NuDAM-6011/D
NuDAM-6012/D
NuDAM-6013
NuDAM-6014D
NuDAM-6017
NuDAM-6018

Analog Input Modules

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- ☐ Environment to Use:
- ☐ OS: ☐ Computer Brand:
- ☐ M/B: CPU: Chipset: Bios:
- ☐ Video Card:
- ☐ Network Interface Card:
- ☐ Problem Description:

- ☐ Any Suggestion is appreciated:

Contents

1. Introduction

1. 1. About the NuDAM Analog Input Modules

The NuDAM provides a series of analog input modules which can sense the analog signal or to control the remote devices. The basic features of each module are shown here.

- NuDAM-6011/D : multi-functions high gain analog input module
- NuDAM-6012/D : multi-functions analog input module
- NuDAM-6013 : 3 channels RTD input module
- NuDAM-6014D:Analog (Transmitter) input module with LED display
- NuDAM-6017 : 8 channels analog input module
- NuDAM-6018 : 8 channels thermocouple input module

∗ The models with an extended D have the same command set and specification as without D, except the D version has a 5 1/2 LED Display.

1. 2. Overview of NuDAM-6011/D

What is NuDAM-6011/D ?

NuDAM-6011/D is a multi-functions analog input module with cold junction compensation (CJC). The maximum input voltage range of analog input channel is ±2.5V. The high gain feature allows very small full range of ±15mV. To measure temperature by directly connect the thermal couple is possible because of using the CJC inside and the high gain feature. The voltage range of the ADC can be set according to different types of thermal couple. The ADC can be calibrated by programming without handy adjustment. This feature insure the best performance under different environment.

The module provides the analog signal monitor or the alarm function. The high and low bound of the alarm limit can be set by programming. The alarm status can be sent to digital output channels if this function is ON. The supervisor of a factory can 'see' or 'hear' the alarm if the digital output channel control a real alarm device. The two digital output channels can be set for general purpose use if the alarm is disabled.

For example, connecting relay devices to DO channels, the NuDAM-6011/D can be used to control the high power devices.

The module provides another one digital input channel. This can be used for general purpose such as monitor digital signal, or be used as input of the event counter.

Features of NuDAM-6011/D

- 1 analog input channel with differential input
- programmable voltage range with high gain amplifier
- Self offset and gain calibration
- On board CJC for temperature measurement
- 5000 Vrms isolation voltage for AD channel (2500 Vrms for NuDAM-6011/D)
- 2 digital output channels of open collector type
- Alarm function with high / low alarm output
- 1 digital input channel / event counter
- Programmable host watchdog timer for host failure protection
- Internal watchdog timer for device failure protection
- Easy programming by software
- Easy installation and wiring
- 5 1/2 digital LED Display (NuDAM-6011/D)

Specifications of NuDAM-6011/D

✧ **Interface**

- Interface : RS-485, 2 wires
- Speed (bps) : 1200, 2400, 4800, 9600, 19.2K, 38.4K,115.2K (115.2K only for firmware reversion above A4.00)

✧ **Analog Input**

- Input type: Differential input
- Resolution: 16 bits
- Unit Convertion: Thermocouple, mV, V, or mA
- Thermocouple Type: J, K, T, E, R, S, B, N, C

J: 0°C~760°C	K: 0°C~1000°C
T: -100°C~400°C	E: 0°C~1000°C
R: 500°C~1750°C	S: 500°C~1750°C
B: 500°C~1800°C	N: -270°C~1300°C
C: 0°C~2320°C	

- Voltage Range: Programmable 6 levels
  ±2.5V, ±1V, ±500mV, ±100mV, ±50mV, ±15mV
- Current Measurement: 20mA (with external 125Ω resistor)

- Accuracy: ±0.4%

✧ **Digital Output**

- Channel numbers : 2
- Output characteristic : open collector transistor
- Maximum current sink : 50mA
- Max. power dissipation : 300mW

✧ **Digital Input**

- Channel numbers : 1
- Logical level 0 : +1V maximum
- Logical level 1: +2.0V~ +30V
- Pull up resister : 10KΩ
- Maximum current : 0.5mA

✧ **Watchdog Function**

- Module internal watchdog timer : 150 ms
- Power failure threshold : 4.65 V
- Safety value : 2 digital output channels
- Host programmable watchdog : 100 ms ~ 25.500 sec

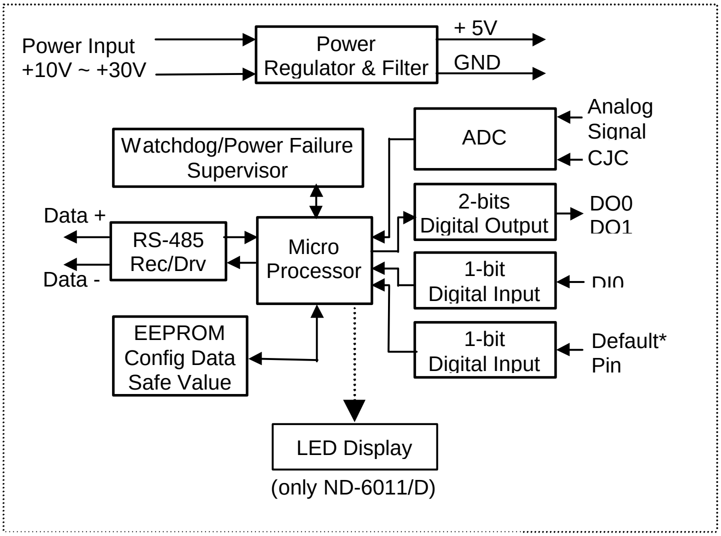
✧ **Power**

- Power supply : +10V to +30V
- Current consumption : 0.76W(1.68W for NuDAM-6011/D)

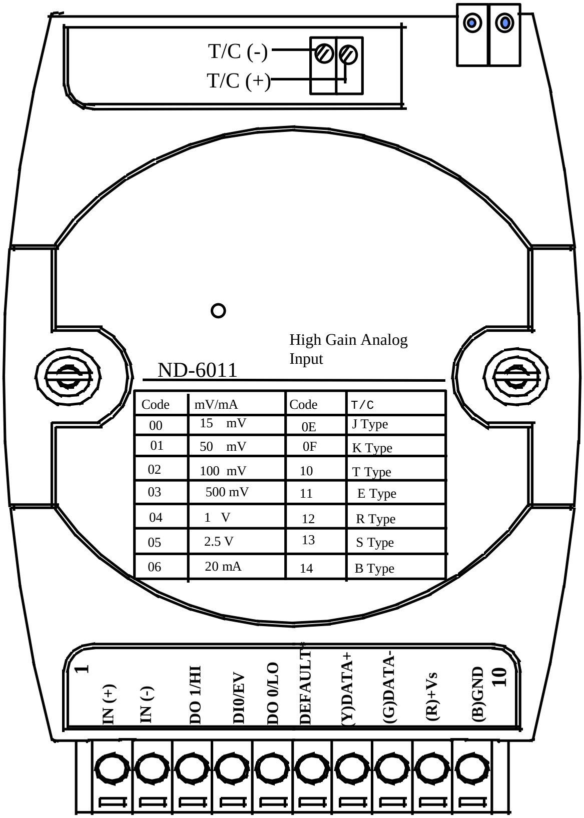
Pin Definitions of ND-6011/D

Pin #	Signal Name	Description
1	IN+	Analog Input Positive Terminal
2	IN-	Analog Input Negative Terminal
3	DO 1/ HI	Digital Output Channel 1 or High alarm status output
4	DI 0 / EV	Digital Input Channel 0 or event counter input
5	DO 0 / LO	Digital Output Channel 0 or Low alarm output
6	DEFAULT*	Initial state setting
7	(Y) DATA+	RS-485 series signal, positive
8	(G) DATA-	RS-485 series signal, negative
9	(R) +Vs	Power supply, +10V~+30V
10	(B) GND	Ground
11	TC(+)	Thermocouple Input positive Terminal
12	TC(-)	Thermocouple Input negative Terminal

Functional Block Diagram of ND-6011/D



A Look at ND-6011/D & Pin Assignment



1. 3. Overview of NuDAM-6012/D

What is NuDAM-6012/D?

NuDAM-6012/D is a multi-functions analog input module. The programmable input voltage range of analog input channel is from ±10V maximum to ±150mV minimum.

The module also provides the alarm function and the event counter just like NuDAM-6011/D. In fact, the NuDAM-6012/D provides almost all functions that NuDAM-6011/D has except the CJC and temperature measurement function.

Features of NuDAM-6012/D

- 1 analog input channel with differential input
- Programmable voltage range
- Self gain and offset calibration
- 5000 Vrms isolation voltage for AD channel (2500 Vrms for ND-6012/D)
- 2 digital output channels of open collector type
- Alarm function with high / low alarm output
- 1 digital input channel / event counter
- Programmable host watchdog timer for host failure protection
- Internal watchdog timer for device failure protection
- Easy programming by software
- Easy installation and wiring
- 51/2 digital LED display (NuDAM-6012/D)

Specifications of NuDAM-6012/D

✧ **Interface**

- Interface : RS-485, 2 wires
- Speed (bps) : 1200, 2400, 4800, 9600, 19.2K, 38.4K ,115.2K (115.2K only for firmware reversion above A4.00)

✧ **Analog Input**

- Input type: Differential input
- Resolution: 16 bits
- Unit Convertion: mV, V, or mA
- Voltage Range: Programmable 5 levels
  ±10V, ±5V, ±1V, ±500mV, ±150mV
- Current Measurement: 20mA (with external 125Ω resistor)
- Accuracy: ±0.05%

- Isolation Voltage : 5000 Vrms(2500 Vrms for NuDAM-6012/D)

✧ **Digital Output**

- Channel numbers : 2
- Output characteristic : open collector transistor
- Maximum current sink : 50mA
- Max. power dissipation : 300mW

✧ **Digital Input**

- Channel numbers : 1
- Logical level 0 : +1V maximum
- Logical level 1: +2.0V~30V
- Pull up resister : 10KΩ
- Maximum current : 0.5mA

✧ **Watchdog Function**

- Module internal watchdog timer : 150 ms
- Power failure threshold : 4.65 V
- Host programmable watchdog : 100 ms ~ 25.500 sec

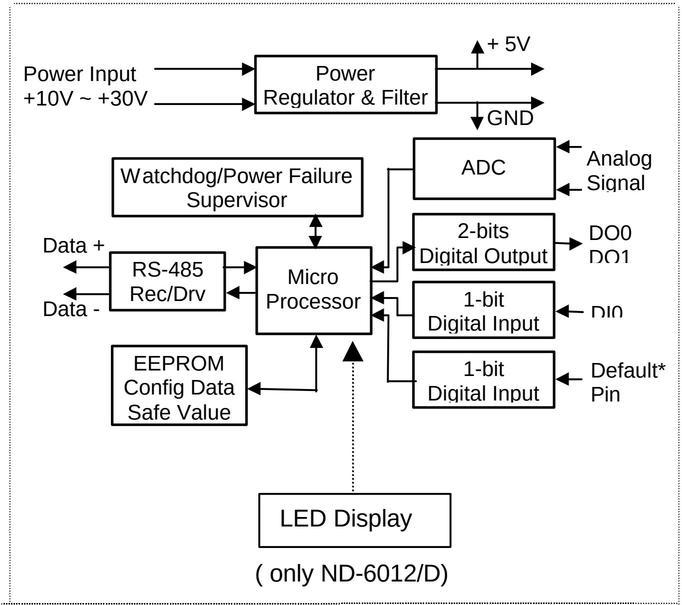
✧ **Power**

- Power supply : +10V to +30V
- Current consumption : 1.1 W(2.0W for NuDAM-6012/D)

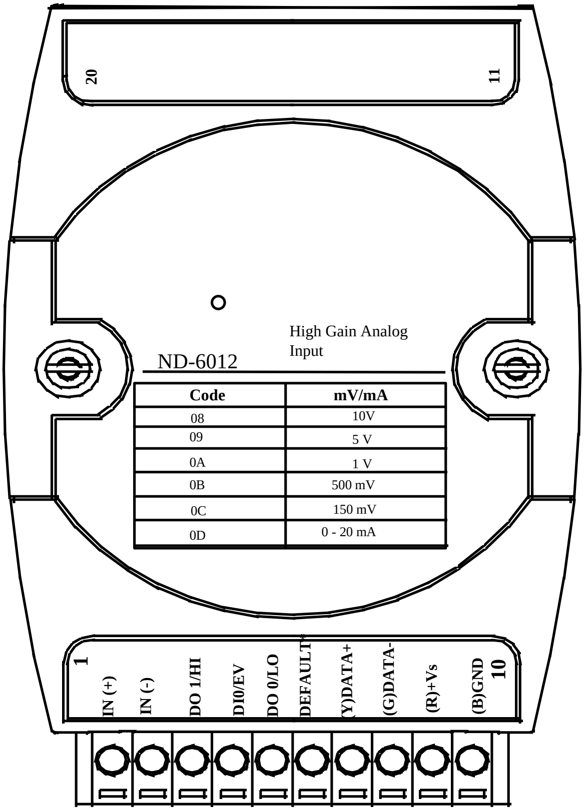
Pin Definitions of ND-6012/D

Pin #	Signal Name	Description
1	IN+	Analog Input Positive Terminal
2	IN-	Analog Input Negative Terminal
3	DO 1/ HI	Digital Output Channel 1 or High alarm status output
4	DI 0 / EV	Digital Input Channel 0 or event counter input
5	DO 0 / LO	Digital Output Channel 0 or Low alarm output
6	DEFAULT*	Initial state setting
7	(Y) DATA+	RS-485 series signal, positive
8	(G) DATA-	RS-485 series signal, negative
9	(R) +Vs	Power supply, +10V~+30V
10	(B) GND	Ground

Functional Block Diagram of ND-6012/D



A Look at ND-6012/D & Pin Assignment



1. 4. Overview of NuDAM-6013

What is NuDAM-6013 ?

NuDAM-6013 is a RTD input module with 3 input channels. It supports 2, 3 or 4 wires RTD input device.

Features of NuDAM-6013

- 3 RTD input channels
- 2, 3 or 4 wire RTD input support
- Programmable RTD input range
- Internal watchdog timer for device failure protection
- Easy programming by software
- Easy installation and wiring

Specifications of NuDAM-6013

✧ **Interface**

- Interface : RS-485, 2 wires
- Speed (bps) : 1200, 2400, 4800, 9600, 19.2K, 38.4K ,115.2K (115.2K only for firmware reversion above A4.00)

✧ **RTD Input**

- Input type: Pt or Ni input, 2, 3 or 4 wires
- Channels Numbers: 3
- Resolution: 16 bits
- Unit Conversion: °C or Ohm
- Temperature Range: Programmable 4 levels , ±100°C, 0~100°C, 0~200°C, 0~600°C
- Accuracy: ±0.1%

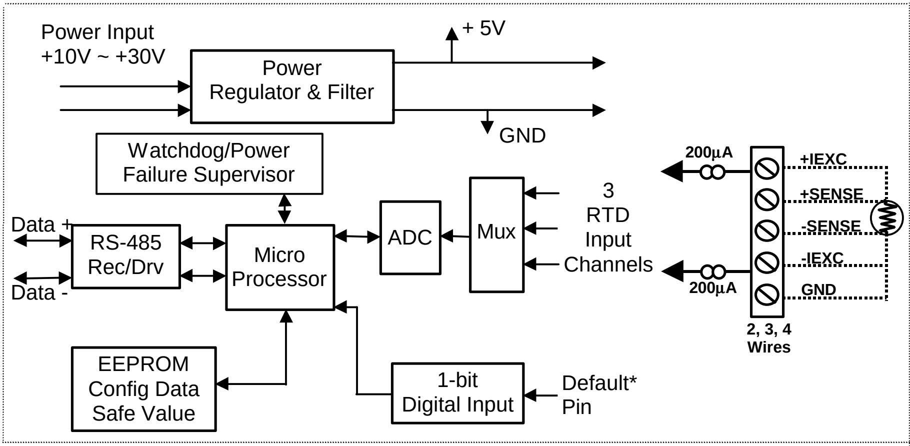
✧ **Power**

- Power supply : +10V to +30V
- Current consumption : 0.65 W

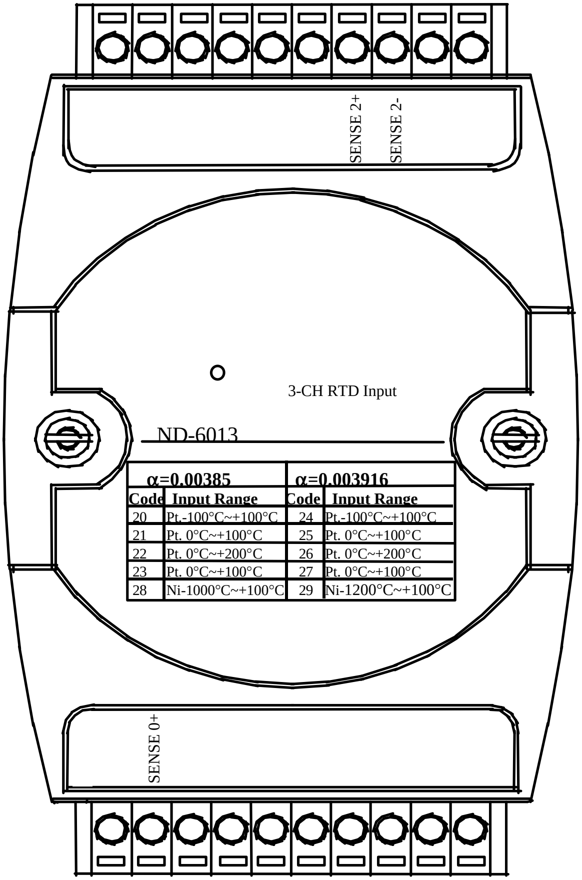
Pin Definitions of ND-6013

Pin #	Signal Name	Description
1	+IEXC0	Current source of CH0
2	+SENSE0	Differential positive input of CH0
3	-SENSE0	Differential negative input of CH0
4	-IEXC0	Current source of CH0
5	AGND0	Analog signal ground of CH0
6	DEFAULT*	Initial state setting
7	(Y) DATA+	RS-485 series signal, positive
8	(G) DATA-	RS-485 series signal, negative
9	(R) +Vs	Power supply, +10V~+30V
10	(B) GND	Ground
11	AGND2	Analog signal ground of CH2
12	-IEXC2	Current source of CH2
13	-SENSE2	Differential negative input of CH2
14	+SENSE2	Differential positive input of CH2
15	+IEXC2	Current source of CH2
16	AGND1	Analog signal ground of CH1
17	-IEXC1	Current source of CH1
18	-SENSE1	Differential negative input of CH1
19	+SENSE1	Differential positive input of CH1
20	+IEXC1	Current source of CH1

Functional Block Diagram of ND-6013



A Look at ND-6013 & Pin Assignment



1. 5. Overview of NuDAM-6014D

What is NuDAM-6014D ?

NuDAM-6014D is a multi-functions analog(transmitter) input module with LED display. The programmable input voltage range of analog input channel is from ±10V maximum to ±150mV minimum.

The module also provides the alarm function and the event counter just like NuDAM-6012/D. In fact, the NuDAM-6014D provides almost all functions that NuDAM-6012/D has but there is more function with transmitter.

