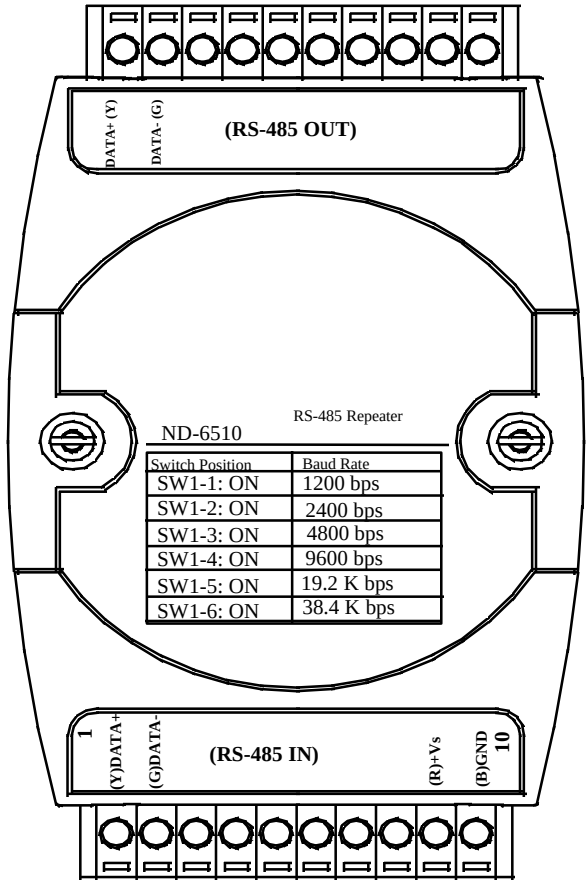
✧ **Isolation**
- Isolation voltage : 3000 V DC

✧ **Bus**
- Max Loading : 128 NuDAM on a bus

✧ **Power**

- Power Supply : +10V to +30V
- Power Consumption : 1.2 W

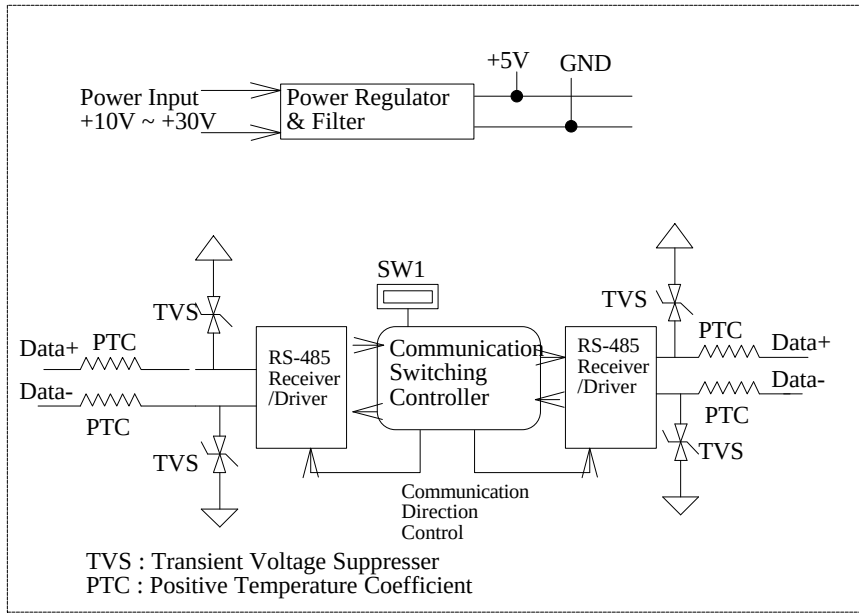
A Look at NuDAM-6510 & Pin Assignment



Pin Definitions

Pin #	Signal Name	Description
1	(Y)DATA+	RS-485 transmission line, positive
2	(G)DATA-	RS-485 transmission line, negative
9	(R)+VS	NuDAM power supply, +10V~+30V
10	(B)GND	NuDAM ground
19	(G)DATA-	RS-485 transmission line, negative
20	(Y)DATA+	RS-485 transmission line, positive

ND-6510 Functional Block Diagram



3. 2. Setup

Objective of Setup

In normal condition, it is only to setup the NuDAM-6510 when the NuDAM bus exceed 128 modules or the distance up to 4000 feet. The default configuration of this communication module is 9600 bps and data format of 8 data bits with 1 start bit, 1 stop bit, and no parity check. Note that the data format is reserved to be compatible with other brand's communication port, it should not be modified if only NuDAM is used in a system. The baud rate can be configured according user's requirement.

Setup Equipments

Only screw driver is used to open the case. Software, power supply, and wiring are not necessary.