Features of NuDAM-6014D

- 1 analog input channel with differential input
- Programmable voltage range
- Self gain and offset calibration
- 2500 Vrms isolation voltage for AD channel
- 2 digital output channels of open collector type
- Alarm function with high / low alarm output
- 1 digital input channel / event counter
- Programmable host watchdog timer for host failure protection
- Internal watchdog timer for device failure protection
- Easy programming by software
- Easy installation and wiring
- 51/2 digital LED Display

Specifications of NuDAM-6014D

✧ **Interface**

- Interface : RS-485, 2 wires
- Speed (bps) : 1200, 2400, 4800, 9600, 19.2K, 38.4K ,115.2K (115.2K only for firmware reversion above A4.00)

✧ **Analog Input**

- Input type: Differential input
- Resolution: 16 bits
- Unit Convertion: mV, V, or mA
- Voltage Range: Programmable 5 levels
  ±10V, ±5V, ±1V, ±500mV, ±150mV
- Current Measurement: 20mA
- Accuracy: ±0.05%
- Isolation Voltage : 2500 Vrms

✧ **Digital Output**

- Channel numbers : 2
- Output characteristic : open collector transistor
- Maximum current sink : 50mA
- Max. power dissipation : 300mW

✧ **Digital Input**

- Channel numbers : 1
- Logical level 0 : +1V maximum
- Logical level 1: +2.0V~30V
- Pull up resister : 10KΩ
- Maximum current : 0.5mA

✧ **Watchdog Function**

- Module internal watchdog timer : 150 ms
- Power failure threshold : 4.65 V
- Host programmable watchdog : 100 ms ~ 25.500 sec

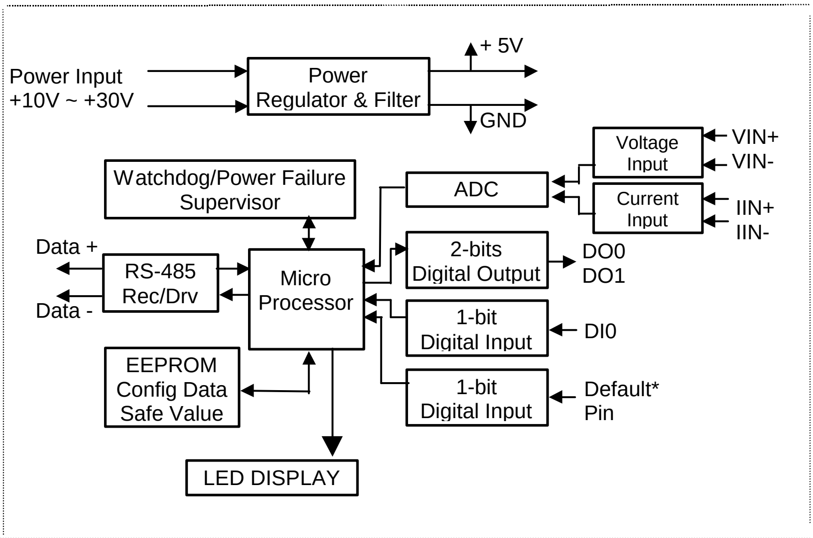
✧ **Power**

- Power supply : +10V to +30V
- Current consumption : 2.0 W

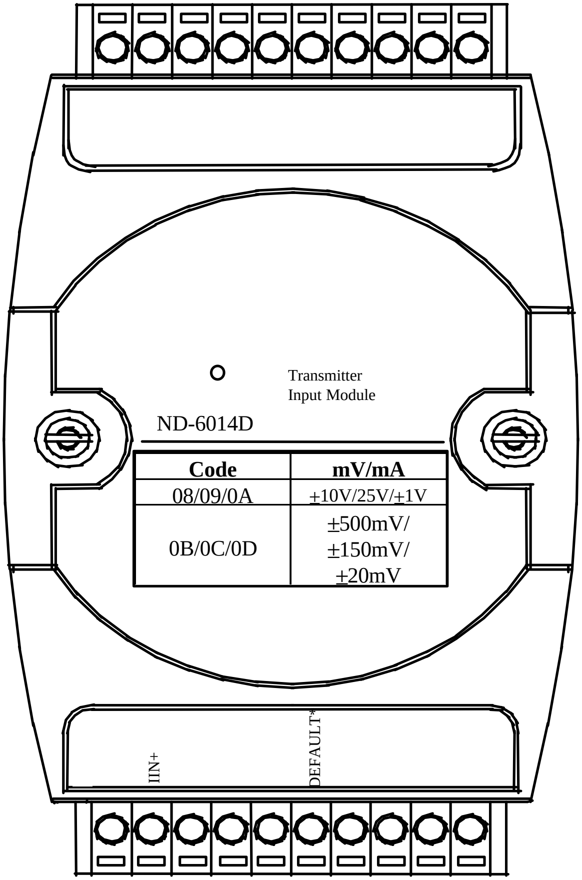
Pin Definitions of ND-6014D

Pin #	Signal Name	Description
1	+15V	External +15V
2	IIN+	Current Input Positive Terminal
3	IIN-	Current Input Negative Terminal
6	DEFAULT*	Initial state setting
7	(Y) DATA+	RS-485 series signal, positive
8	(G) DATA-	RS-485 series signal, negative
9	(R) +Vs	Power supply, +10V~+30V
10	(B) GND	Ground
11	VIN-	Analog Input Negative Terminal
12	VIN+	Analog Input Positive Terminal
13	+15V out	External +15V Output
18	DO 0 / LO	Digital Output Channel 0 or Low alarm output
19	DI 0 / EV	Digital Input Channel 0 or event counter input
20	DO 1/ HI	Digital Output Channel 1 or High alarm status output

Functional Block Diagram of ND-6014D



A Look at ND-6014D & Pin Assignment



1. 6. Overview of NuDAM-6017

What is NuDAM-6017 ?

NuDAM-6017 is an analog input module with 8 input channels. Six of the eight channels are differential type and the other two are single ended type.

Features of NuDAM-6017

- 8 analog input channels
- 6 differential input and 2 single ended input
- programmable input voltage range
- Programmable host watchdog timer for host failure protection
- 5000 Vrms isolation voltage
- Internal watchdog timer for device failure protection
- Easy programming by software
- Easy installation and wiring

Specifications of NuDAM-6017

✧ **Interface**

- Interface : RS-485, 2 wires
- Speed (bps) : 1200, 2400, 4800, 9600, 19.2K, 38.4K ,115.2K (115.2K only for firmware reversion above A4.00)

✧ **Analog Input**[1]

- Input type: Differential input
- Channels Numbers: 8
- Resolution: 16 bits
- Unit Conversion: mV, V, or mA
- Voltage Range: Programmable 5 levels , ±10V, ±5V, ±1V, ±500mV, ±150mV
- Current Measurement: 20mA (with external 125Ω resistor)
- Accuracy: ±0.1%

✧ **Power**

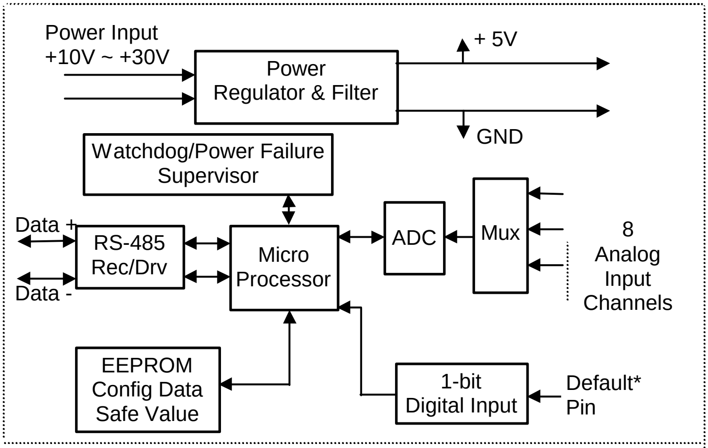
- Power supply : +10V to +30V
- Current consumption : 1.2 W

Note[1]: The maximum input voltage shall not exceed to ±30V with reference to AGND otherwise, they may cause an unrecoverable harm to the hardware component.

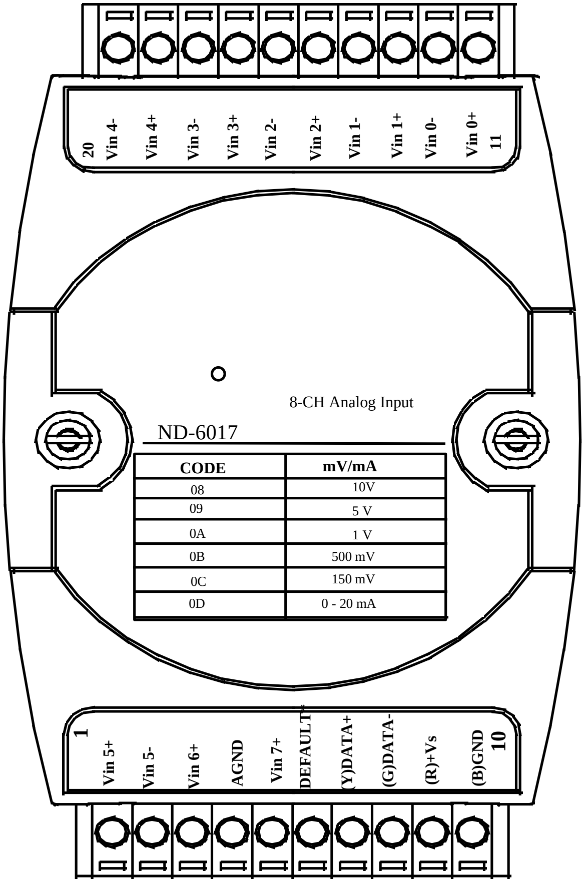
Pin Definitions of ND-6017

Pin #	Signal Name	Description
1	Vin5+	Differential positive input channel 5
2	Vin5-	Differential negative input channel 5
3	Vin6+	Single-ended voltage input channel 6
4	AGND	Analog signal ground of CH6 & 7
5	Vin7+	Single-ended voltage input channel 7
6	DEFAULT*	Initial state setting
7	(Y) DATA+	RS-485 series signal, positive
8	(G) DATA-	RS-485 series signal, negative
9	(R) +Vs	Power supply, +10V~+30V
10	(B) GND	Ground
11	Vin0+	Differential positive input channel 0
12	Vin0-	Differential negative input channel 0
13	Vin1+	Differential positive input channel 1
14	Vin1-	Differential negative input channel 1
15	Vin2+	Differential positive input channel 2
16	Vin2-	Differential negative input channel 2
17	Vin3+	Differential positive input channel 3
18	Vin3-	Differential negative input channel 3
19	Vin4+	Differential positive input channel 4
20	Vin4-	Differential negative input channel 4

Functional Block Diagram of ND-6017



A Look at ND-6017 & Pin Assignment



1. 7. Overview of NuDAM-6018

What is NuDAM-6018 ?

NuDAM-6018 is a thermocouple input module with 8 input channels. Six of the eight channels are differential type and the other two are single ended type.

Features of NuDAM-6018

- 8 analog input channels
- 6 differential input and 2 single ended input
- programmable input voltage range
- Programmable host watchdog timer for host failure protection
- On board CJC for temperature measurement
- 2500 Vrms isolation voltage
- Internal watchdog timer for device failure protection
- Easy programming by software
- Easy installation and wiring

Specifications of NuDAM-6018

✧ **Interface**

- Interface : RS-485, 2 wires
- Speed (bps) : 1200, 2400, 4800, 9600, 19.2K, 38.4K ,115.2K (115.2K only for firmware reversion above A4.00)

✧ **Analog Input**[1]

- Input type: Differential input
- Channels Numbers: 8
- Resolution: 16 bits
- Unit Conversion: Thermocouple, mV, V or mA
- Thermocouple Type: J, K, T, E, R, S, B, N, C

J: 0°C~760°C	K: 0°C~1000°C
T: -100°C~400°C	E: 0°C~1000°C
R: 500°C~1750°C	S: 500°C~1750°C
B: 500°C~1800°C	N: -270°C~1300°C
C: 0°C~2320°C	

- Voltage Range: Programmable 6 levels ±2.5V, ±1V, ±500mV, ±100mV, ±50mV, ±15mV
- Current Measurement: 20mA (with external 125Ω resistor)

✧ **Power**

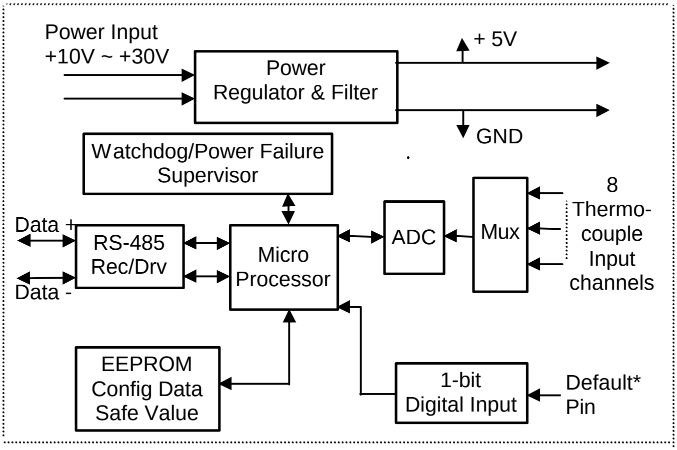
- Power supply : +10V to +30V
- Current consumption : 0.9 W

Note[1]: The maximum input voltage shall not exceed to ±30V with reference to AGND otherwise, they may cause an unrecoverable harm to the hardware component.

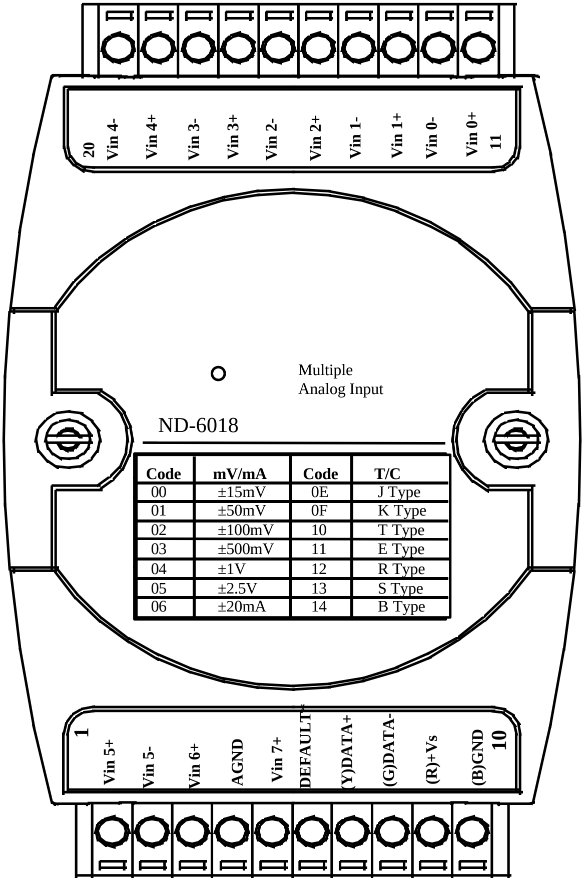
Pin Definitions of ND-6018

Pin #	Signal Name	Description
1	Vin5+	Differential positive input channel 5
2	Vin5-	Differential negative input channel 5
3	Vin6+	Single-ended voltage input channel 6
4	AGND	Analog signal ground of CH6 & 7
5	Vin7+	Single-ended voltage input channel 7
6	DEFAULT*	Initial state setting
7	(Y) DATA+	RS-485 series signal, positive
8	(G) DATA-	RS-485 series signal, negative
9	(R) +Vs	Power supply, +10V~+30V
10	(B) GND	Ground
11	Vin0+	Differential positive input channel 0
12	Vin0-	Differential negative input channel 0
13	Vin1+	Differential positive input channel 1
14	Vin1-	Differential negative input channel 1
15	Vin2+	Differential positive input channel 2
16	Vin2-	Differential negative input channel 2
17	Vin3+	Differential positive input channel 3
18	Vin3-	Differential negative input channel 3
19	Vin4+	Differential positive input channel 4
20	Vin4-	Differential negative input channel 4

Functional Block Diagram of ND-6018



A Look at ND-6018 & Pin Assignment



2. Initialization & Installation

2. 1. Software Installation

1. If you have already installed “NuDAM Administration” then skip other steps.
2. Backup your software diskette.
3. Insert “NuDAM Administration” disc into CD-ROM:
4. Change drive to the path of CD-ROM. For example, your drive of CD-ROM is F:, then change the drive to F:

5. Find the setup of NuDAM Administration and run it.

6. Please follow the steps of setup program then you can successful to install the nudism Administration.

2. 2. Initializing a Brand-New Module

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. Every brand-new NuDAM has a factory default setting as following:

- Address ID is 01.
- Baud rate is 9600 bps
- Check-sum disable
- Host Watchdog timer is disable

Therefore, to configure the brand-new NuDAM before using is necessary to avoid conflicting address. The baud rate may also be changed according to user‘s requirements.

The initialization procedures of a brand-new NuDAM are shown in the following sections. The procedures are applicable for initializing NuDAM-6011/D, NuDAM-6012/D, NuDAM-6013, NuDAM-6014D, NuDAM-6017, and NuDAM-6018.

Default State

The NuDAM modules must be set at *Default State* when you want to change the default settings, including the ID address, baud rate, check-sum status etc. All NuDAM modules have an special pin labeled as **DEFAULT***. The module will be in *Default State* if the **Default***[1] pin is shorted to ground when power ON. Under this state, the default configuration is set as following:

- **Address ID is 00.**
- **Baud rate is 9600 bps.**
- **Check-sum disable.**
- **Watchdog timer is disable.**

Therefore, the configuration of the host and the module can be easily set identically and initializing a module will be possible no matter what configuration is set under operating state.

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 V_{DC} to +30 V_{DC}) for NuDAM modules
- Administration utility software

Note1: Never Connect the DRFAULT* pin to Vs or power source just left it open or wired to GND.

Initialization Procedure

1. Power off the host computer and the installed NuDAM-6520. Be sure of the baud rate of the NuDAM-6520 is 9600 bps.
2. Connect a brand new NuDAM module with the RS-485. Set the module in *Default State* by shorting the **DEFAULT*** pin. Refer to Figure 2.1 for detailed wiring.
3. Power on the host computer.
4. Power on the power supply for NuDAM modules.
5. Use the NuDAM Administration utility to configure the address ID, Baud rate and check-sum status of the module.

Initialization Wiring

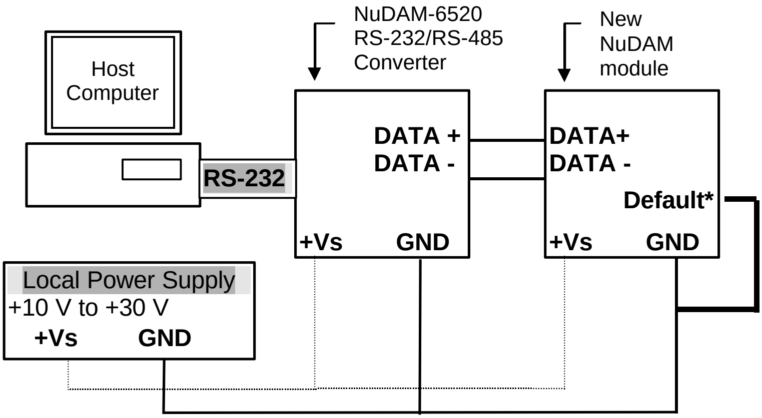


Figure 2-1 Layout for Initialization the NuDAM module

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

Equipments for Install a New Module

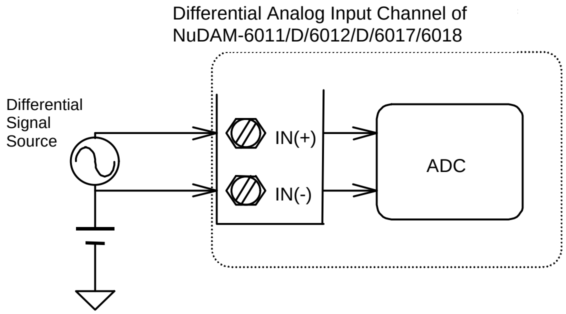
- A existing NuDAM network
- New NuDAM modules.
- Power supply (+10 to +30 V_{DC}).