Setup Procedure

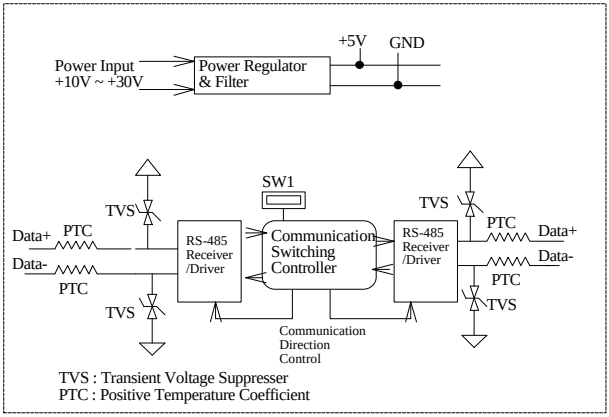
Only hardware switch setting can be setup in NuDAM-6510. The user can set the speed and the data format of the RS-485 interface. The speed and the data format on the whole network must be identity otherwise the communication will be not correct.

To setup the ND-6510, use the screw driver to open the case, then change the switch setting. The new setting is available after power on. The case must be put back and locked carefully. Note that do not scratch the surface of the circuit while setting up, otherwise the surface coating or even the circuits will be damaged.

Default Setting

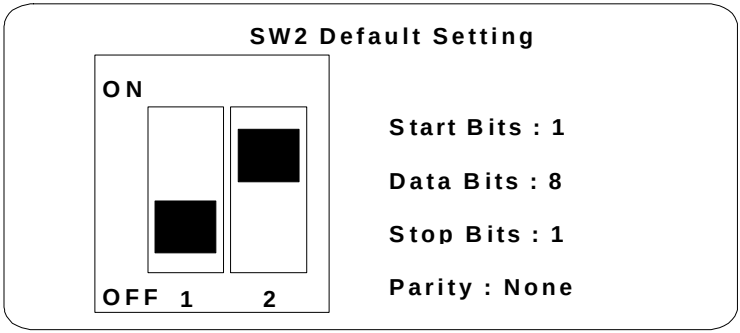
- 9600 Baud rate
- 10 bits series data format : one start bit, eight data bits, one stop bit, no parity check

SW1 Setting



1	2	3	4	5	6	Baud Rate
ON	OFF	OFF	OFF	OFF	OFF	1200 bps
OFF	**ON**	OFF	OFF	OFF	OFF	2400 bps
OFF	OFF	**ON**	OFF	OFF	OFF	4800 bps
OFF	OFF	OFF	**ON**	OFF	OFF	9600 bps
OFF	OFF	OFF	OFF	**ON**	OFF	19200 bps
OFF	OFF	OFF	OFF	OFF	**ON**	38400 bps

SW2 Setting



*** Do not changed this default setting. ***

3. 3. Installation

Software Utility

Software is not necessary.

Equipments for Installation

A 2 wire RS-485 network
Power supply (+10V~+30V)
Wires

Installation Procedure

1. Make sure the original RS-485 network is power off.
2. Wire the power supply to NuDAM-6510. Note that the power supply should meet the specification.
3. Wire other NuDAMs to the extend RS-485 bus.

Application Wiring

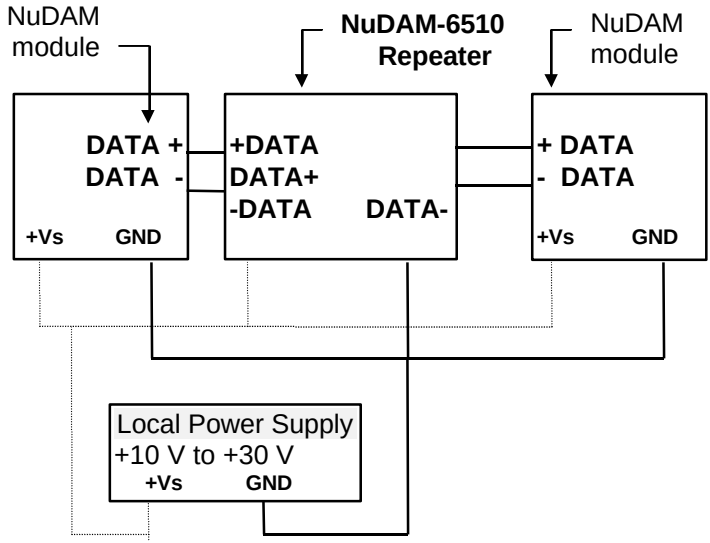


Figure 3-1 NuDAM-6510 wiring.

3. 4. Programming

The NuDAM-6510 is a communication module, it is not necessary to be programmed.

4. Install a Brand-New NuDAM

4. 1. Initialize a Brand-New NuDAM

Objective of Initializing a Brand-New NuDAM

All NuDAM modules. except NuDAM-6520 and NuDAM-6510, in a RS-485 network must have an *unique* address ID, however, every brand-new NuDAM has a factory default setting as following:

- Baud rate is 9600 bps.
- Address ID is 01.
- Checksum is disable.
- Host watchdog timer is disable.

Therefore, to configure the brand-new NuDAM before using is necessary, otherwise the address ID will conflict with others. The baud rate may also be changed according to user's requirements.

The following initialization procedures are need not only for a brand-new module, but also for a installed NuDAM module. When the user want to change the setting, the initialization procedure can also be used.

Initial State

The NuDAM I/O modules must be set a *Initial State* when you want to change the default settings of the modules, such as the ID address, baud rate, check-sum status etc. All NuDAM I/O modules have an special pin labeled as **Default***. "The module will be set as *Initial State* if the **Default*** pin is shorted to ground." Under this state, the default configuration is set as following:

- Address ID is 00.
- Baud rate is 9600 bps.
- Checksum is disable.

- Host watchdog timer is disable.

Initialization Equipments

- Host computer with an RS-232 port.
- An installed RS-485 module (NuDAM-6520) with 9600 baud rate.
- The brand new NuDAM module
- Power supply (+10 to +30 V_{DC}) for NuDAM modules
- A NuDAM-6510 if the connection distance is more than 4000 ft.

Initialization Procedure A

-- As Baud rate is 9600 bps and check-sum is disable

1. Power off the host computer and the installed NuDAM-6520. Be suring the baud rate of the NuDAM-6520 is 9600 bps.
2. Connect a brand new NuDAM module with the RS-485. Refer to Figure 4.1 for detail wiring.
3. Power on the host computer.
4. Power on the power supply for NuDAM modules.
5. Use the NuDAM Administrating utility to configure the address ID, Baud rate and check-sum status of the module.

Initialization Procedure B

-- As Baud rate is not 9600 bps or check-sum is not disable

1. Power off the host computer and the installed NuDAM-6520.
2. Connect a brand new NuDAM module with the RS-485. Refer to Figure 4.1 for detail wiring.
3. Configure the NuDAM-6520 to Baud rate 9600 bps.
4. Short the **DEFAULT*** pin of the brand-new module.
5. Power on the host computer.
6. Power on the power supply for NuDAM modules.
7. Use the NuDAM Administrating utility to configure the address ID, Baud rate and check-sum status of the module.
8. Power of the local power supply.
9. Disconnect the **DEFAULT*** pin.
10. Configure the NuDAM-6520 to desired Baud rate.
11. Power on the local power supply

12. Use NuDAM Administration utility to check the module‘s new setting.

Initialization Wiring

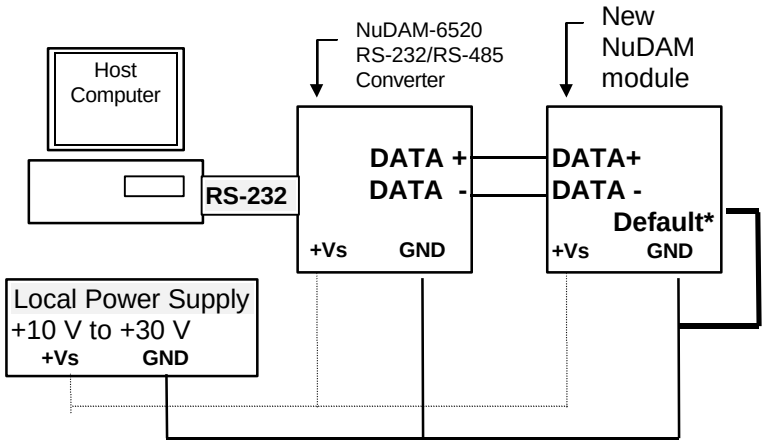


Figure 4-1 Layout for Configuring the NuDAM module

4. 2. Install a New NuDAM to a Existing Network

Equipments for Install a New Module

- A existing NuDAM network
- New NuDAM modules.
- Power supply (+10 to +30 V_{DC}).

Installing Procedure

1. Configure the new NuDAM module according the initialization procedure in section 4.1.
2. The baud rate and check-sum status must be identity with the existing RS-485 network. The address ID must not be conflict with other NuDAM modules.
3. Power off the NuDAM local power supply of the existing RS-485 network.
4. Power off the host computer.

5. Add the new module to the existing RS-485 network.
6. Power on the host computer.
7. Power on the NuDAM local power supply.
8. Use the NuDAM administration utility to check entire network.