Installing Procedures

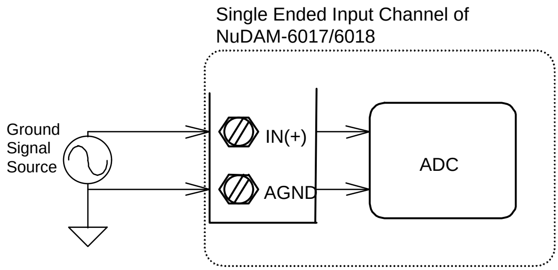
1. Configure the new NuDAM module according to the initialization procedures in section 2.2.
2. The baud rate and check-sum status of the new module must be identity with the existing RS-485 network. The address ID must not be conflict with other NuDAM modules on the network.
3. Power off the NuDAM power supply of the existing RS-485 network.
4. Power off the host computer.
5. Wire the power lines for the new NuDAM with the existing network. Be careful about the signal polarity as wiring.
6. Wire the RS-485 data lines for the new NuDAM with the existing network. Be careful about the signal polarity as wiring.
7. Wire to the input or output devices. Refer to section 2.4 for illustrations.
8. Power on the host computer.
9. Power on the NuDAM local power supply.
10. Use the NuDAM administration utility to check entire network.

2. 4. Application Wiring for NuDAM-6011/D/6012/D/6013/6014D/6017/6018

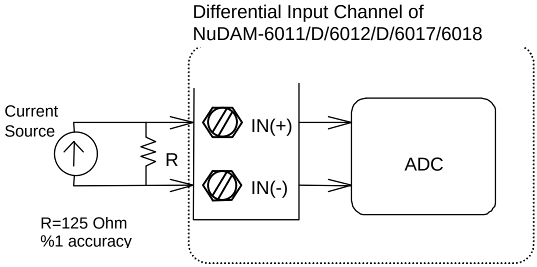
Differential Voltage Input



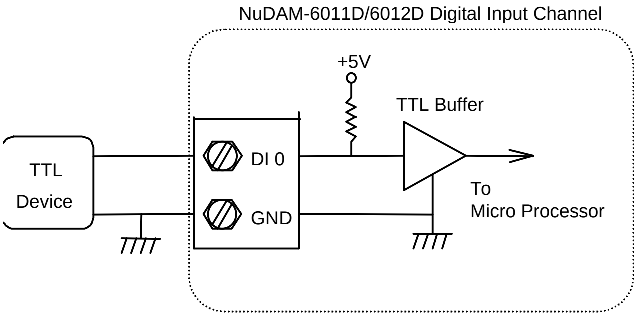
Single Ended Voltage Input



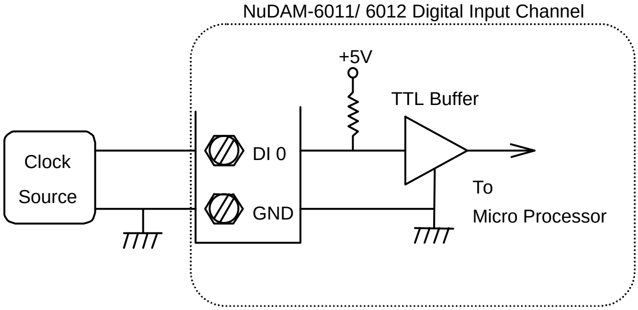
Current Measurement



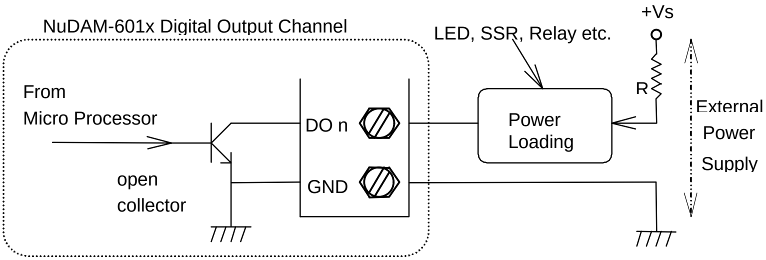
Digital Input Connect with TTL Signal



Digital Input Used as an Event Counter

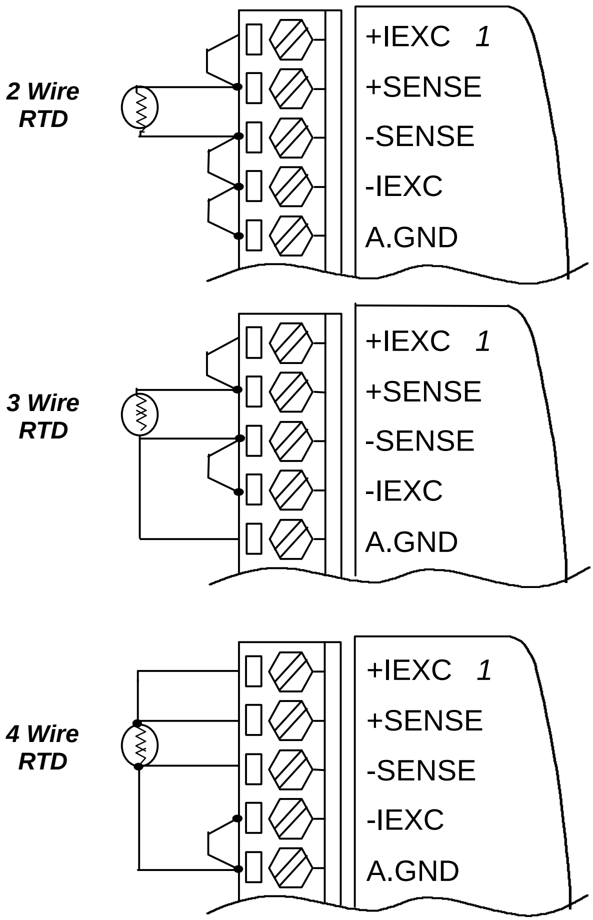


Digital Output Connect with Power Loading



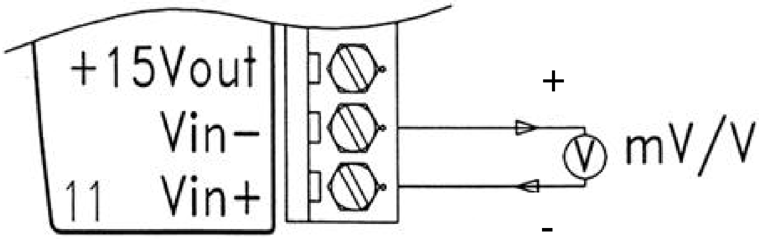
R : current limit resistor

RTD Input (NuDAM-6013)

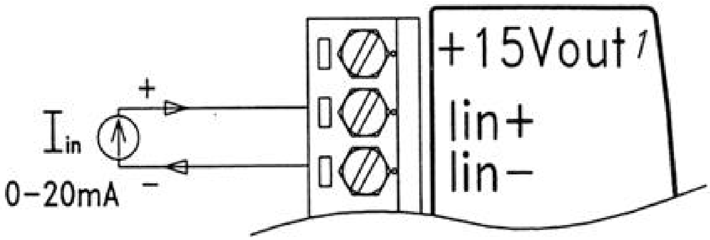


Application Wiring for NuDAM-6014D

Millivolt and Volt Input

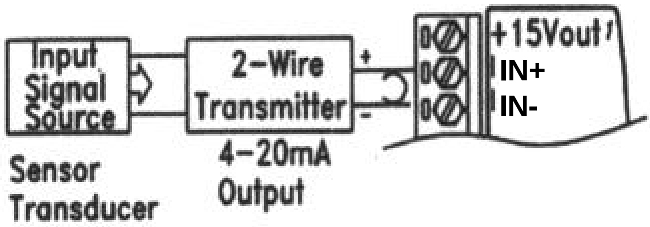


Process Current Input

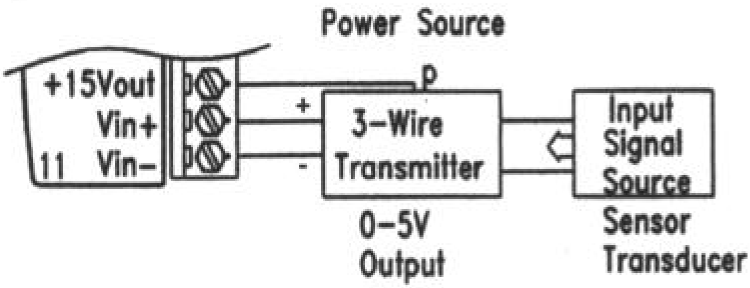


Transmitter wiring for NuDAM-6014D

2-wire Transmitter Input



3-wire Transmitter Input



3. Command Set

3. 1. Command and Response

Introduction

The NuDAM command is composed by numbers of characteristics, including the leading code, address ID, the variables, the optional check-sum bytes, and a carriage return to indicate the end of a command. The host computer can only command only one NuDAM module except those synchronized commands with wildcard address "**". The NuDAM may or may not give response to the command. The host should check the response to handshake with the modules.

Document Conventions

The following syntax conventions describes the NuDAM commands in this manual.

(Leading Code)	Leading Code is the first characteristic of the NuDAM command. All NuDAM commands need a command leading code, such as %,$,#,@,...etc. **1- character**
(Addr)	Module's address ID, the value is in the range of 00 - FF (Hex). **2- character**
(Command Variable)	Command codes or value of variables. **Variable length**
[Data]	Some commands need additional data. **Variable length**
[Checksum]	Checksum in brackets indicate optional parameter, only checksum is enable then this field is required. **2- character**
< >	Identifies a control code character, such as <CR> for carriage return, its value is 0x0D. **1- character**

Format of NuDAM Commands

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

When checksum is enable then **[Checksum]** is needed, it is 2-character. Both command and response must append the checksum characters.

How to calculate checksum value ?

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

Example 1: checksum is **disable**

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

$	: LeadingCode
01	: Address
2	: Command (Read Configuration)
<CR>	: Carriage return 0x0D

Example 2: checksum is **enable**

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

$	: LeadingCode
01	: Address
2	: Command (Read Configuration)
B7	: Checksum value
<CR>	: Carriage return 0x0D

'$' = 0x24 '0' = 0x30 '1' = 0x31 '2' = 0x32
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**

Note :
1. There is no spacing between the command words and The checksum characters.
2. Every command follows a <CR> carriage return for ending.
3. The checksum characters are optional.

Response of NuDAM Commands

The response message depends on versatile NuDAM command. The response is composed with a few characteristics, including leading code, variables, and carriage return for ending. There are two categories of leading code for response message, ”!“ or ”>“ means valid command and ”?“ means invalid. By checking the response message, user can monitor the command is valid or not.

Note : Under the following conditions, there will have **no response** message.

1. The specified address ID is not exist.
2. Syntax error.
3. Communication error.
4. Some special commands do not have response.

---

3. 2. Summary of Command Set

There are three categories of NuDAM commands. The first is the ***general commands***, including set configuration command, read configuration, reset, read module's name or firmware version, etc. Every NuDAM can response to the general commands. The second is the ***functional commands***, which depends on functions of each module. Not every module can execute all function commands. The third is the ***special commands*** including functions about the programmable watchdog timer, safe values, and the programmable leading code. All the commands used in the NuDAM analog input module are list in the following table.

Command Set of Analog Input Modules			
Command	**Syntax**	**Modules**	**Page**
General Commands			
Set Configuration	**%(OldAddr)(NewAddr)(InputRange)(BaudRate)(DataFormat)**	ALL	3-8
Read Configuration	**$(Addr)2**	ALL	3-12
Read Module Name	**$(Addr)M**	ALL	3-13
Read Firmware Version	**$(Addr)F**	ALL	3-14
Functional Commands			
Synchronized Sampling	**#****	6011/D, 6012/D, 6014D	3-15
Read Synchronized Analog Data	**$(Addr)4**	6011/D, 6012/D, 6014D	3-16
Read Analog Data	**#(Addr)**	6011/D, 6012/D, 6014D	3-18
Read Analog Data Channel 0	**#(Addr)**	6013	3-18
Span Calibration	**$(Addr)0**	6011/D, 6012/D, 6014D, 6017, 6018	3-19
Span Calibration to each Channel	**$(Addr)0(Channel No)**	6013	3-20

Offset Calibration	**$(Addr)1**	6011/D, 6012/D, 6014D, 6017, 6018	3-21
Offset Calibration to each Channel	**#(Addr)1(Channel No)**	6013	3-22
Read Analog Data From Channel N	**#(Addr)(ChannelNo)**	6013, 6017, 6018	3-23
Read All Analog Data	**$(Addr)A**	6013, 6017, 6018	3-24
Enable/Disable Channel for Multiplexing	**$(Addr)5(ChannelVal)**	6013, 6017, 6018	3-25
Read Channel Status	**$(Addr)6**	6013, 6017, 6018	3-26
Read CJC Status	**$(Addr)3**	6011/D, 6018	3-27
Open Thermocouple Detection of Channel N	**$(Addr)B(ChannelNo)**	6018	3-28
Enable/Disable Open Thermocouple Detection	**$(Addr)O(Status)**	6018	3-30
Read Source High/Low Values for Linear Mapping	**$(Addr)3**	6014D	3-31
Read Target High/Low Values for Linear Mapping	**$(Addr)5**	6014D	3-32
Write Source High/Low Values for Linear Mapping	**$(Addr)6(Data_L)(Data_H)**	6014D	3-33
Write Target High/Low Values for Linear Mapping	**$(Addr)7(Data_L)(Data_H)**	6014D	3-35

Enable/Disable Linear Mapping	**$(Addr)A(Status)**	6014D	3-37
Read Enable/Disable Linear Mapping Status	**$(Addr)R**	6014D	3-38
CJC Offset Calibration	**$(Addr)9(Counts)**	6011/D, 6018	3-39
Clear Latch Alarm	**@(Addr)CA**	6011/D, 6012/D, 6014D	3-40
Clear Event Counter	**@(Addr)CE**	6011/D, 6012/D, 6014D	3-41
Disable Alarm	**@(Addr)DA**	6011/D, 6012/D, 6014D	3-42
Read Digital I/O and Alarm Status	**@(Addr)DI**	6011/D, 6012/D, 6014D	3-43
Set Digital Output	**@(Addr)DO(OutData)**	6011/D, 6012/D, 6014D	3-45
Enable Alarm	**@(Addr)EA(Mode)**	6011/D, 6012/D, 6014D	3-46
Set High Alarm	**@(Addr)HI(Data)**	6011/D, 6012/D, 6014D	3-47
Set Low Alarm	**@(Addr)LO(Data)**	6011/D, 6012/D, 6014D	3-48
Read Event Counter	**@(Addr)RE**	6011/D, 6012/D, 6014D	3-49
Read High Alarm	**@(Addr)RH**	6011/D, 6012/D, 6014D	3-50
Read Low Alarm	**@(Addr)RL**	6011/D, 6012/D, 6014D	3-51
Special Commands			
Read Command Leading Code Setting	**~(Addr)0**	ALL	3-52

Change Command Leading Code Setting	**~(Addr)10(C1)(C2)(C3)(C4)(C5)(C6)**	ALL	3-54
Set Host Watchdog / Safety Value	**~(Addr)2(Flag)(TimeOut)(SafeValue)**	ALL	3-56
Read Host WatchDog / Safe Value	**~(Addr)3**	ALL	3-58
Host is OK	**~****	ALL	3-60

Note: "ALL" means for ND-6011/D, ND-6012/D, ND-6013, ND-6014D, ND-6017 and ND-6018.

@Description

Configure the basic setting of NuDAM, including the address ID, input range, baud rate, and data format. The new configuration will be available after executing the command.

@Syntax

%(OldAddr)(NewAddr)(InputRange)(BaudRate)(DataFormat)<CR>

%	Command leading code. **(1-character)**
(OldAddr)	NuDAM module original address ID. The default address ID of a brand new module is 01. The value range of address ID is 00 to FF in hexadecimal. **(2-character)**
(NewAddr)	New address ID, if you don't want to change address ID, let new address ID equals to the old one. **(2-character)**
(InputRange)	Define analog input range, refers to Table 3-1 for details. **(2-character)**
(BaudRate)	Define communication baud rate, refers to Table 3-2 for details. **(2-character)**
(DataFormat)	Define checksum, integration time and output data format, refers to Figure 3-1 for details. **(2-character)**

@Response

!(Addr)<CR>
or
?(Addr)<CR>

(Addr)	Address ID.
!	Command is valid.
?	Command is invalid, parameter values are invalid, or change the setting without grounding the DEFAULT* pin.

Note : 1. When you want to change the checksum or baud rate, the DEFAULT* pin must be grounded at first.

2. Waiting a maximum of 7 seconds to perform auto calibration and ranging after the analog input module is reconfigured. Please don't execute any other command during this time period.

@Example

User command:	%0130050600<CR>
Response:	!30<CR>

Item	Meaning	Description
%	(Leading Code)	Command leading code.
01	(OldAddr)	Original address ID is 01(Hex).
30	(NewAddr)	New address ID is 30(Hex).
05	(InputRange)	Analog input range is ±2.5V
06	(BaudRate)	Baud rate is 9600.
00	(DataFormat)	00 means data format is engineering units, checksum is disable and integration time is 50 ms (60Hz).
<CR>	Carriage return	0x0D.

Code (Hex)	Input Range	Modules
00	±15 mV	6011/D,6018
01	±50 mV	6011/D,6018
02	±100 mV	6011/D,6018
03	±500 mV	6011/D,6018
04	±1 V	6011/D,6018
05	±2.5 V	6011/D,6018
06	±20 mA (Required 125Ω current conversion resistor.)	6011/D,6018
08	±10 V	6012/D,6017, 6014D
09	±5 V	6012/D,6017, 6014D
0A	±1 V	6012/D,6017, 6014D
0B	±500 mV	6012/D,6017, 6014D
0C	±150 mV	6012/D,6017, 6014D
0D	±20 mA (Required 125Ω current conversion resistor.)	6012/D,6017, 6014D
0E	Type J Thermocouple 0° to 760°C	6011/D,6018
0F	Type K Thermocouple 0° to 1000°C	6011/D,6018
10	Type T Thermocouple -100° to 400°C	6011/D,6018
11	Type E Thermocouple 0° to 1000°C	6011/D,6018
12	Type R Thermocouple 500° to 1750°C	6011/D,6018
13	Type S Thermocouple 500° to 1750°C	6011/D,6018
14	Type B Thermocouple 500° to 1800°C	6011/D,6018
15	Type N Thermocouple -270° to 1300°C	6011/D,6018
16	Type C Thermocouple 0° to 2320°C	6011/D,6018
20	Pt-100, -100°C to +100°C, α=0.00385	6013
21	Pt-100, 0°C to +100°C, α=0.00385	6013
22	Pt-100, 0°C to +200°C, α=0.00385	6013
23	Pt-100, 0°C to +600°C, α=0.00385	6013
24	Pt-100, -100°C to +100°C, α=0.003916	6013
25	Pt-100, 0°C to +100°C, α=0.003916	6013
26	Pt-100, 0°C to +200°C, α=0.003916	6013
27	Pt-100, 0°C to +600°C, α=0.003916	6013
28	Ni-100, 0°C to +100°C	6013
29	Ni-120, 0°C to +100°C	6013

Table 3-1 AD Input Range Setting

Code	Baudrate
03	1200 bps
04	2400 bps
05	4800 bps
06	9600 bps
07	19200 bps
08	38400 bps
09	115200 bps

Table 3-2 Baud rate setting code

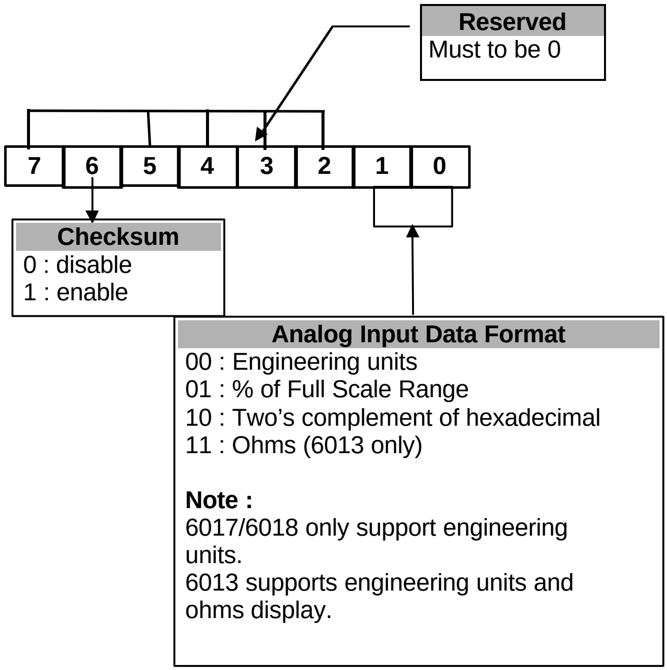


Figure 3-1 Data Format Setting of Analog Input Modules

3. 4. Read Configuration (6011/D, 6012/D, 6013 6014D, 6017, 6018)

@Description

Read the configuration of module on a specified address ID.