5. Software Utility

5. 1. Software Installation

1. Backup your software diskette
2. Insert "NuDAM Adminstration" diskette into floppy drive A:
3. Change drive to A:
4. Installation command syntax

   INSTALL drive:
   drive name is C to Z.

   Example 1 : install to drive C:
   A:\> **INSTALL C:**

   Example 2 : install to drive F:
   A:\> **INSTALL F:**

5. NuDAM Administration Utility will be installed in the directory C:\NUDAM

5. 2. How to Execute the NuDAM Administration

What environment you needed ?

1. At least one RS-232 communication port.
2. VGA monitor
3. Mouse (optional)

Execute the NuDAM Administration Utility

- C:\> **CD \NUDAM**
- C:\NUDAM> **NUDAM**

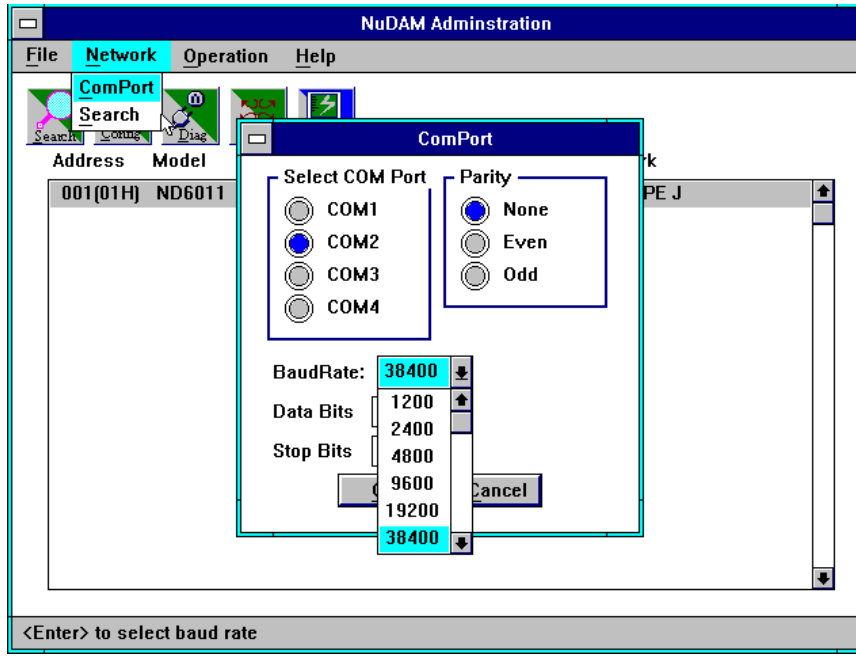
5. 3. Change Communication Setting

Default RS-232 Communication Port Setting.

- Communication Port : **COM2**
- Baud Rate : **9600**
- Data Bits : **8**
- Stop Bits : **1**
- Parity : **None**

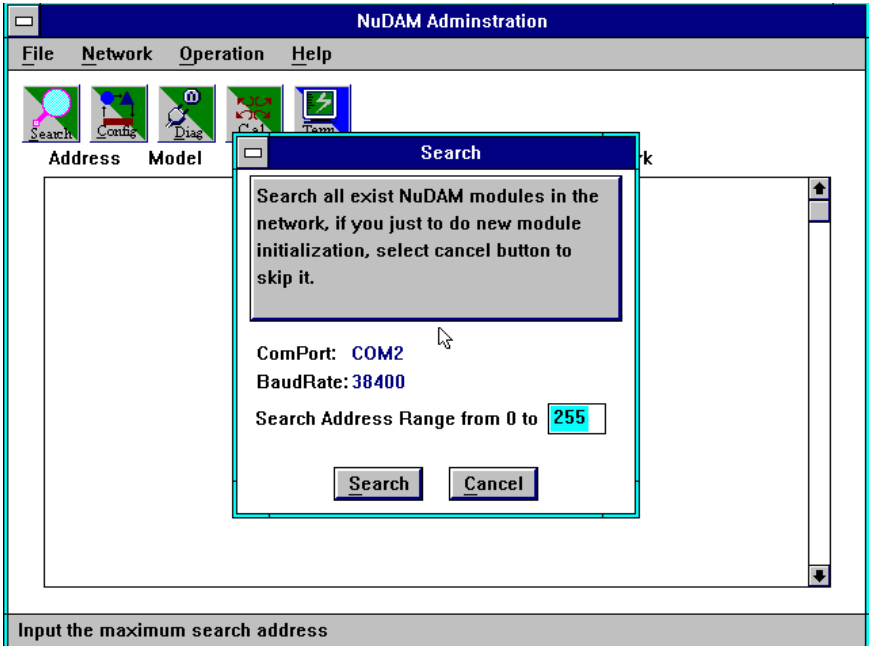
Change RS-232 Communication Port Setting.