@Syntax

$(Addr)2<CR>

$	Command leading code
(Addr)	Address ID.
2	Command code for reading configuration

@Response

!(Addr)(InputRange)(BaudRate)(DataFormat)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(InputRange)	Current setting of analog voltage input, refers to Table 3-1 for details.
(BaudRate)	Current setting of communication baud rate, refers to Table 3-2 for details.
(DataFormat)	Current settings of checksum, integration time and output data format, refers to Figure 3-1 for details.

@Example

User command:	$302<CR>
Response:	!30050600<CR>

!	Command is valid.
30	Address ID.
05	Analog input range is ±2.5 V.
06	Baud rate is 9600 bps.
00	checksum is disable.

3. 5. Read Module Name (6011/D, 6012/D, 6013 6014D, 6017, 6018)

@Description

Read module name of NuDAM at specified address.

@Syntax

$(Addr)M<CR>

$	Command leading code.
(Addr)	Address ID
M	Read module name

@Response

!(Addr)(ModuleName)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(ModuleName)	NuDAM module's name could be '6011', '6011/D', '6012', '6012/D', '6013', '6017' or '6018'. **4 or 5 characters**

@Example

User command:	$30M<CR>
Response:	!306011/D<CR>

!	Command is valid.
30	Address
6011/D	ND-6011/D (Analog Input Module)

3. 6. Read Firmware Version

(6011/D, 6012/D, 6013 6014D, 6017, 6018)

@Description

Read firmware version of NuDAM at specified address.

@Syntax

$(Addr)F<CR>

$	Command leading code.
(Addr)	Address ID
F	Read module firmware version.

@Response

!(Addr)(FirmRev) <CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(FirmRev)	NuDAM module's firmware version.

@Example

User command:	$30F<CR>
Response:	!30A2.10<CR>

!	Command is valid.
30	Address
A2.10	Firmware Version

3. 7. Synchronized Sampling (6011/D, 6012/D, 6014D)

@Description

Synchronized all modules to sample **analog input** values and stored the values in the module’s register at the same time. The sampled data can be read by “Read Synchronized Data” command.

@Syntax

#<CR>**

#	Command leading code.
**	Synchronized sampling command

@Response

Note : Synchronized sampling command **has NO response**.

@Example

User command: #**<CR>

3. 8. Read Synchronized Data (6011/D, 6012/D, 6014D)

@Description

After a synchronized sampling command **#**** was issued, you can read the sampled value that was stored in the register of the module at specified address.

@Syntax

$(Addr)4<CR>

$	Command leading code.
(Addr)	Address ID
4	Read synchronized data.

@Response

>(Addr)(Status)(Data)<CR>
or
?(Addr)<CR>

>	Command is valid.
?	Command is invalid or no synchronized sampling command was issued.
(Addr)	Address ID.
(Status)	0 : Data has been sent at least once before. 1 : Data has been sent for the first time since a synchronized sampling command was issued. **(1-character)**
(Data)	There are four types of Data format, refers to Chapter 4 for details.

@Examples

User command:	$064<CR>
Response:	>060+1.6888<CR>

Read synchronized data at address 06H, analog input module send its analog input data +1.6888 (units). Status is 0 means it has sent the same data at least once. The current units is set by the data format.

User command:	$064<CR>
Response:	>061+1.6888<CR>

Read synchronized data at address 06H, analog input module send its analog input data +1.6888 (units). Status is 1 means it is the first time that the data has been sent. The current units is set by the data format

3. 9. Read Analog Data (6011/D, 6012/D, 6013, 6014D)

@Description

Read the analog input value from an analog input module at specified address in a NuDAM network. While for ND-6013, it returns the channel 0 analog data.

@Syntax

#(Addr)<CR>

#	Command leading code
(Addr)	Address ID

@Response

>(InputData)<CR>

>	Delimiter character
(InputData)	The input data represents the analog signal. The unit of the digits depends on the data format used. There are four types of data format. The format is set by the set configuration command.

@Example

User command:	#06<CR>
Response:	>+1.6888<CR>

Read the analog input module data at address 06 (Hex). The analog input module response data is +1.6888 units. The unit depends on the data format.

3. 10.Span Calibration

@Description

To correct the gain errors of AD converter by using the span calibration.

@Syntax

$(Addr)0<CR>

$	Command leading code **(1 character)**
(Addr)	Address ID **(2 character)**
0	Span calibration **(1 character)**

@Response

!(Addr)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Example

User command:	$060<CR>
Response:	!06<CR>

To perform the span calibration for analog input module, address ID is 06H.

Note : To perform the calibration, a proper input signal should be connected to the analog input module. Different input range have different input voltage, detail refer chapter 5 “**Calibration**”.

3. 11.Span Calibration to each Channel (6013)

@Description

To correct the gain errors of AD converter by using the span calibration.

@Syntax

$(Addr)0(Channel No)<CR>

$	Command leading code **(1 character)**
(Addr)	Address ID **(2 character)**
0	Span calibration **(1 character)**
(Channel No)	Channel for Calibration **(1 character) 0~2**

@Response

!(Addr)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Example

User command:	$0601<CR>
Response:	!06<CR>

To perform the span calibration for analog input module ND-6013 channel 1, address ID is 06H.

Note : To perform the calibration, a proper input signal should be connected to the analog input module. Different input range have different input voltage, detail refer chapter 5 “**Calibration**” .

3. 12.Offset Calibration

@Description

To correct the offset errors of AD converter by using the offset calibration.

@Syntax

$(Addr)1<CR>

$	Command leading code
(Addr)	Address ID
1	Offset calibration.

@Response

!(Addr)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Example

User command:	$061<CR>
Response:	!06<CR>

To perform the offset calibration for analog input module at specified address 06 (Hex).

Note : To perform the calibration, a proper input signal should be connected to the analog input module. Different input range have different input voltage, detail refer chapter 5 “**Calibration**” .

3. 13.Offset Calibration to each Channel (6013)

@Description

To correct the offset errors of AD converter by using the offset calibration.

@Syntax

$(Addr)1(Channel No)<CR>

$	Command leading code
(Addr)	Address ID
1	Offset calibration.
(Channel No)	Channel for calibration.**(1 character)0~2**

@Response

!(Addr)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Example

User command:	$0612<CR>
Response:	!06<CR>

To perform the offset calibration for analog input module ND-6013 channel 2 at specified address 06 (Hex).

Note : To perform the calibration, a proper input signal should be connected to the analog input module. Different input range have different input voltage, detail refer chapter 5 “**Calibration**” .

3. 14.Read Analog Data From Channel N (6013, 6017, 6018)

@Description

Read the analog input value of a specified AD channel from an analog input module at specified address in a NuDAM network.

@Syntax

#(Addr)(ChannelNo)<CR>

#	Command leading code. **(1-character)**
(Addr)	Address ID. **(2-character)**
(ChannelNo)	Channel number, range (0 - 7). **(1-character)** Range (0-2). For ND-6013

@Response

>(InputData)<CR>

>	Delimiter character
(InputData)	Input value from a specified channel number, the data format is a + or - sign with five decimal digits and a fixed decimal point.

@Example

User command:	#061<CR>
Response:	>+1.6888<CR>

Read the analog input channel 1 of AD module at address 06 (Hexadecimal) in the network. The analog input data is +1.6888 Volts (Data format is engineering unit)

3. 15.Read All Analog Data Channel (6013, 6017, 6018)

@Description

Read all the enable analog input channel value of a specified from an analog input module at specified address in a NuDAM network.

@Syntax

#(Addr)A<CR>

#	Command leading code. **(1-character)**
(Addr)	Address ID. **(2-character)**
A	All the enable channel

@Response

>(InputData)(InputData)(InputData)<CR>

>	Delimiter character
(InputData)	Input value from a specified channel number, the data format is a + or - sign with five decimal digits and a fixed decimal point.

@Example

User command:	#06A<CR>
Response:	>+100.88+020.66+006.79<CR>

Read the analog input of AD module at address 06 (Hexadecimal) in the network. The analog input data are +100.88 °C for channel 0, +020.66 °C for channel 1 and +006.79°C for channel 3. (Data format is engineering unit)

3. 16.Enable/Disable channels for Multiplexing

(6013, 6017, 6018)

@Description

Enable/Disable multiplexing simultaneously for individual channel.

@Syntax

$(Addr)5(ChannelVal)<CR>

$	Command leading code. **(1-character)**
(Addr)	Address ID **(2-character)**
5	Enable/Disable channel. **(1-character)**
(ChannelVal)	bit 3~0 of 1st character: control channel 7 - 4. bit 3~0 of 2nd character: control channel 3 - 0. bit value 0 : Disable channel bit value 1 : Enable channel **(2-character)**

@Response

!(Addr)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Example

User command:	$06548<CR>
Response:	!06<CR>

$	Command leading code.
06	Address ID.
5	Disable/Enable channel.
48	Channel Value is 0x48. ‘**48**’ is 01001000 that means enable channel 3 and channel 6, the other channels are all disable.

3. 17.Read Channel Status (6013, 6017, 6018)

@Description

Read the enable/disable status the channels of ND-6013, ND-6017 or 6018.

@Syntax

$(Addr)6<CR>

$	Command leading code. **(1-character)**
(Addr)	Address ID **(2-character)**
6	Read channel status. **(1-character)**

@Response

!(Addr)(ChannelVal)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(ChannelVal)	bit 3~0 of 1st character: controlt channel 7 - 4. bit 3~0 of 2nd character: control channel 3 - 0. bit value 0 : Disable channel bit value 1 : Enable channel **(2-character)**

@Example

User command:	$066<CR>
Response:	!0648<CR>

4 is equals binary 0100 that means enable channel 6 and disable channel 7, 5, 4.
8 is equals binary 1000 that means enable channel 3 and disable channel 2, 1, 0.

3. 18.Read CJC Status (6011/D, 6018)

@Description

Read the CJC (Cold Junction Compensation) sensors data.

@Syntax

$(Addr)3<CR>

$	Command leading code.
(Addr)	Address ID
3	Read CJC status.

@Response

>(Data)<CR>
or
?(Addr)<CR>

>	Command is valid.
(Data)	CJC sensor's data. Data format is engineering units. (an + or - sign with five decimal digits and a decimal fixed point. The resolution is 0.1°C
?	Command is invalid.
(Addr)	Address ID.

@Example

User command:	$063<CR>
Response:	>+0037.9<CR>

This command is to read analog input module CJC status at address 06H, return data is 37.9°C.

3. 19. Read Open Thermocouple Detection of Channel N (6018)

@Description

Read the status of open thermocouple from specified channel number or all channel.

@Syntax

$(Addr)B(ChannelNo)<CR>

$	Command leading code.
(Addr)	Address ID
B	Open thermocouple detection command code
ChannelNo	Channel number, range(0-7) for specified channel, A for all the channel

@Response

!(Addr)(OpSts)<CR>

or

?(Addr)<CR>

!	Command is valid.
(Addr)	Address ID
(OpSts)	For specified channel (0-7) (1 character) 0 : Close thermocouple 1 : Open thermocouple For all the channel (00-FF) (2 character) Two character hexadecimal value, for bit 0-7 Representing the corresponding open thermocouple status channel 0-7.
?	Command is invalid.

@Example

User command:	$01B0<CR>
Response:	!011<CR>
!	Command is valid.
01	Address ID.
1	Open thermocouple of channel 0

User command:	$01BA<CR>
Response:	!1FE<CR>
!	Command is valid.
01	Address ID.
FE	Open thermocouple of channel 1~7 Close thermocouple of channel 0

Notice: The open detection function is immediate scanning by hardware every 500ms. Disable channel and input out of high temperature range will be recognized as open T/C.

3. 20.Enable/Disable Open Thermocouple Detection (6018)

@Description

Enable and disable the open thermocouple detection function.

@Syntax

$(Addr)O(Status)<CR>

$	Command leading code.
(Addr)	Address ID
O	Enable/Disable Open thermocouple detection command
(Status)	0: Disable Open thermocouple detection 1: Enable Open thermocouple detection

@Response

!(Addr)<CR>
or
?(Addr)<CR>

!	Command is valid.
(Addr)	Address ID.
?	Command is invalid.

@Example

User command:	$05O0<CR>
Response:	! 05<CR>

This command is to disable Open thermocouple detection.

User command:	$05O1<CR>
Response:	! 05<CR>

This command is to enable Open thermocouple detection.

3. 21.Read Source High/Low Values for Linear Mapping (6014D)

@Description

Read the high/low limit values from input for linear mapping.

@Syntax

$(Addr)3<CR>

$	Command leading code.
(Addr)	Address ID
3	Read the high/low limit values from input for linear mapping .

@Response

!(Addr)(Data_L)(Data_H)<CR>
or
?(Addr)<CR>

!	Command is valid.
(Addr)	Address ID.
(Data_L)	Low limit value for linear mapping. Data format is with an + or - sign with five decimal digits and a decimal fixed point.
(Data_H)	High limit value for linear mapping. Data format is with an + or - sign with five decimal digits and a decimal fixed point.
?	Command is invalid.

@Example

User command:	$023<CR>
Response:	!02+04.000+20.000<CR>

The module is configured for +20~-20mA input current range. The linear mapping function should already have been executed. This command is to read the high/low values for linear mapping. The high limit value is +20mA and low limit value is +4mA. The address of this module is 06H.

3. 22.Read Target High/Low Values for Linear Mapping (6014D)

@Description

Read the mapped high/low limit values from input for linear mapping.

@Syntax

$(Addr)5<CR>

$	Command leading code.
(Addr)	Address ID
5	Read the mapped high/low limit values from input for linear mapping .

@Response

!(Addr)(Data_L)(Data_H)<CR>
or
?(Addr)<CR>

!	Command is valid.
(Addr)	Address ID.
(Data_L)	Mapped low limit value for linear mapping. Data format is with an + or - sign with five decimal digits and a decimal fixed point.
(Data_H)	Mapped high limit value for linear mapping. Data format is with an + or - sign with five decimal digits and a decimal fixed point.
?	Command is invalid.

@Example

User command:	$055<CR>
Response:	!05-20.000+20.000<CR>

The module is configured for +20~-20mA input current range. The linear mapping function had been executed. This command is to read the mapped high/low values for linear mapping. The mapped high limit value is +20mA and mapped low limit value is -20mA. The address of this module is 05H.

3. 23.Write Source High/Low Values for Linear Mapping (6014D)

@Description

Write the source high/low limit values from input for linear mapping.

@Syntax

$(Addr)6(Data_L)(Data_H)<CR>

$	Command leading code.
(Addr)	Address ID
6	Set the high/low limit values from input for linear mapping .
(Data_L)	Low limit input value for linear mapping. It must be lower than the high limit input value. The format of data is the same as input current range. The minimum input value could equal to the minimum input value of input current range. Data format is with an + or - sign with five decimal digits and a decimal fixed point.
(Data_H)	High limit input value for linear mapping. It must be higher than the low limit input value. The format of data is the same as input current range. The maximum input value could equal to the maximum input value of input current range. Data format is with an + or - sign with five decimal digits and a decimal fixed point.

@Response

!(Addr)<CR>
or
?(Addr)<CR>

!	Command is valid.
(Addr)	Address ID.
?	Command is invalid.

@Example

User command:	$036-100.00+100.00<CR>
Response:	!03<CR>

The module is configured for +150~-150mV input range. This command is to set the input high/low values from +100.00 to –100.00mV for linear mapping. The address of this module is 05H.

3. 24.Write Target High/Low Values for Linear Mapping (6014D)

@Description

Write the target high/low limit values from input for linear mapping.

@Syntax

$(Addr)7(Data_L)(Data_H)<CR>

$	Command leading code.
(Addr)	Address ID
7	Set the mapped high/low limit values from input for linear mapping .
(Data_L)	Mapped low limit input value for linear mapping. It must be lower than the mapped high limit input value. Data format is with an + or - sign with five decimal digits and a decimal fixed point.
(Data_H)	Mapped high limit input value for linear mapping. It must be Higher than mapped the low limit input value. Data format is with an + or - sign with five decimal digits and a decimal fixed point.

@Response

!(Addr)<CR>
or
?(Addr)<CR>

!	Command is valid.
(Addr)	Address ID.
?	Command is invalid.

@Example

User command:	$036-100.00+100.00<CR>
Response:	!03<CR>

The module is configured for +150~-150mV input range. This command is to set the input high/low values from +100.00 to –100.00mV for linear mapping. The address of this module is 03H.

3. 25.Enable/Disable Linear Mapping (6014D)

@Description

Enable or disable the linear mapping function for the module.

@Syntax

$(Addr)A(Status)<CR>

$	Command leading code.
(Addr)	Address ID
A	Reference to control the linear mapping function.
(Status)	One char to determine the linear mapping function enable or disable. 1: means enable. 0: means disable.

@Response

!(Addr)<CR>
or
?(Addr)<CR>

!	Command is valid.
(Addr)	Address ID.
?	Command is invalid.

@Example

User command:	$03A1<CR>
Response:	!03<CR>

This command set the linear mapping function of ND-6014D is enable, and the address of this module is 03H.

3. 26.Read enable/Disable Linear Mapping Status (6014D)

@Description

Read enable or disable the linear mapping status for the module.

@Syntax

$(Addr)R<CR>

$	Command leading code.
(Addr)	Address ID
R	Read to the linear mapping status.

@Response

!(Addr)(Status)<CR>
or
?(Addr)<CR>

!	Command is valid.
(Addr)	Address ID.
(Status)	One char to means the state of linear mapping. 1: means enable. 0: means disable.
?	Command is invalid.

@Example

User command:	$07R<CR>
Response:	!070<CR>

This command means the linear mapping function of ND-6014D is disable, and the address of this module is 07H.

3. 27.CJC Offset Calibration (6011/D, 6018)

@Description

To correct the CJC offset errors use CJC (Cold Junction Compensation) offset calibration.

@Syntax

$(Addr)9(Counts)<CR>

$	Command leading code.
(Addr)	Address ID
9	CJC offset calibration.
(Counts)	It is a 4-characters (Hexadecimal) with a sign + or -, range is 0000 to FFFF, each count equals approximately 0.0153°C. Example : +0042 = 4x16 + 2 = 66 66 * 0.0153°C = 1.009°C

@Response

!(Addr)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Example

User command:	$089+0042<CR>
Response:	!08<CR>

CJC offset calibration at address 08H. The calibrated offset temperature is +0042(Hex) = 66, 66 x 0.0153°C = 1.009°C

3. 28.Clear Latched Alarm (6011/D, 6012/D, 6014D)

@Description

Clear the High/Low alarm state at specified analog input module.

@Syntax

@(Addr)CA<CR>

@	Command leading code.
(Addr)	Address ID
CA	Clear latched alarm.

@Response

!(Addr)<CR>

!	Command is valid.
(Addr)	Address ID.

@Example

User command:	@06CA<CR>
Response:	!06<CR>

Clear the both High/Low latch alarm state at address 06H.

3. 29.Clear Event Counter (6011/D, 6012/D, 6014D)

@Description

Reset the event counter to zero at specified analog input module.