Select " Network-ComPort" to change setting.



5. 4. NuDAM Administration Function Overview

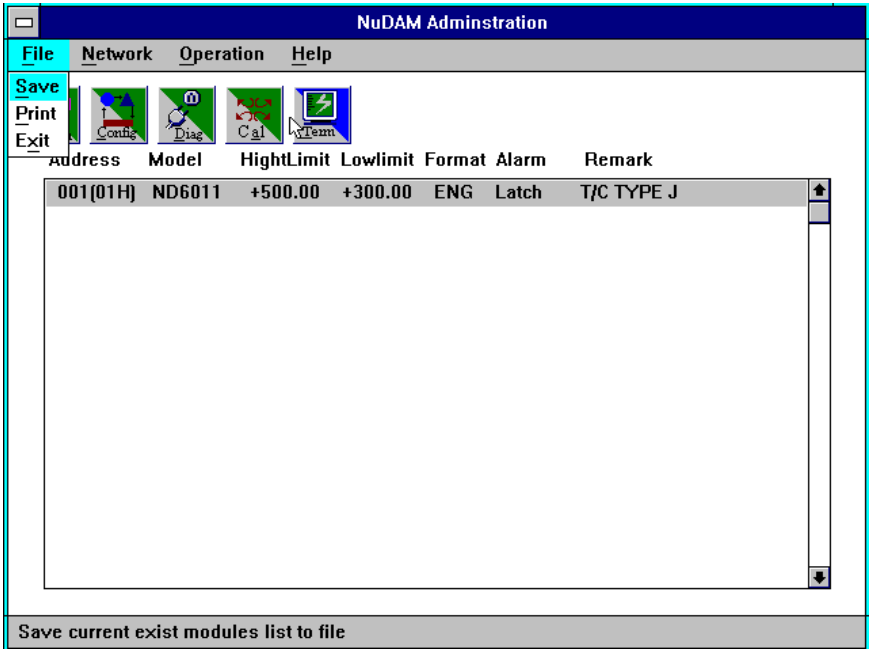
You can change maximum search address or press <Enter> two times to start search.



File-Save : Save all exist NuDAM modules information as display as in the listbox in the current RS-485 network.

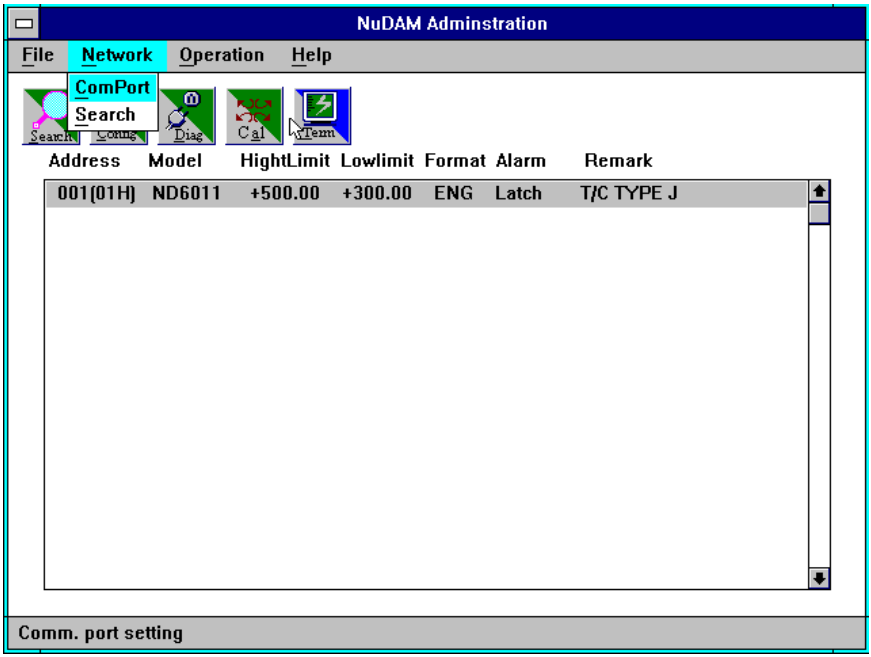
File-Print : Print the NuDAM module information in the listbox.

File-Exit : Quit the NuDAM Administration Utility.