@Syntax

@(Addr)CE<CR>

@	Command leading code.
(Addr)	Address ID
CE	Clear event counter.

@Response

!(Addr)<CR>

!	Command is valid.
(Addr)	Address ID.

@Example

User command:	@06CE<CR>
Response:	!06<CR>

Set the event counter to zero at address 06H, response data means its event counter has been reset.

3. 30.Disable Alarm

@Description

Disable High/Low alarm functions at specified analog input module.

@Syntax

@(Addr)DA<CR>

@	Command leading code.
(Addr)	Address ID
DA	Disable Alarm.

@Response

!(Addr)<CR>

!	Command is valid.
(Addr)	Address ID.

@Example

User command:	@06DA<CR>
Response:	!06<CR>

Disable all alarm functions at address 06H.

3. 31.Read Digital I/O and Alarm Status

(6011/D, 6012/D, 6014D)

@Description

Read the digital input channel, digital output channel and the alarm state at specified analog input module.

@Syntax

@(Addr)DI<CR>

@	Command leading code.
(Addr)	Address ID
DI	Read digital I/O and alarm state.

@Response

!(Addr)(Alarm)(DigitalO)(DigitalI)<CR>

!	Command is valid.
(Addr)	Address ID.
(Alarm)	0 : alarm is disable 1 : MOMENTARY mode enable. 2 : LATCH mode enable. **(1-character)**
(DigitalO)	Digital output channel, port 0 and 1 status. 00 : channel 0 is OFF, channel 1 is OFF 01 : channel 0 is ON , channel 1 is OFF 02 : channel 0 is OFF, channel 1 is ON 03 : channel 0 is ON , channel 1 is ON **(2-character)**
(DigitalI)	Digital input channel, port status. 00 : channel is LOW. 01 : channel is HIGH. **(2-character)**

@Example

User command: @06DI<CR>
Response: !0620301<CR>

Item	Meaning	Description
!	(Leading Code)	Command leading code.
06	(Addr)	Analog module's address ID is 06H.
2	(Alarm)	2 means alarm state is LATCH.
03	(DigitalO)	Digital output channel status. **03** : channel 0 is ON channel 1 is ON
01	(DigitalI)	Digital input channel status **01** : digital input is HIGH.

Read digital I/O and alarm at address 06H. alarm state is LATCH, digital output channel port 0 and 1 are ON and digital input channel is HIGH.

@Description

Set digital output channel at specified module.

@Syntax

@(Addr)DO(OutData)<CR>

@	Command leading code.
(Addr)	Address ID
DO	Set digital output
(OutData)	Digital output data .(2 - characters) 00 : bit 1 is OFF, bit 0 is OFF. 01 : bit 1 is OFF, bit 0 is ON. 02 : bit 1 is ON , bit 0 is OFF 03 : bit 1 is ON , bit 0 is ON.

@Response

!(Addr)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Example

User command:	@06DO02<CR>
Response:	!06<CR>

Set the digital output channel state at address 06H, digital output channel port 0 is OFF, port 1 is ON.

@Description

Enable alarm to Latch mode or Momentary mode at specified analog input module.

@Syntax

@(Addr)EA(Mode)<CR>

@	Command leading code.
(Addr)	Address ID
EA	Enable alarm command code
(Mode)	**M** : enable alarm to MOMENTARY mode. **L** : enable alarm to LATCH mode.

@Response

!(Addr)<CR>

!	Command is valid.
(Addr)	Address ID.

@Example

User command:	@06EAL<CR>
Response:	!06<CR>

Enable alarm to LATCH mode at address 06H.

User command:	@06EAM<CR>
Response:	!06<CR>

Enable alarm to MOMENTARY mode at address 06H.

3. 34.Set High Alarm (6011/D, 6012/D, 6014D)

@Description

Set high alarm limit value at specified analog input module.

@Syntax

@(Addr)HI(Data)<CR>

@	Command leading code.
(Addr)	Address ID
HI	Set high alarm limit value.
(Data)	Alarm high limit value. Data format is engineering units. (an + or - sign with five decimal digits and a decimal fixed point.

@Response

!(Addr)<CR>

!	Command is valid.
(Addr)	Address ID.

@Example

User command:	@06HI+300.00<CR>
Response:	!06<CR>

Set high alarm limit value to 300°C for type J thermocouple to input at address 06H.

3. 35.Set Low Alarm (6011/D, 6012/D, 6014D)

@Description

Set low alarm limit value at specified analog input module.

@Syntax

@(Addr)LO(Data)<CR>

@	Command leading code.
(Addr)	Address ID
LO	Set low alarm limit value.
(Data)	Alarm low limit value. Data format is engineering units. (an + or - sign with five decimal digits and a decimal fixed point.

@Response

!(Addr)<CR>

!	Command is valid.
(Addr)	Address ID.

@Example

User command:	@06LO+100.00<CR>
Response:	!06<CR>

Set low alarm limit value to +100°C to accept J-type thermocouple input at address 06H.

3. 36.Read Event Counter (6011/D, 6012/D, 6014D)

@Description

Read the event counter value at specified analog input module.

@Syntax

@(Addr)RE<CR>

@	Command leading code.
(Addr)	Address ID
RE	Read event counter.

@Response

!(Addr)(Data)<CR>

!	Command is valid.
(Addr)	Address ID.
(Data)	5-character (Decimal), range 00000 to 65535, if the event counter exceed 65535 then event counter value is 65535 (No changed). **(5-character)**

@Example

User command:	@06RE<CR>
Response:	!0612345<CR>

Read event counter, its value is 12345 (Decimal) at address 06H.

3. 37.Read High Alarm Limit (6011/D, 6012/D, 6014D)

@Description

Read the high alarm limit at specified analog input module.

@Syntax

@(Addr)RH<CR>

@	Command leading code.
(Addr)	Address ID
RH	Read high alarm limit.

@Response

!(Addr)(Data)<CR>

!	Command is valid.
(Addr)	Address ID.
(Data)	High alarm limit value. Data format is engineering units. (an + or - sign with five decimal digits and a decimal fixed point.

@Example

User command:	@06RH<CR>
Response:	!06+01.500<CR>

Read the high alarm limit value at address 06H, its value is 1.500 Volts, presume this module is configured to accept ±2.5 Volts input.

3. 38.Read Low Alarm Limit (6011/D, 6012/D, 6014D)

@Description

Read the low alarm limit at specified analog input module.

@Syntax

@(Addr)RL<CR>

@	Command leading code.
(Addr)	Address ID, range (00 - FF).
RL	Read low alarm limit.

@Response

!(Addr)(Data)<CR>

!	Command is valid.
(Addr)	Address ID.
(Data)	Alarm low limit value. Data format is engineering units. (an + or - sign with five decimal digits and a decimal fixed point.

@Example

User command:	@06RL<CR>
Response:	!06-0.3850<CR>

Read the low alarm limit value at address 06H, its value is -0.3850 Volts, presume this module is configured to accept 1 Volts input.

3. 39.Read Leading Code Setting (6011/D, 6012/D, 6013 6014D, 6017, 6018)

@Description

Read command leading code setting and host watchdog status.

@Syntax

~(Addr)0<CR>

~	Command leading code.
(Addr)	Address ID
0	Read command leading code setting.

@Response

!(Addr)(Status)(C1)(C2)(C3)(C4)(C5)(C6)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID
(Status)	**(2-character)** Bit 0 : Reserved Bit 1 : Power failure or watchdog failure Bit 2 : Host watchdog is enable Bit 3 : Host failure
(C1)	Leading code 1, for read configuration status, firmware version, etc. default is **$.** **(1-character)**
(C2)	Leading code 2, for read synchronize sampling, digital output, default is **#.** **(1-character)**
(C3)	Leading code 3, for change configuration. default is **%. (1-character)**
(C4)	Leading code 4, for read alarm status, enable alarm, etc. default is **@. (1-character)**

(C5)	Leading code 5, for read command leading code, change command leading code, etc. default is **~. (1-character)**
(C6)	Leading code 6, this leading code is reserved. default is ***. (1-character)**

@Example

User command:	~060<CR>
Response:	!0600$#%@~*<CR>

Command leading code setting is $#%@~* for module address ID is 06, current status is factory default setting.

3. 40.Change Leading Code Setting

@Description

User can use this command to change command leading code setting as he desired.

@Syntax

~(Addr)10(C1)(C2)(C3)(C4)(C5)(C6)<CR>

~	Command leading code.
(Addr)	Address ID, range (00 - FF).
10	Change command leading code setting.
(C1)	Leading code 1, for read configuration status, firmware version, etc. default is **$.** **(1-character)**
(C2)	Leading code 2, for read synchronize sampling, digital output ,default is **#.** **(1-character)**
(C3)	Leading code 3, for change configuration. default is **%. (1-character)**
(C4)	Leading code 4, for read alarm status, enable alarm, etc. default is **@. (1-character)**
(C5)	Leading code 5, for read command leading code, change leading code, etc. default is **~.** **(1-character)**
(C6)	Leading code 6, this leading code is reserved. default is ***. (1-character)**

@Response

!(Addr)< CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Examples

User command:	~060<CR>
Response:	!0600**$**#%@~*<CR>
User command:	~0610**A**#%@~*<CR>
Response:	!06<CR>
User command:	**A**06F
Response:	!06A1.8<CR>

Read leading code setting is $#%@~* for module address 06 and change leading code **$** to **A**, then use A06F to read firmware version of module on address 06.

***** WARNING *****

- We do not recommend users to change the default setting of leading code, because it will confuse yourself.
- The leading code change only use the command conflicts other devices of other brand on the network.
- The changing of leading code is not necessary if all modules in a network are NuDAMs'.

3. 41.Set Host Watchdog Timer & Safety Value

(6011/D, 6012/D, 6013 6014D, 6017, 6018)

@Description

Set host watchdog timer, module will change to safety state when host is failure. Define the output value in this command.

@Syntax

~(Addr)2(Flag)(TimeOut)(SafeValue)<CR>

~	Command leading code.
(Addr)	Address ID, range (00 - FF).
2	Set host watchdog timer and safe state value.
(Flag)	0 : Disable host watchdog timer 1 : Enable host watchdog timer **(1-character)**
(TimeOut)	Host timeout value, between this time period host must send (Host is OK) command to module, otherwise module will change to safety state. Range 01 - FF. **(2-character)** **One unit is 100 ms** 01 = 1 * 100 = 100 ms FF = 255 * 100 = 25.5 sec
(SafeValue)	2 channels safety value of digital output channels when host is failure. **(2-character)**

@Response

!(Addr)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID

@Example

User command:	~06211203<CR>
Response:	!06<CR>

06	Address ID
2	Set host watchdog timer and safe state value.
1	Enable host watchdog timer.
12	Timeout value. 0x12 = 18 18 * 100 = 1800 ms
03	03 (00000011) The two digital output channels are high as failure or reset.

3. 42.Read Host Watchdog Timer & Safety Value

(6011/D, 6012/D, 6013 6014D, 6017, 6018)

@Description

Read host watchdog timer setting and the safety value.

@Syntax

~(Addr)3<CR>

~	Command leading code.
(Addr)	Address ID
3	Read host watchdog setting and module safety state value.

@Response

!(Addr) (Flag)(TimeOut)(SafeValue)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID, range (00 - FF).
(Flag)	0 : Host watchdog timer is disable 1 : Host watchdog timer is enable**(1-character)**
(TimeOut)	Host timeout value. Range 01 - FF. **(2-character)** **One unit is 100 ms** 01 = 1 * 100 = 100 ms FF = 255 * 100 = 25.5 sec
(SafeValue)	2 channels safety state digital output value when host is failure. **(2-character)**

@Example

User command:	~063<CR>
Response:	!0611203<CR>

06	Address ID
1	Host watchdog timer is enable.
12	Timeout value. 0x12 = 18 18 * 100 = 1800 ms
03	03 (00000011) The safety status of the two digital output channels are high.

3. 43.Host is OK

@Description

When host watchdog timer is enable, host computer must send this command to every module before timeout otherwise **“host watchdog timer enable”** module‘s output value will go to safety state output value.

Timeout value and safety state output value is defined in 3.30. “Set Host Watchdog Timer & Safety Value”

@Syntax

~<CR>**

~	Command leading code.
**	Host is OK.

@Response

Note : Host is OK command **has NO response.**

@Example

User command: ~**<CR>

4. Data Format and Input Range

4. 1. Data Format of Analog Input Modules

There are four types of data format used in analog input modules.

1. Engineering units
2. Percent of FSR (Full Scale Range)
3. Two's complements hexadecimal
4. Ohms

Engineering Units

- Set bit 1 and bit 0 of data format variable to "00" means the data is represented in engineering units.
- This data format including three components.
  1. sign (+ or -)
  2. digits
  3. decimal point
- Data is composited with a sign (+ or -) followed with 5-digits and a decimal point.
- It does not exceed 7-characters.

The different analog input ranges have different resolutions or number of decimal places. Refer to Table 4-1 for details.

Input Range	Resolution	
±15 mV, ±50 mV	1μV	three decimal places
±100 mV, ±150 mV, ±500 mV	10μV	two decimal places
±1 V, ±2.50 V, ±5 V	100μV	four decimal places
±10 V	1mV	three decimal places
±20 mA	1μA	three decimal places
Type J and T thermocouple, RTD	0.01°C	two decimal places
Type K, E, R, S, B, N and C thermocouple	0.1°C	one decimal places

Table 4-1 Data format and resolution

Example 1 :

- Input Range is ±5 V
- Input is -1.37 Volts

engineering units : **-1.3700<CR>**

Example 2 :

- Input Range is ±10 V
- Input is +3.653 Volts

engineering units : **+03.653<CR>**

Example 3 :

- Input Range is Type K thermocouple (range 0°C to 1000°C)
- Input is 406.5°C

engineering units : **+0406.5<CR>**

Example 4 :

- Input Range is Type T thermocouple (range -100°C to 400°C)
- Input is -50.5°C

engineering units : **-050.50<CR>**

Percent of FSR (Full Scale Range)

- Data format bit 1 and 0 set to 01 is percent of FSR.
- This data format including three components.
    1. sign (+ or -)

2. digits
3. decimal point

- Data is sign (+ or -) followed with 5-digits and a decimal point.
- It does not exceed 7-characters.
- Maximum resolution is 0.01%, the decimal point is fixed.
- Data is the ratio of input signal to the value of full scale range.

Example 1 :

- Input Range is ±5 V
- Input is +1 Volts

% of FSR : **+020.00<CR>**
(+(20/100) x 5 V) = +1 V

Example 2 :

- Input Range is ±10 V
- Input is +4 Volts

% of FSR : **+040.00<CR>**
(+(40/100) x 10 V) = +4 V

Example 3 :

- Input Range is Type K thermocouple (range 0°C to 1000°C)
- Input is 406.5°C

% of FSR : **+040.65<CR>**
(+(40.65/100) x 1000°C) = 406.5°C

Two's Complement Hexadecimal

- Data format bit 1 and 0 set to 10 is 2's complement.
- Data is 4-character(16 binary bits) hexadecimal string.
- Positive full scale is 7FFF (+32767)
- Negative full scale is 8000 (-32768)

Example 1 :

- Input Range is ±5 V
- Input is +1 Volts

Two's complement hexadecimal : **1999<CR>**
((1/5) x 32768) = 6553.6 = 1999H

Example 2 :

- Input Range is ±5 V
- Input is -2 Volts

Two's complement hexadecimal : **CD27<CR>**
((-2/5) x 32768) = -13107.2 = CD27H

Example 3 :

- Input Range is ±10 V
- Input is +4 Volts

Two's complement hexadecimal : **3333<CR>**
((4/10) x 32768) = 13107.2 = 3333H

Example 4 :

- Input Range is Type K thermocouple (range 0°C to 1000°C)
- Input is 406.5°C

Two's complement hexadecimal : **3408<CR>**
((406.5/1000) x 32768) = 13320.2 = 3408H

Ohm

- Data format bit 1 and 0 set to 11 is ohm presentation.
- This data format including three components.
    1. sign (+)
    2. digits
    3. decimal point
- Data is sign (+) followed with 5-digits and a decimal point.
- It does not exceed 7-characters.
- Maximum resolution is 0.01ohm, the decimal point is fixed.

Example 1 :

- Input Range is Pt-100, -100°C to +100°C, α=0.00385
- Input is 120.23 ohm

ohm : **+120.23<CR>**

4. 2. Analog Input Range

The following table shows the relation between the input range setting with the data format and the resolution.

Engineering Units Table :

Code	Input Range	Data Format	+Full Scale	Zero	- Full Scale	Displayed Resolution
00	±15mV	Eng. Units	+15.000	±00.000	-15.000	1µV
01	±50mV	Eng. Units	+50.000	±00.000	-50.000	1µV
02	±100mV	Eng. Units	+100.00	±000.00	-100.00	10µV
03	±500mV	Eng. Units	+500.00	±000.00	-500.00	10µV
04	±1V	Eng. Units	+1.0000	±0.0000	-1.0000	100.00µV
05	±2.5V	Eng. Units	+2.5000	±0.0000	-2.5000	100.00µV
06	±20mA	Eng. Units	+20.000	±00.000	-20.000	1µA
07	**Reserved**					
08	±10V	Eng. Units	+10.000	±00.000	-10.000	1mV
09	±5V	Eng. Units	+5.0000	±0.0000	-5.0000	100.00µV
0A	±1V	Eng. Units	+1.0000	±0.0000	-1.0000	100.00µV
0B	±500mV	Eng. Units	+500.00	±000.00	-500.00	10µV
0C	±150mV	Eng. Units	+150.00	±000.00	-150.00	10µV
0D	±20mA	Eng. Units	+20.000	±00.000	-20.000	1µA

Code	Input Range	Data Format	+Full Scale	Zero	- Full Scale	Disp. Reso.
20	Pt-100, -100°C to +100°C, α=0.00385	Eng. Units	+100.00	±000.00	-100.00	0.01°C
21	Pt-100, 0°C to +100°C, α=0.00385	Eng. Units	+100.00	+000.00	+000.00	0.01°C
22	Pt-100, 0°C to +200°C, α=0.00385	Eng. Units	+200.00	+000.00	+000.00	0.01°C
23	Pt-100, 0°C to +600°C, α=0.00385	Eng. Units	+600.00	+000.00	+000.00	0.01°C
24	Pt-100, -100°C to +100°C, α=0.003916	Eng. Units	+100.00	±000.00	-100.00	0.01°C
25	Pt-100, 0°C to +100°C, α=0.003916	Eng. Units	+100.00	+000.00	+000.00	0.01°C

26	Pt-100, 0°C to +200°C, α=0.003916	Eng. Units	+200.00	+000.00	+000.00	0.01°C
27	Pt-100, 0°C to +600°C, α=0.003916	Eng. Units	+600.00	+000.00	+000.00	0.01°C
28	Ni-100, 0°C to +100°C	Eng. Units	+100.00	+000.00	+000.00	0.01°C
29	Ni-120, 0°C to +100°C	Eng. Units	+100.00	+000.00	+000.00	0.01°C

Percent of Full Scale Range Table :

Code	Input Range	Data Format	+Full Scale	Zero	- Full Scale	Displayed Resolution
00	±15mV	% of FSR	+100.00	±000.00	-100.00	0.01%
01	±50mV	% of FSR	+100.00	±000.00	-100.00	0.01%
02	±100mV	% of FSR	+100.00	±000.00	-100.00	0.01%
03	±500mV	% of FSR	+100.00	±000.00	-100.00	0.01%
04	±1V	% of FSR	+100.00	±000.00	-100.00	0.01%
05	±2.5V	% of FSR	+100.00	±000.00	-100.00	0.01%
06	±20mA	% of FSR	+100.00	±000.00	-100.00	0.01%
07	**Reserved**					
08	±10V	% of FSR	+100.00	±000.00	-100.00	0.01%
09	±5V	% of FSR	+100.00	±000.00	-100.00	0.01%
0A	±1V	% of FSR	+100.00	±000.00	-100.00	0.01%
0B	±500mV	% of FSR	+100.00	±000.00	-100.00	0.01%
0C	±150mV	% of FSR	+100.00	±000.00	-100.00	0.01%
0D	±20mA	% of FSR	+100.00	±000.00	-100.00	0.01%

Tow's Complement Table :

Code	Input Range	Data Format	+Full Scale	Zero	- Full Scale	Displayed Resolution
00	±15mV	2's Comp.	7FFF	0000	8000	1 LSB
01	±50mV	2's Comp.	7FFF	0000	8000	1 LSB
02	±100mV	2's Comp.	7FFF	0000	8000	1 LSB
03	±500mV	2's Comp.	7FFF	0000	8000	1 LSB
04	±1V	2's Comp.	7FFF	0000	8000	1 LSB
05	±2.5V	2's Comp.	7FFF	0000	8000	1 LSB
06	±20mA	2's Comp.	7FFF	0000	8000	1 LSB
07	**Reserved**					
08	±10V	2's Comp.	7FFF	0000	8000	1 LSB
09	±5V	2's Comp.	7FFF	0000	8000	1 LSB
0A	±1V	2's Comp.	7FFF	0000	8000	1 LSB
0B	±500mV	2's Comp.	7FFF	0000	8000	1 LSB
0C	±150mV	2's Comp.	7FFF	0000	8000	1 LSB
0D	±20mA	2's Comp.	7FFF	0000	8000	1 LSB

The following table shows the relation between the input range setting with the data format and the resolution when using ND-6011/D or 6018 to measure temperature by thermocouple.