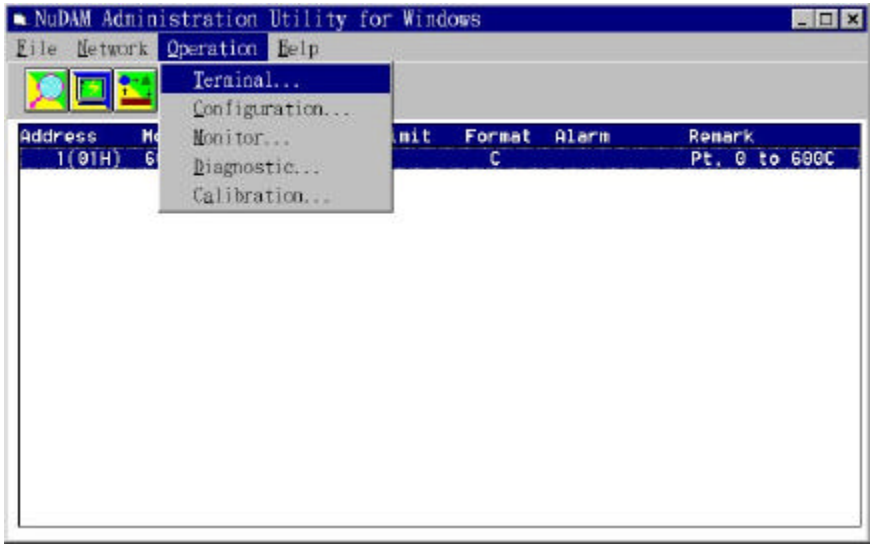


Network-ComPort : Communication port setting.

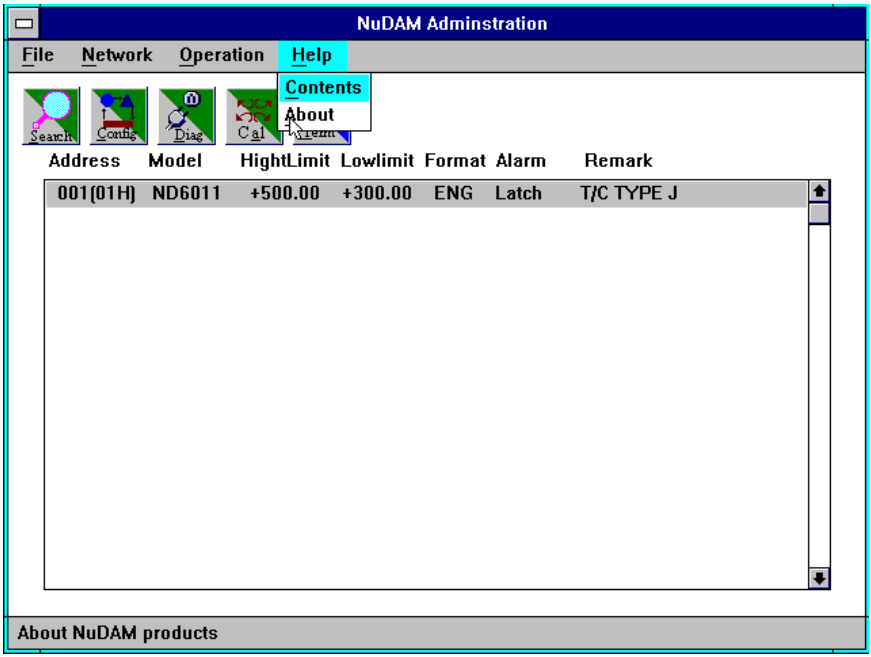
Network-Search : Search all exist NuDAM modules in the current RS-485 network.



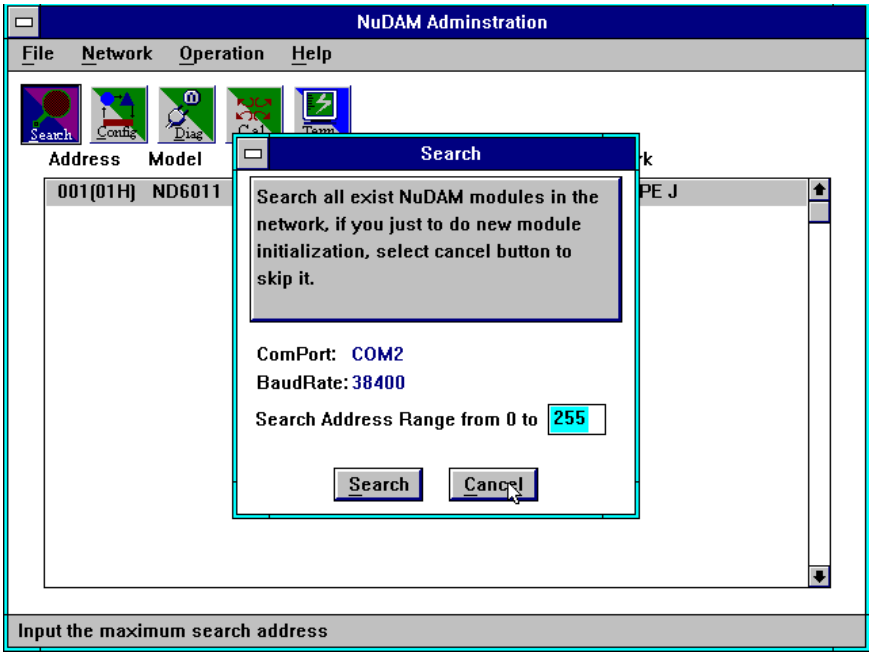
Operation-Terminal :	Terminal Emulation, user can input command and get response message.
Operation-Configuration :	Select one exist NuDAM module and select Configuration to do this module‘s common and private setting .
Operation-Monitor :	Monitor all the module’s function on the network.
Operation-Diagnostic :	Diagnostic module‘s function.
Operation-Calibration :	Some A/D modules need do calibration.