Code	**Input Range** Thermocouple	Data Format	Maximum	Minimum	Displayed Resolution
0E	**J** (0°C to 760°C)	Eng. Units	+760.00	+000.00	0.01°C
0F	**K** (0°C to 1000°C)	Eng. Units	+1000.0	+0000.0	0.1°C
10	**T** (-100°Cto400°C)	Eng. Units	+400.00	-100.00	0.01°C
11	**E** (0°C to 1000°C)	Eng. Units	+1000.0	+0000.0	0.1°C
12	**R** (500°C to 1750°C)	Eng. Units	+1750.0	+0500.0	0.1°C
13	**S** (500°C to 1750°C)	Eng. Units	+1750.0	+0500.0	0.1°C
14	**B** (500°C to 1800°C)	Eng. Units	+1800.0	+0500.0	0.1°C
15	**N** (-270°C to 1300°C)	Eng. Units	+1300.0	-0270.0	0.1°C
16	**C** (0°C to 2320°C)	Eng. Units	+2320.0	+0000.0	0.1°C

Code	**Input Range** Thermocouple	Data Format	Maximum	Minimum	Displayed Resolution
0E	**J** (0°C to 760°C)	% of FSR	+100.00	+000.00	0.01%
0F	**K** (0°C to 1000°C)	% of FSR	+100.00	+000.00	0.01%
10	**T** (-100°Cto400°C)	% of FSR	+100.00	-025.00	0.01%
11	**E** (0°C to 1000°C)	% of FSR	+100.00	+000.00	0.01%
12	**R** (500°C to 1750°C)	% of FSR	+100.00	+028.57	0.01%
13	**S** (500°C to 1750°C)	% of FSR	+100.00	+028.57	0.01%
14	**B** (500°C to 1800°C)	% of FSR	+100.00	+027.27	0.01%
15	**N** (-270°C to 1300°C)	% of FSR	+100.00	-020.76	0.01%
16	**C** (0°C to 2320°C)	% of FSR	+100.00	+000.00	0.01%

Code	**Input Range** Thermocouple	Data Format	Maximum	Minimum	Displayed Resolution
0E	**J** (0°C to 760°C)	2’s Comp.	7FFF	0000	1 LSB
0F	**K** (0°C to 1000°C)	2’s Comp.	7FFF	0000	1 LSB
10	**T** (-100°Cto400°C)	2’s Comp.	7FFF	E000	1 LSB
11	**E** (0°C to 1000°C)	2’s Comp.	7FFF	0000	1 LSB
12	**R** (500°C to 1750°C)	2’s Comp.	7FFF	2492	1 LSB
13	**S** (500°C to 1750°C)	2’s Comp.	7FFF	2492	1 LSB
14	**B** (500°C to 1800°C)	2’s Comp.	7FFF	238E	1 LSB
15	**N** (-270°C to 1300°C)	2’s Comp.	7FFF	E56B	1 LSB
16	**C** (0°C to 2320°C)	2’s Comp.	7FFF	0000	1 LSB

5. Calibration

5. 1. How to Calibrate the Analog Input Modules ?

What do you need to do calibration ?

1. One 5 1/2 digit multimeter
2. A voltage calibrator or very stable and noise free DC voltage generator.
3. A precision resistance decade box or discrete resistors.
4. NuDAM Administration Utility

Calibration Procedure for ND-6011/D, 6012/D,6014D, 6017

1. Select the correct input range, different input range have different apply calibration voltage.
2. Apply the correct **offset voltage** to the analog input module, detail voltage value, see table 5-1.
3. Send “**Offset Calibration $(Addr)1**” to analog input module five times.
4. Apply the correct **span voltage** to the analog input module, detail voltage value, see table 5-1.
5. Send “**Span Calibration $(Addr)0**” to analog input module five times.
6. Repeat procedure 2 to procedure 5 two times.

Calibration Procedure for ND-6013

1. Select the correct input range, different input range have different apply calibration resistance.
2. Apply the correct **offset resistance** to the analog input module ND-6013 channel 0, detail resistance value, see table 5-2
3. Send “**Offset Calibration $(Addr)10**” to analog input module ND-6013 channel 0 .
4. Apply the correct **span resistance** to the analog input module ND-6013 channel 0, detail resistance value, see table 5-2

5. Send “**Span Calibration $(Addr)00**” to analog input module ND-6013 channel 0 .
6. Apply the correct **offset resistance** to the analog input module ND-6013 channel 1, detail resistance value, see table 5-2
7. Send “**Offset Calibration $(Addr)11**” to analog input module ND-6013 channel 1 .
8. Apply the correct **span resistance** to the analog input module ND-6013 channel 1, detail resistance value, see table 5-2.
9. Send “**Span Calibration $(Addr)01**” to analog input module ND-6013 channel 1 .
10. Apply the correct **offset resistance** to the analog input module ND-6013 channel 2, detail resistance value, see table 5-2.
11. Send “**Offset Calibration $(Addr)12**” to analog input module ND-6013 channel 2 .
12. Apply the correct **span resistance** to the analog input module ND-6013 channel 2, detail resistance value, see table 5-2.
13. Send “**Span Calibration $(Addr)02**” to analog input module ND-6013 channel 2 five times.
14. Repeat procedure 2 to procedure 13 two times.

Calibration Procedure for ND-6018 Firmware Rev B1.10

1. Disable all the channel and open detect function
2. Select the correct input range, different input range have different apply calibration voltage.
3. Apply the correct **offset voltage** to **channel 0**, detail voltage value, see table 5-1.
4. Send “**Offset Calibration $(Addr)1**” to analog input module five times.
5. Apply the correct **span voltage** to **channel 0**, detail voltage value, see table 5-1
6. Send “**Span Calibration $(Addr)0**” to analog input module five times..

Repeat procedure 3 to procedure 6 two times

CJC Calibration Procedure

1. Ensure that the NuDAM units has been powered up for at least 30 minutes and is located away from sources of heat, in still air at constant temperature.

2. Place a calibrated temperature meter, with a resolution of 0.1°C, in close proximity to the CJC sensor of the NuDAM module.
3. Send command "**Read CJC Status $(Addr)3**" to read temperature of CJC, then compare the temperature returned from the CJC sensor with the calibrated temperature
4. If the difference is less than ±0.1°C， the CJC offset is correctly calibrated, if it is greater or less, proceed to step 5
5. Send "**CJC Offset Calibration $(Addr)9(+0000)"** to set initial CJC offset value to zero.
6. Repeat step 3, then proceed to step 7.
7. Send "**CJC Offset Calibration $(Addr)9(Counts)**" to correct the CJC offset error.(counts is a 4-characters with a sign + or -,range is 0000 to FFFF, each count equals approximately 0.0153 °C). (*For more detail, please refer the CJC Offset Calibration Command*).
8. Repeat procedure 4 to procedure 7 if the CJC value still does not conform to the ambient temperature.

Analog Input Module's Calibration Voltages

Table 5-1 : ND-6011/D/ND-6018 Calibration voltages

Code	Input Range	Offset Calibration voltage	Span Calibration Voltage
00	±15 mV	0 mV	+15 mV
01	±50 mV	0 mV	+50 mV
02	±100 mV	0 mV	+100 mV
03	±500 mV	0 mV	+500 mV
04	±1 V	0 V	+1 V
05	±2.5 V	0 V	+2.5 V
06	±20 mA	0 mA	+20 mA
0E	**J** (0°C to 760°C)	0 mV	+50 mV
0F	**K** (0°C to 1000°C)	0 mV	+55 mV
10	**T** (-100°C to 400°C)	0 mV	+30 mV
11	**E** (0°C to 1000°C)	0 mV	+78 mV
12	**R** (500°C to 1750°C)	0 mV	+25 mV
13	**S** (500°C to 1750°C)	0 mV	+19.5 mV
14	**B** (500°C to 1800°C)	0 mV	+15 mV
15	**N** (-270°C to 1300°C)	0 mV	+55 mV
16	**C** (0°C to 2320°C)	0 mV	+39 mV

Table 5-1 : ND-6012/D/ND-6017 Calibration voltages

Code	Input Range	Offset Calibration voltage	Span Calibration Voltage
08	±10 V	0 mV	+10 V
09	±5 V	0 mV	+5 V
0A	±1 V	0 mV	+1 V
0B	±500 mV	0 mV	+500 mV
0C	±150 mV	0 mV	+150 mV
0D	±20 mA	0 mA	+20 mA

Table 5-2 : ND-6013 Calibration Resistance

Code	Input Range	Span Calibration Resistance	Offset Calibration Resistance
20	Pt-100, -100°C to +100°C, α=.00385	200Ω	50Ω
21	Pt-100, 0°C to +100°C, α=.00385	200Ω	50Ω
22	Pt-100, 0°C to +200°C, α=.00385	200Ω	50Ω
23	Pt-100, 0°C to +600°C, α=.00385	350Ω	50Ω
24	Pt-100, -100°C to +100°C, α=.003916	200Ω	50Ω
25	Pt-100, 0°C to +100°C, α=.003916	200Ω	50Ω
26	Pt-100, 0°C to +200°C, α=.003916	200Ω	50Ω
27	Pt-100, 0°C to +600°C, α=.003916	350Ω	50Ω
28	Ni-100, 0°C to +100°C	200Ω	50Ω
29	Ni-120, 0°C to +100°C	350Ω	50Ω

6. Product Warranty/Service

Seller warrants that equipment furnished will be free form defects in material and workmanship for a period of one year from the confirmed date of purchase of the original buyer and that upon written notice of any such defect, Seller will, at its option, repair or replace the defective item under the terms of this warranty, subject to the provisions and specific exclusions listed herein.

This warranty shall not apply to equipment that has been previously repaired or altered outside our plant in any way as to, in the judgment of the manufacturer, affect its reliability. Nor will it apply if the equipment has been used in a manner exceeding its specifications or if the serial number has been removed.

Seller does not assume any liability for consequential damages as a result from our products uses, and in any event our liability shall not exceed the original selling price of the equipment.

The equipment warranty shall constitute the sole and exclusive remedy of any Buyer of Seller equipment and the sole and exclusive liability of the Seller, its successors or assigns, in connection with equipment purchased and in lieu of all other warranties expressed implied or statutory, including, but not limited to, any implied warranty of merchant ability or fitness and all other obligations or liabilities of seller, its successors or assigns.

The equipment must be returned postage-prepaid. Package it securely and insure it. You will be charged for parts and labor if you lack proof of date of purchase, or if the warranty period is expired.

NuDAM®

ND-6021 Analog Output

ND-6024 4-Channel Analog Output

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Contents

1. Introduction

1. 1. About the NuDAM Analog Output Modules

The NuDAM provides an analog output modules which can convert the digital command to analog. The basic features of each module are shown here.

- NuDAM-6021 : analog signal output module with safety functions
- NuDAM-6024 : 4 channel analog output module

1. 2. Overview of NuDAM-6021

What is NuDAM-6021 ?

ND-6021 is an analog signal output module. It receives the digital command from host computer through RS-485 network. The format of the digital value can be engineering units, hexdecimal format or percentage of full-scale range(FSR). A microprocessor is used to convert the digital command to digital value to send to DAC. The DAC converts the digital value into analog form. The analog output can be either voltage or current output.

The ND-6021 is designed for safety. It provides many safety functions such as isolation, watchdog, and power on safe value. The opto-isolators provide 5000Vrms isolation voltage to isolate the digital section and the remote controlled analog equipments. The damage of power surges is avoided.

Another safety fucntion is the watchdog. Whenever the host is loss contact with the remoted NuDAM module, or the micro-processor is down, the module will reset itself and send the safety value to the analog output therefore the industry safety is guarantee. The safety value / power-up value can be set by configuration software.

The analog output can be readback through the module's ADC. which can monitor the 'real' output of the device. The host can check the digital command and the real output to avoid short circuits. The slew rate of the output signal is also controllable by software.

Features of NuDAM-6021

- One uni-polar analog output channel
- Two sets of differential current and voltage output terminals
- Versatile digital signal format
- Programmable host watchdog timer for host failure protection
- Internal watchdog timer for device failure protection
- Easy programming by software
- Easy installation and wiring

Specifications of NuDAM-6021

✧ **Interface**

- Interface : RS-485, 2 wires
- Speed (bps) : 1200, 2400, 4800, 9600, 19.2K, 38.4K

✧ **Analog Output**

- Singal Output type: Differential type
- Resolution: 12 bits
- Accuracy: ±0.1% of FSR for current output
  ±0.2% of FSR for voltage output
- Unit Convertion: V or mA
- Output range:
  Voltage output: 0 to 10 V (uni-polar)
  Current output: 0 to 20 mA
  4 to 20 mA
- Maximum Sampling Rate: 100 samples /sec
- Slew rate:
  Voltage output: 0.0625 to 64 V/sec
  Current output: 0.125 to 128 mA/sec
- Internal Current Load Resistor: 500Ω (%1)

✧ **Readback Analog Input**
- Accuracy: ±0.2% of FSR

✧ **Isolation**
- Isolation voltage: 5000 Vrms

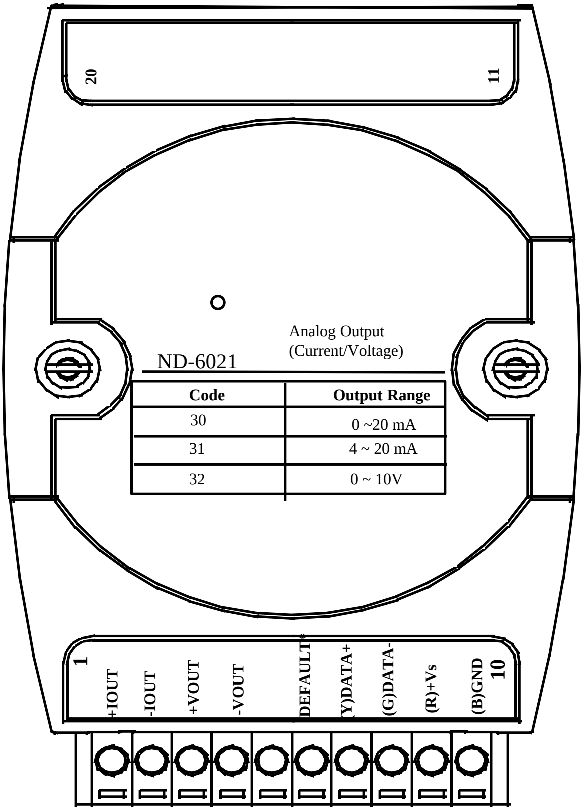
✧ **Watchdog Function**
- Module internal watchdog timer : 150 ms
- Power failure threshold : 4.65 V
- Host programmable watchdog : 100 ms ~ 25.500 sec

✧ **Power**
- Power supply : +10V to +30V
- Power consumption : 1.0W

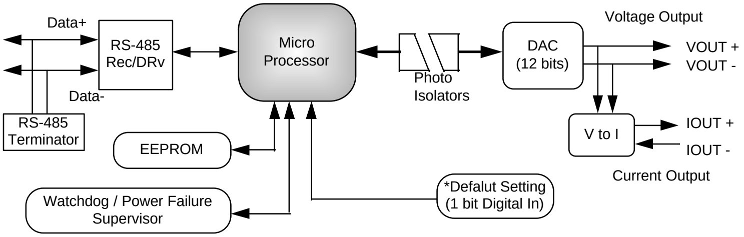
Pin Definitions of ND-6021

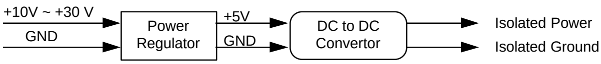
Pin #	Signal Name	Description
1	+IOUT	Positive Current Output Terminal
2	-IOUT	Negative Current OutputTerminal
3	+VOUT	Positive Voltage Output Terminal
4	-VOUT	Negative Voltage Output Terminal
6	Default*	Initial state setting
7	(Y) DATA+	RS-485 series signal, positive
8	(G) DATA-	RS-485 series signal, negative
9	(R) +Vs	Power supply, +10V~+30V
10	(B) GND	Ground

A Look at ND-6021 & Pin Assignment



Functional Block Diagram of ND-6021





1. 3. Overview of NuDAM-6024

What is NuDAM-6024 ?

ND-6024 is a 4 channel bipolar analog signal output module. It receives the digital command from host computer through RS-485 network. A microprocessor is used to convert the digital command to digital value to send to DAC. The DAC converts the digital value into analog form.

The ND-6024 is designed for safety. It provides many safety functions such as isolation, watchdog, and power on safe value. The opto-isolators provide 5000Vrms isolation voltage to isolate the digital section and the remote controlled analog equipments. The damage of power surges is avoided.

Another safety fucntion is the watchdog. Whenever the host is loss contact with the remoted NuDAM module, or the microprocessor is down, the module will reset itself and send the safety value to the analog output therefore the industry safety is guarantee. The safety value / power-up value can be set by configuration software.