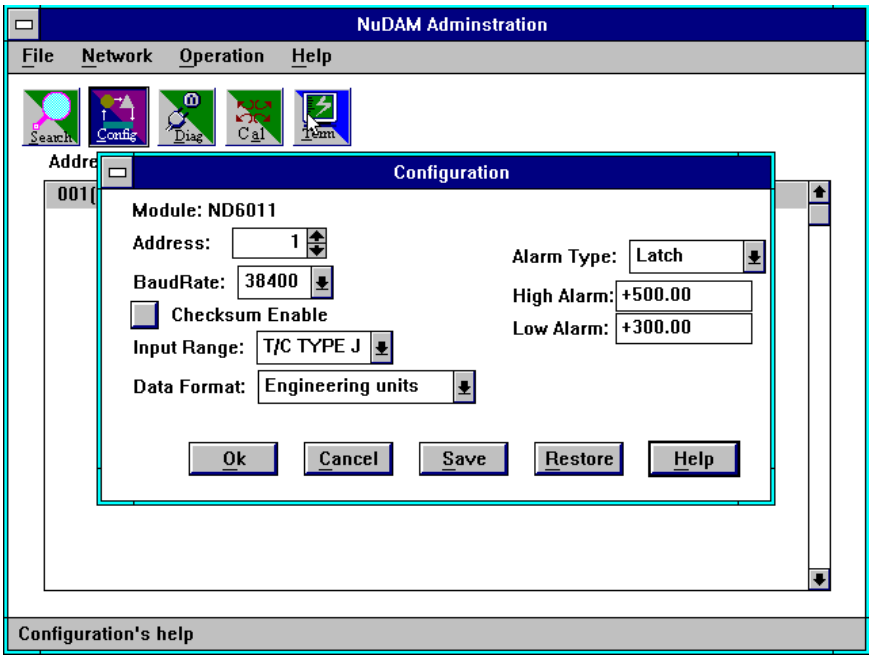
Help-Contents : Information for NuDAM products
Help-About Version information