Features of NuDAM-6024

- 4 channel bipolar analog output
- Programmable host watchdog timer for host failure protection
- Internal watchdog timer for device failure protection
- Easy programming by software
- Easy installation and wiring

Specifications of NuDAM-6024

✧ **Interface**
- Interface : RS-485, 2 wires
- Speed (bps) : 1200, 2400, 4800, 9600, 19.2K, 38.4K

✧ **Analog Output**
- Channel numbers : 4
- Singal Output type: Differential output
- Voltage Output: ±10V
- Resolution: 12-bit resolution
- Accuracy: ±1/2 LSB
- Gain Drift: ±5ppm/°C

✧ **Digital Input**
- Channel numbers : 7
- Logical level 0: +2V max.
  Logical Level 1: +3.5V ~ +30V

✧ **Isolation**
- Isolation voltage: 5000 Vrms

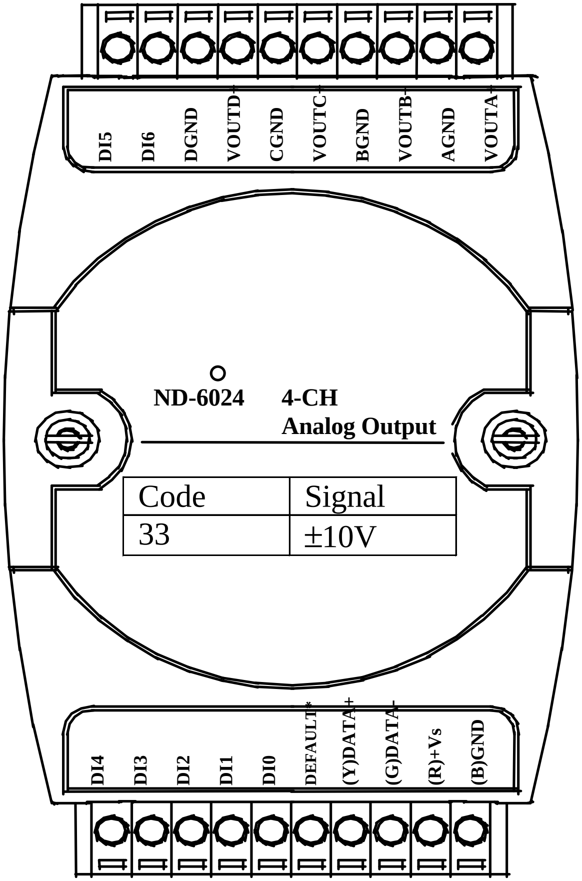
✧ **Watchdog Function**
- Module internal watchdog timer : 150 ms
- Power failure threshold : 4.65 V
- Host programmable watchdog : 100 ms ~ 25.500 sec

✧ **Power**
- Power supply : +10V to +30V
- Power consumption : 2.5W

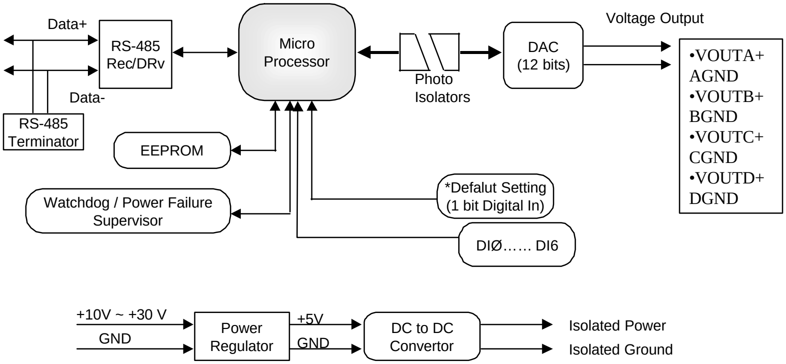
Pin Definitions of ND-6024

Pin #	Signal Name	Description
1	DI4	Digital input channel 4
2	DI3	Digital input channel 3
3	DI2	Digital input channel 2
4	DI1	Digital input channel 1
5	DI0	Digital input channel 0
6	Default*	Initial state setting
7	(Y) DATA+	RS-485 series signal, positive
8	(G) DATA-	RS-485 series signal, negative
9	(R) +Vs	Power supply, +10V~+30V
10	(B) GND	Ground
11	VOUTA+	Positive Voltage Output A Terminal
12	AGND	Negative Voltage Output A Terminal
13	VOUTB+	Positive Voltage Output B Terminal
14	BGND	Negative Voltage Output B Terminal
15	VOUTC+	Positive Voltage Output C Terminal
16	CGND	Negative Voltage Output C Terminal
17	VOUTD+	Positive Voltage Output D Terminal
18	DGND	Negative Voltage Output D Terminal
19	DI6	Digital input channel 6
20	DI5	Digital input channel 5

A Look at ND-6024 & Pin Assignment



Functional Block Diagram of ND-6024



2. Initialization & Installation

2. 1. Software Installation

1. If you have already installed “NuDAM Administration” then skip other steps.
2. Backup your software diskette.
3. Insert “NuDAM Administration” diskette into floppy drive A:
4. Change drive to A:
5. 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:**

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

2. 2.Initializing a Brand-New Module

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. Every brand-new NuDAM has a factory default setting as following:

- Address ID is 01.
- Baud rate is 9600 bps
- Check-sum disable
- Host Watchdog timer is disable

Therefore, to configure the brand-new NuDAM before using is necessary to avoid conflicting address. The baud rate may also be changed according to user's requirements.

The initialization procedures of a brand-new NuDAM are shown in the following sections.

Default State

The NuDAM modules must be set at *Default State* when you want to change the default settings, including the ID address, baud rate, check-sum status etc. All NuDAM modules have an special pin labeled as **DEFAULT***. The module will be in *Default State* if the **DEFAULT*** pin is shorted to ground when power ON. Under this state, the default configuration is set as following:

- Address ID is 00.
- Baud rate is 9600 bps.
- Check-sum disable.
- Watchdog timer is disable.

Therefore, the configuration of the host and the module can be easily set identically and initializing a module will be possible no matter what configuration is set under operating state.

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
- Administrating utility software

Initialization Procedure

1. Power off the host computer and the installed NuDAM-6520. Be sure of the baud rate of the NuDAM-6520 is 9600 bps.
2. Connect a brand new NuDAM module with the RS-485. Set the module in *Default State* by shorting the **DEFAULT*** pin. Refer to Figure 2.1 for detailed 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 Wiring

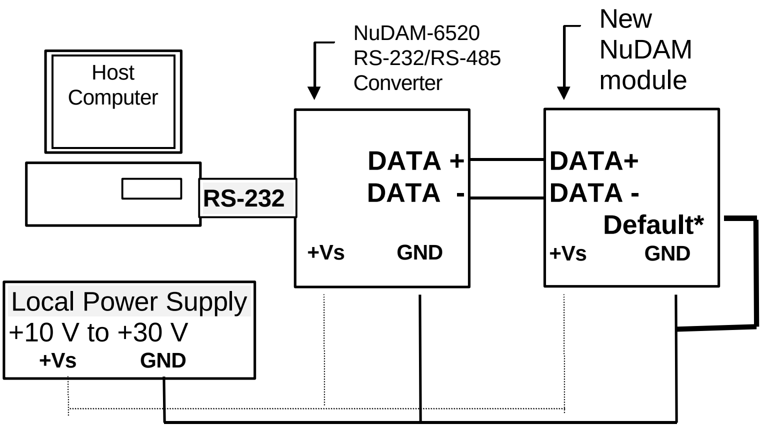


Figure 2-1 Layout for Initialization the NuDAM module

2. 3. 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 Procedures

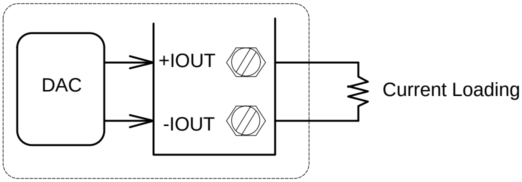
1. Configure the new NuDAM module according to the initialization procedure in section 2.2.
2. The baud rate and check-sum status of the new module must be identity with the existing RS-485 network. The address ID must not be conflict with other NuDAM modules on the network.
3. Power off the NuDAM power supply of the existing RS-485 network.

4. Power off the host computer.
5. Wire the power lines for the new NuDAM with the existing network. Be careful about the signal polarity as wiring.
6. Wire the RS-485 data lines for the new NuDAM with the existing network. Be careful about the signal polarity as wiring.
7. Wire to the input or output devices. Refer to section 2.4 for illustrations.
8. Power on the host computer.
9. Power on the NuDAM local power supply.
10. Use the NuDAM administration utility to check entire network.

2. 4. Application Wiring for NuDAM-6021

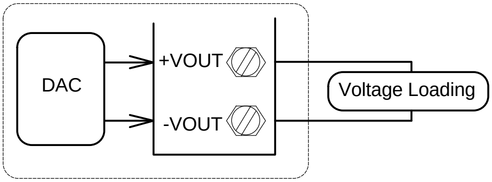
Differential Current Output

Differential Current Output Channel of NuDAM 6021



Differential Voltage Output

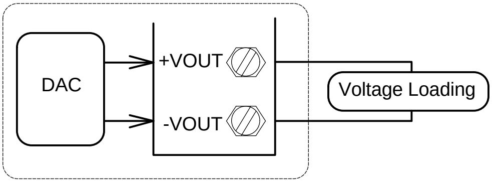
Differential Voltage Output Channel of NuDAM 6021



2. 5. Application Wiring for NuDAM-6024

Differential Voltage Output

Differential Voltage Output Channel of NuDAM 6021



3. Command Set

3. 1. Command and Response

Introduction

The NuDAM command is composed by numbers of characteristics, including the leading code, address ID, the variables, the optional check-sum bytes, and a carriage return to indicate the end of a command. The host computer can only command only one NuDAM module except those synchronized commands with wildcard address “**”. The NuDAM may or may not give response to the command. The host should check the response to handshake with the modules.

Document Conventions

The following syntax conventions describes the NuDAM commands in this manual.

(Leading Code)	Leading Code is the first characteristic of the NuDAM command. All NuDAM commands need a command leading code, such as %,$,#,@,...etc. **1- character**
(Addr)	Module’s address ID, the value is in the range of 00 - FF (Hex). **2- character**
(Command Variable)	Command codes or value of variables. **Variable length**
[Data]	Some commands need additional data. **Variable length**
[Checksum]	Checksum in brackets indicate optional parameter, only checksum is enable then this field is required. **2- character**
< >	Identifies a control code character, such as <CR> for carriage return, its value is 0x0D. **1- character**

Format of NuDAM Commands

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

When checksum is enable then **[Checksum]** is needed, it is 2-character. Both command and response must append the checksum characters.

How to calculate checksum value ?

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

Example 1: checksum is **disable**

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

$	: LeadingCode
01	: Address
2	: Command (Read Configuration)
<CR>	: Carriage return 0x0D

Example 2: checksum is **enable**

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

$	: LeadingCode
01	: Address
2	: Command (Read Configuration)
B7	: Checksum value
<CR>	: Carriage return 0x0D

‘$’ = 0x24 ‘0’ = 0x30 ‘1’ = 0x31 ‘2’ = 0x32

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**

Note : 1. There is no spacing between the command words and the checksum characters.
2. Every command follows a <CR> carriage return for ending.
3. The checksum characters are optional.

Response of NuDAM Commands

The response message depends on versatile NuDAM command. The response is composed with a few characteristics, including leading code, variables, and carriage return for ending. There are two categories of leading code for response message, "!" or ">" means valid command and "?" means invalid. By checking the response message, user can monitor the command is valid or not.

Note : Under the following conditions, there will have **no response** message.
1. The specified address ID is not exist.
2. Syntax error.
3. Communication error.
4. Some special commands does not have response message .

---

3. 2. Summary of Command Set

There are three categories of NuDAM commands. The first is the general commands, including set configuration command, read configuration, reset, read module‘s name or firmware version, etc. Every NuDAM can response to the general commands. The second is the functional commands, which depends on functions of each module. Not every module can execute all function commands. The third is the special commands including functions about the programmable watchdog timer, safe values, and the programmable leading code. All the commands used in the NuDAM analog output module are list in the following table.

Command Set of Analog Output Modules			
Command	**Syntax**	**Modules**	**Page**
General Commands			
Set Configuration	%(OldAddr)(NewAddr) (OutputRange)(BaudRate) (DataFormat)	All	3-6
Read Configuration	**$(Addr)2**	All	3-9
Read Module Name	**$(Addr)M**	All	3-10
Read Firmware Version	**$(Addr)F**	All	3-11
Reset Status	**$(Addr)5**	All	3-12
Functional Commands			
Synchronized Sampling	**#****	6024	
Read Synchronized Data	**$(Addr)9**	6024	
Digital Input	**$(Addr)8**	6024	
Analog Data Out	**#(Addr)(OutData)**	6021	3-13
	#(Addr)(Port)(OutData)	6024	
4 mA Offset Calibration	**$(Addr)0**	6021	3-18
20 mA Offset	**$(Addr)1**	6021	3-19

Calibration			
Trim Calibration	**$(Addr)3(Counts)**	All	3-20
Save Power On Analog Value	**$(Addr)4**	All	3-21
Last Value Readback	**$(Addr)6**	6021	3-22
	$(Addr)6(Port)	6024	
Current Readback	**$(Addr)8**	6021	3-23
Special Commands			
Read Command Leading Code Setting	**~(Addr)0**	All	3-24
Change Command Leading Code Setting	**~(Addr)10(C1)(C2)(C3)(C4)(C5)(C6)**	All	3-26
Set Host Watchdog / Safety Value	**~(Addr)2(Flag)(TimeOut) (SafeValue)**	6021	3-28
	~(Addr)2(Flag)(TimeOut) (SafeA)(SafeB)(SafeC)(SafeD)	6024	
Read Host WatchDog / Safe Value	**~(Addr)3**	All	3-31
Host is OK	**~****	All	3-33

3. 3. Set Configuration

@Description

Configure the basic setting of NuDAM, including the address ID, output signal range, baud rate, and data format. The new configuration will be available after executing the command.

@Syntax

%(OldAddr)(NewAddr)(OutputRange)(BaudRate)(DataFormat)<CR>

%	Command leading code. **(1-character)**
(OldAddr)	NuDAM module original address ID. The default address ID of a brand new module is 01. The value range of address ID is 00 to FF in hexadecimal. **(2-character)**
(NewAddr)	New address ID, if you don't want to change address ID, let new address ID equals to the old one. **(2-character)**
(OutputRange)	Define analog output range, refers to Table 3-1 for details. **(2-character)**
(BaudRate)	Define communication baud rate, refers to Table 3-2 for details. **(2-character)**
(DataFormat)	Define checksum, integration time and output data format, refers to Figure 3-1 for details. **(2-character)**

@Response

!(Addr)<CR>
or
?(Addr)<CR>

(Addr)	Address ID.
!	Command is valid.
?	Command is invalid, parameter values are invalid, or change the setting without grounding the DEFAULT* pin.

Note : When you want to change the checksum or baud rate, the DEFAULT* pin must be grounded at first.

@Example

User command: %0118310610<CR>
Response: !18<CR>

Item	**Meaning**	**Description**
%	(Leading Code)	Command leading code.
01	(OldAddr)	Original address ID is 01(Hex).
18	(NewAddr)	New address ID is 18(Hex).
31	(OutputRange)	Analog output range is 4 to 20 mA
06	(BaudRate)	Baud rate is 9600.
10	(DataFormat)	10 means a slew rate is 1.000 mA/sec and checksum is disable.
<CR>	Carriage return	0x0D.

Code (Hex)	**Signal Range of Output Range**	**Modules**
30	0 to 20 mA	6021
31	4 to 20 mA	6021
32	0 to 10 V	6021
33	-10 to 10 V	6024

Table 3. -1 Analog Output Range Setting

Code	**Baudrate**
03	1200 bps
04	2400 bps
05	4800 bps
06	9600 bps
07	19200 bps
08	38400 bps

Table 3-2 Baud rate setting code

7	6	5	4	3	2	1	0

Reserved (bit 7)
Must to be 0

Checksum (bit 6)
0 : disable
1 : enable

Slew Rate (bits 5–2)

BitCode	Voltage	Current
0000	immediate change	
0001	0.0625 V/sec	0.125 mA/sec
0010	0.125 V/sec	0.250 mA/sec
0011	0.250 V/sec	0.500 mA/sec
0100	0.500 V/sec	1.000 mA/sec
0101	1.000 V/sec	2.000 mA/sec
0110	2.000 V/sec	4.000 mA/sec
0111	4.000 V/sec	8.000 mA/sec
1000	8.000 V/sec	16.00 mA/sec
1001	16.00 V/sec	32.00 mA/sec
1010	32.00 V/sec	64.00 mA/sec
1011	64.00 V/sec	128.0 mA/sec

Analog Output Data Unit (bits 1–0)
00 : Engineering units
01 : % of Full Scale Range
10 : Hexadecimal

Figure 3. -1 Data format of Analog Output Setting

*****6024 only supports immediate change and engineering units.

3. 4. Read Configuration

@Description

Read the configuration of module on a specified address ID.

@Syntax

$(Addr)2<CR>

$	Command leading code
(Addr)	Address ID.
2	Command code for reading configuration

@Response

!(Addr)(OutputRange)(BaudRate)(DataFormat)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(OutputRange)	Current setting of analog voltage output, refers to Table 3-1 for details.
(BaudRate)	Current setting of communication baud rate, refers to Table 3-2 for details.
(DataFormat)	Current settings of checksum, integration time and output data format, refers to Figure 3-1 for details.

@Example

User command: $182<CR>
Response: !18320610<CR>

!	Command is valid.
18	Address ID.
32	Analog output range is 0 to 10V
06	Baud rate is 9600 bps.
10	The output data is in engineering units, slew rate is 1mA/sec, checksum is disable.

3. 5.Read Module Name

@Description

Read module name of NuDAM at specified address.

@Syntax

$(Addr)M<CR>

$	Command leading code.
(Addr)	Address ID
M	Read module name

@Response

!(Addr)(ModuleName) <CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(ModuleName)	NuDAM module's name would be '6021'. **4 characters**

@Example

User command: $18M<CR>
Response: !186021<CR>

!	Command is valid.
18	Address ID is 18 (Hex)
6021	ND-6021 (It is a analog output module)

3. 6. Read Firmware Version

@Description

Read firmware version of NuDAM at specified address.

@Syntax

$(Addr)F<CR>

$	Command leading code.
(Addr)	Address ID
F	Read module firmware version.

@Response

!(Addr)(FirmRev) <CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(FirmRev)	NuDAM module's firmware version.

@Example

User command:	$18F<CR>
Response:	!18A2.30<CR>

!	Command is valid.
18	Address ID is 18 (Hex).
A2.30	Firmware Version

3. 7. Reset Status

@Description

Read the reset status of module at specified address to check whether if it has been reset since the last reset status command was issued to the module.

@Syntax

$(Addr)5<CR>

$	Command leading code.
(Addr)	Address ID
5	Reset Status Command

@Response

!(Addr)(Status)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(Status)	0 : It has not been reset since the last reset status command was issued. 1 : It has been reset since the last reset status command was issued

@Example

User command:	$185<CR>
Response:	!180<CR>

Status is 0 means this digital I/O module has not been reset, since the last reset status command was issued.

3. 8. Synchronized Sampling (6024 only)

@Description

Synchronized all modules to sample input values and stored the values in the module's register at the same time and use "Read Synchronized Data" command to read the data and process it one by one.

For analog output module, this command is only available to modules involving the digital input function, such as NuDAM-6024.

@Syntax

#<CR>**

#	Command leading code.
**	Synchronized sampling command

@Response

Note : Synchronized sampling command **has NO response**.

@Example

User command: #**<CR>

Synchronized sampling command **has no response**.

3. 9. Read Synchronized Data (6024 only)

@Description

After a synchronized sampling command **#**** was issued, you can read the input value that was stored in the addressed module's register and use same method to process other module's data one by one.

@Syntax

$(Addr)9<CR>

$	Command leading code.
(Addr)	Address ID
9	Read synchronized data.

@Response

!(Status)(DataIn)<CR>

or

?(Addr)<CR>

>	Command is valid.
?	Command is invalid.
(Status)	0 : Data has been sent at least once before. 1 : Data has been sent for the first time since a synchronized sampling command was issued.**(1-character)**
(DataIn)	Value of digital input channel. **(2-character)**

@Examples

User command: $309<CR>
Response: >17F<CR>

>	Command is valid.
1	Data has not been sent before.
7F	7F(01111111) means digital input channel 0,1,2,3,4,5,6 are HIGH.

3. 10.Digital Input (6024 only)

@Description

Read the digital input channel value.

@Syntax

$(Addr)8<CR>

$	Command leading code.
(Addr)	Address ID
8	Digital data input command.

@Response

!(DataIn)0000<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(DataIn)	Value of digital input. **(2-character)**

@Example

User command:	$308<CR>
Response:	!320000<CR>

!	Command is valid.
32	32 (00110010) means digital output channel 1, 4, 5 are ON, channel 0, 2, 3, 6 are OFF.
0000	No used

3. 11. Analog Data Output

@Description

Send a value to analog output module at specified address. The data format of the value can be engineering unit, percent, or hexdecimal value, which is set by configuration setting command. (ND-6024 only supports engineering format.)

@Syntax

#(Addr)(OutData)<CR> (6021 Only)
#(Addr)(Port)(OutData)<CR> (6024 Only)

#	Command leading code. **(1-character)**
(Addr)	Address ID. **(2-character)**
(Port)	A, B, C or D
(OutData)	Value of the analog output signal,. The unit of the value can be engineering units, % of FSR, or hexadecimal value. Refers to chapter 4 for details of the data format.