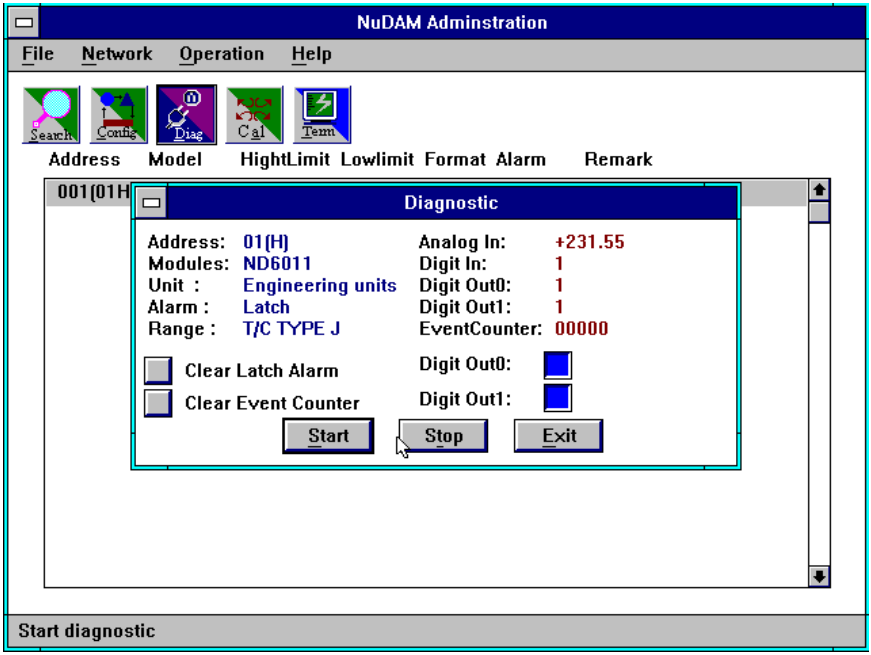
Search ICON for Network-Search



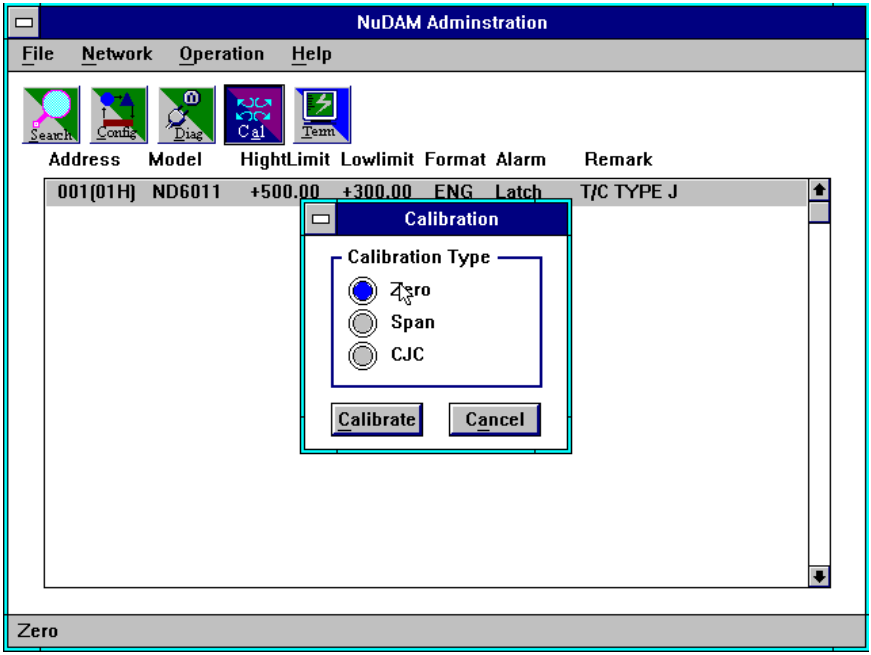
Config ICON for Operation-Configuration



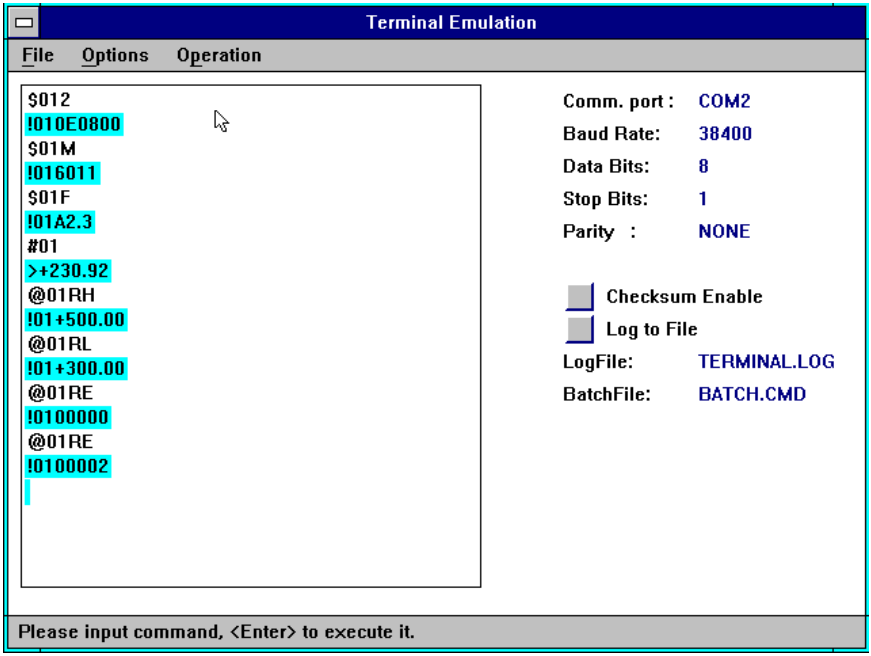
Diag ICON for Operation-Diagnostic



Cal ICON for Operation-Calibration



Term ICON for Operation-Terminal



Operation-Run Batch : Run batch command file in BATCH.CMD
user can edit this text file.

Operation-Step Batch : Run the batch command step by step.

Operation-Display Batch: Display content of BATCH.CMD

Operation-Repeat : Repeat one command n times