@Response

><CR>
or
?(Addr)<CR>

>	Command is valid.
?	Command is invalid or no synchronized sampling command was issued.
(Addr)	Address ID.

@Examples

User command:	#0616.000<CR>
Response:	><CR>

The command sets the analog output to be 16 mA at address 06H, if the data format is configured as engineering units and 0~20mA output range.

User command:	#08+020.00<CR>
Response:	><CR>

The command sets the analog output to be 4 mA at address 08H, if the data format is configured as % of FSR and 0~20mA output range.

4mA = 20mA x 20.00%

User command:	#097FF<CR>
Response:	><CR>

The command sets the analog output to be 5 V at address 09H, if the data format is configured as hexdecimal format and output range of 0~10V.

5 V = 7FF / FFF x 10V

User command:	#08A-05.000<CR>
Response:	><CR>

The command sets the analog output port A to be –5 V at address 08H.

3. 12. 4mA Offset Calibration

@Description

Stores the current output value as 4 mA reference at the specified analog output module.(only 6021)

@Syntax

$(Addr)0<CR>

$	Command leading code
(Addr)	Address ID
0	Command Code

@Response

!(Addr)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid or no synchronized sampling command was issued.
(Addr)	Address ID.

@Example

User command:	$060<CR>
Response:	!06<CR>

To perform the 4 mA calibartion for analog output module at address 06H.

Note : Analog output module should be trimmed to the correct value by “Trim Calibration” command before to execute “4 mA Calibration”. Refers to Chapter 5 “Analog Output Calibration” for details.

3. 13. 20mA Calibration

@Description

Stores the current output value as 20 mA reference at the specified analog output module. (only 6021)

@Syntax

$(Addr)1<CR>

$	Command leading code (1 character)
(Addr)	Address ID (2 characters)
1	Function Code, 20 mA calibration (1 character)

@Response

!(Addr)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Example

User command:	$061<CR>
Response:	!06<CR>

To perform the 20 mA calibration for analog input module at address ID 06H.

Note : Analog output module should be trimmed to the correct value by “Trim Calibration” command before to execute “20 mA Calibration”. Refers to Chapter 5 “Analog Output Calibration” for details .

3. 14. Trim Calibration

@Description

Trims the specified analog output module a specified number of units up or down.

@Syntax

$(Addr)3(Counts)<CR>

$	Command leading code
(Addr)	Address ID
3	Function Code
(Counts)	Number of counts to increase or decrease the output current. Range 00 - 5F : 0 to +95 counts (increase) Range A1 - FF : -95 to -1 counts (decrease) 1 count equals approximately 4.88µA or 2.44mV (4.88mV for ND-6024)

@Response

!(Addr)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Example

User command: $06314<CR>
Response: !06<CR>

Increase analog output value about 97.6µA (14H * 4.88µA = 97.6µA) at address 06H.

Note : Analog output module trim calibration should have a corrent calibration wiring. Refers to Chapter 5 “Analog Output Calibration” for details.

3. 15.Save Power On Analog Output Value

@Description

Save the current output value to the non-volatile register for NuDAM analog output module. The power on value be put on the output channel when system power ON.

@Syntax

$(Addr)4<CR>

$	Command leading code. **(1-character)**
(Addr)	Address ID. **(2-character)**
4	Function code of saving power on analog value. **(1-character)**

@Response

!(Addr)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Example

User command:	$064<CR>
Response:	!06<CR>

Save the current analog output value as the default value when the analog output module start-up.

3. 16. Last Value Readback

@Description

Return the latest analog output value which is set by "Analog Data Out" command. If the analog output module never execute the "Analog Data Out" command then it return the start-up output value. (only 6021)

@Syntax

$(Addr)6<CR>
$(Addr)6(Port)<CR> (6024 Only)

$	Command leading code. **(1-character)**
(Addr)	Address ID. **(2-character)**
6	Function code of last value readback. **(1-character)**
(Port)	Port A, B, C or D.

@Response

!(Addr)(Data)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(Data)	The current analog output value, the data format depends on module configuration.

@Example

User command:	$086<CR>
Response:	!0802.000<CR>

This analog output module return the latest output value is 2.000 mA at address 08H, if data format is engineering units and the signal range is 0~20mA.

3. 17. Current Readback

@Description

Read the estimated current output value at the specified analog output module. .

@Syntax

$(Addr)8<CR>

$	Command leading code. **(1-character)**
(Addr)	Address ID. **(2-character)**
6	Function code of last value readback. **(1-character)**

@Response

!(Addr)(Data)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(Data)	The current analog output value, the data format depends on module configuration.

@Example

User command:	$088<CR>
Response:	!0802.000<CR>

This analog output module return the latest output value is 2.000 mA at address 08H, if data format is engineering units and the signal range is 0~20mA.

Read Leading Code Setting

@Description

Read command leading code setting and host watchdog status.

@Syntax

~(Addr)0<CR>

~	Command leading code.
(Addr)	Address ID
0	Read command leading code setting.

@Response

!(Addr)(Status)(C1)(C2)(C3)(C4)(C5)(C6)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID
(Status)	**(2-character)** Bit 0 : Reserved Bit 1 : Power failure or watchdog failure Bit 2 : Host watchdog is enable Bit 3 : Host failure
(C1)	Leading code 1, for read configuration status, firmware version, etc. default is **$. (1-character)**
(C2)	Leading code 2, for read synchronize sampling, digital output ,default is **#. (1-character)**
(C3)	Leading code 3, for change configuration. default is **%. (1-character)**
(C4)	Leading code 4, for read alarm status, enable alarm, etc. default is **@. (1-character)**
(C5)	Leading code 5, for read command leading code, change command leading code, etc. default is **~.** **(1-character)**
(C6)	Leading code 6, this leading code is reserved.

default is ***. (1-character)**

@Example

User command:	~060<CR>
Response:	!0600$#%@~*<CR>

Command leading code setting is $#%@~* for module address ID is 06, current status is factory default setting.

3. 18. Change Leading Code Setting

@Description

User can use this command to change command leading code setting as he desired.

@Syntax

~(Addr)10(C1)(C2)(C3)(C4)(C5)(C6)<CR>

~	Command leading code.
(Addr)	Address ID, range (00 - FF).
10	Change command leading code setting.
(C1)	Leading code 1, for read configuration status, firmware version, etc. default is **$. (1-character)**
(C2)	Leading code 2, for read synchronize sampling, digital output ,default is **#. (1-character)**
(C3)	Leading code 3, for change configuration. default is **%. (1-character)**
(C4)	Leading code 4, for read alarm status, enable alarm, etc. default is **@. (1-character)**
(C5)	Leading code 5, for read command leading code, change leading code, etc. default is **~. (1-character)**
(C6)	Leading code 6, this leading code is reserved. default is ***. (1-character)**

@Response

!(Addr)< CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Examples

User command:	~060<CR>
Response:	!0600**$**#%@~*<CR>
User command:	~0610**A**#%@~*<CR>
Response:	!06<CR>
User command:	**A**06F
Response:	!06A1.8<CR>

Read leading code setting is $#%@~* for module address 06 and change leading code **$** to **A**, then use A06F to read firmware version of module on address 06.

***** WARNING *****

- We do not recommend users to change the default setting of leading code, because it will confuse yourself.
- The leading code change only use the command conflicts other devices of other brand on the network.
- The changing of leading code is not necessay if all modules in a network are NuDAMs‘.

3. 19. Set Host Watchdog Timer & Safety Value

@Description

Set host watchdog timer, module will change to safety state when host is failure. Define the output value in this command.

@Syntax

~(Addr)2(Flag)(TimeOut)(SafeValue)<CR>
~(Addr)2(Flag)(TimeOut)(SafeA)(SafeB)(SafeC)(SafeD) (6024 Only)

~	Command leading code.
(Addr)	Address ID, range (00 - FF).
2	Set host watchdog timer and safe state value.
(Flag)	0 : Disable host watchdog timer 1 : Enable host watchdog timer **(1-character)**
(TimeOut)	Host timeout value, between this time period host must send (Host is OK) command to module, otherwise module will change to safety state. Range 01 - FF. **(2-character)** **One unit is 53.3 ms (Firmware version 1.x)** 01 = 1 * 53.3 = 53.3 ms FF = 255 * 53.3 = 13.6 sec **One unit is 100 ms (Firmware version 2.x)** 01 = 1 * 100 = 100 ms FF = 255 * 100 = 25.5 sec
(SafeValue)	Safety value of analog output when host is failure. **(3-character)** **000:** analog output is 0mA or 0 V **7FF:** analog output is 10 mA or 5V **FFF:** analog output is 20 mA or 10V
(SafeA) **(SafeB)** **(SafeC)** **(SafeD)**	Safety value of analog output for port A, B, C and D when host is failure. **(3-character)** **000:** analog output is –10 V **800:** analog output is 0 V **FFF:** analog output is 10 V

@Response

!(Addr)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID

@Example

User command: ~0621123F0<CR>
Response: !06<CR>

06	Address ID
2	Set host watchdog timer and safe state value.
1	Enable host watchdog timer.
12	Timeout value. 0x12 = 18 18 * 53.3 = 959 ms (Firmware Version 1.x) 18 * 100 = 1800 ms (Firmware Version 2.x)
3F0	0x3F0 is hexadecimal Analog output value is **4.923 mA** for 0-20mA Analog output value is **4.923 mA** for 4-20mA Analog output value is **2.462 V** for 0-10 V

Analog output safety value are as following :

For type is 0 ~20 mA or 4~20 mA (Output Range is 0x30, 0x31)
value = (0x3F0 / 0xFFF) * 20 mA = **4.923 mA**

For type is 0 ~10V (Output Range is 0x32)
value = (0x3F0 / 0xFFF) * 10 V = **2.462 V**

User command:	~0621128008008008OO<CR>
Response:	!06<CR>

06	Address ID
2	Set host watchdog timer and safe state value.
1	Enable host watchdog timer.
12	Timeout value. 0x12 = 18 18 * 53.3 = 959 ms (Firmware Version 1.x) 18 * 100 = 1800 ms (Firmware Version 2.x)
800	0x800 is hexadecimal
800	Analog output value is **0V** for port A
800	Analog output value is **0V** for port B
800	Analog output value is **0V** for port C
	Analog output value is **0V** for port D

3. 20. Read Host Watchdog Timer & Safety Value

@Description

Read host watchdog timer setting and the safety value.

@Syntax

~(Addr)3<CR>

~	Command leading code.
(Addr)	Address ID
3	Read host watchdog setting and module safety state value.

@Response

!(Addr)(Flag)(TimeOut)(SafeValue)<CR>
!(Addr)(Flag)(TimeOut)(SafeA)(SafeB)(SafeC)(SafeD)<CR>
(6024 Only)

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID, range (00 - FF).
(Flag)	0 : Host watchdog timer is disable 1 : Host watchdog timer is enable**(1-character)**
(TimeOut)	Host timeout value. Range 01 - FF. **(2-character)** **One unit is 53.3 ms (Firmware version 1.x)** 01 = 1 * 53.3 = 53.3 ms FF = 255 * 53.3 = 13.6 sec **One unit is 100 ms (Firmware version 2.x)** 01 = 1 * 100 = 100 ms FF = 255 * 100 = 25.5 sec
(SafeValue)	Safety value of analog output when host is failure. **(3-character)**
(SafeA) **(SafeB)**	Safety value of analog output for port A, B, C and D when host is failure. **(3-character)**

(SafeC)

@Example

User command:	~063<CR>
Response:	!061123F0<CR>

06	Address ID
1	Host watchdog timer is enable.
12	Timeout value. 0x12 = 18
	18 * 53.3 = 959 ms (Firmware Version 1.x)
	18 * 100 = 1800 ms (Firmware Version 2.x)
3F0	0x3F0 is hexadecimal
	Analog output value is **4.923 mA** for 0-20mA
	Analog output value is **4.923 mA** for 4-20mA
	Analog output value is **2.462 V** for 0-10 V

User command:	~063<CR>
Response:	!06112800800800800<CR>

06	Address ID
1	Host watchdog timer is enable.
12	Timeout value. 0x12 = 18
	18 * 53.3 = 959 ms (Firmware Version 1.x)
	18 * 100 = 1800 ms (Firmware Version 2.x)
800	0x800 is hexadecimal
800	Analog output value is **0V** for port A
800	Analog output value is **0V** for port B
800	Analog output value is **0V** for port C
	Analog output value is **0V** for port D

3. 21. Host is OK

@Description

When host watchdog timer is enable, host computer must send this command to every module before timeout otherwise **“host watchdog timer enable”** module‘s output value will go to safety state output value.

Timeout value and safety state output value is defined in 3.14. “Set Host Watchdog Timer & Safety Value”

@Syntax

~<CR>**

~	Command leading code.
**	Host is OK.

@Response

Note : Host is OK command **has NO response.**

@Example

User command: ~**<CR>

4. Data Format

4. 1. Unit Conversion

The data value in the command of the analog output module is corresponding to the amplitude of the physical analog signal. The user should understand the data format to represent a analog signal by an ASCII string. The physical meaning of a data depends on both the unit conversion and the value. The unit conversion of the digits value can be configured by the setting configuration command. Three types of unit conversion are used in analog output modules.

1. Engineering units
2. Percent of FSR (Full Scale Range)
3. Hexdecimal

4. 2. Engineering Units

The date is in engineering unit when the bit 1 and 0 of the configuration register are ‘00’. The data string is composited by ***6*** characters. Because the output of ND-6021 is unipolar, the value is always positive.
The meaning of the value depends on the output range setting too. When the output range is set to 0~10V, the unit of the value is in ‘Volts’. When the output range is set to 0~20mA or 4~20mA, the unit of the value is in ‘mA’.

- Set bit 1 and bit 0 of data format variable to “00” means the data is represented in engineering units.
- Data string is fixed length of 6 characters. The value is composed of five decimal digits with a decimal fixed point.
- Two digits present the integer part and three present the fraction.

Example 4.2.1:

- If the output range is set as 0 to 20 mA
- The desired analog output value is +5.678 mA

The data value should be : **05.678<CR>**

Example 4.2.2:

- If the output range is set as 0 to 10 V
- The desired analog output value is +2.345 V

The data value should be : **02.345<CR>**

4. 3. Percent of FSR

The date is in percent of FSR(Full Scale Range) when the bit 1 and 0 of the configuration register are '01'. The data string is composited by ***6*** characters. Because the output of ND-6021 is unipolar, the value is always positive.
The value is unit-less and depends on the output range setting too.

- Set bit 1 and bit 0 of data format variable to "01" means the data is represented in percent of FSR.
- Data string is fixed length of 6 characters. The value is composed of five decimal digits with a decimal fixed point.
- Three digits present the integer part and two digits present the fraction
- Maximum resolution is 0.2%.

Example 4.3.1 :

- If the output range is set as 0 to 20 mA
- The desired analog output current is 10 mA

The data value should be : **050.00<CR>**

10 mA / 20 mA = 50.00 %

Example 4.3.2 :

- If the output range is set as 4 to 20 mA
- The desired analog output current is 10 mA

The data value should be : **037.50<CR>**

(10 mA - 4 mA) / (20 mA - 4mA) = 37.50 %

4. 4. Hexdecimal Format

The data is in hexdecimal format as the bit 1 and 0 are set as '10'. The data string length is ***3*** characters. It is equivilant to 12 binary bits. Because the output of ND-6021 is unipolar, the maximum value of the digits is FFF(H) and the minimum value of the digits is 000(H).
As the output range is set to 0~20mA, the value 'FFF(H)' represents 20mA and '000(H)' represents 0mA. Similarily, as the output range is set to 4~20mA, the value 'FFF(H)' represents 20mA and '000(H)' represents 4mA.

Example 4.3.1 :

- If the output range is set as 0 to 20 mA
- The desired analog output current is 10 mA

Two's complement hexdecimal : **7FF<CR>**

4. 5. Summary of Data Format

The following table shows the relation between the output range setting with the data format and the resolution.

Code	Output Range	Data Format	Maximum Value	Minimum Value	Output Resolution
30	0 to 20 mA	Eng. Units	20.000	00.000	4.88µA
31	4 to 20 mA	Eng. Units	20.000	04.000	4.88µA
32	0 to 10 V	Eng. Units	10.000	00.000	2.442 mV

Code	Output Range	Data Format	Maximum Value	Minimum Value	Output Resolution
30	0 to 20 mA	% of FSR	100.00	000.00	4.88µA
31	4 to 20 mA	% of FSR	100.00	000.00	4.88µA
32	0 to 10 V	% of FSR	100.00	000.00	2.442 mV

Code	Output Range	Data Format	Maximum Value	Minimum Value	Output Resolution
30	0 to 20 mA	Hexdecimal	FFF	000	4.88µA
31	4 to 20 mA	Hexdecimal	FFF	000	4.88µA
32	0 to 10 V	Hexdecimal	FFF	000	2.442 mV

5. Analog Output Calibration

5. 1. Calibration

The NuDAM analog output module needs to be calibrated. It has a factory default calibration . User can use NuDAM Adminstration utility to do any type of calibration.

5. 2. Analog Output Module Calibration

What do you need to do calibration ?

1. One 5 1/2 digit multimeter
2. A resistor 250 Ω (Accurary is 0.01 %).
3. NuDAM Aministration Utility

Calibration Procedure

1. Select output range to 0 ~20 mA or 4~20 mA.

2. Put the resistor 250 Ω to the NuDAM-6021 (+ IOUT (Pin.1) and -IOUT (Pin.2))

3. Put 5 1/2 digit multimeter to measure + IOUT (Pin.1) and -IOUT (Pin.2) .

4. Send the "**Analog Data Output** #(Addr)(OutData**)**" command with output value is **4 mA**. For example if the address is 0x03 then the command is **#0304.000**

5. Use "**Trim calibration** $(Addr)3(Counts)" command to adjust until the output value to **1 V (4 mA)**.

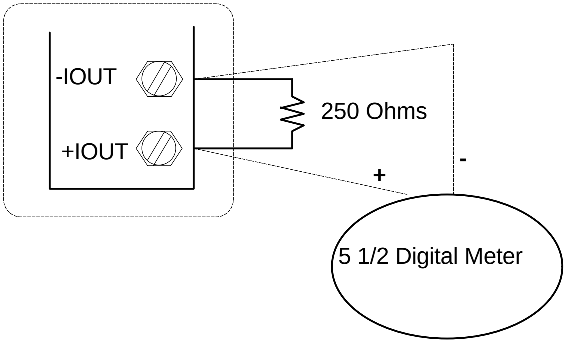
6. Send "**4mA Calibration** $(Addr)0" command to the analog output module to complete the 4 mA calibration.

7. Send the “**Analog Data Output** #(Addr)(OutData**)**” command with output value is **20 mA**. For example if the address is 0x03 then the command is **#0320.000**

8. Use “**Trim calibration** $(Addr)3(Counts)” command to adjust until the output value to **5 V (20 mA)**.

9. Send “**20mA Calibration** $(Addr)1” command to the analog output module to complete the 20 mA calibration.

Calibration wiring of NuDAM-6021



NuDAM-6050	**NuDAM-6052**
NuDAM-6053	**NuDAM-6054**
NuDAM-6056	**NuDAM-6058**
NuDAM-6060	**NuDAM-6063**

Analog Input Modules

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☐ OS: ☐ Computer Brand:
☐ M/B: CPU: Chipset: Bios:
☐ Video Card:
☐ Network Interface Card:
☐ Problem Description:

☐ Any Suggestion is appreciated:

Contents

1. Introduction

1. 1. About the NuDAM DIO Modules

The NuDAM provides a series of digital input or output (DIO) modules to sense the digital signal or to control the remote devices.

The specified features of each module are shown here.

- NuDAM-6050 : Digital I/O module
- NuDAM-6052 : Isolated digital input module
- NuDAM-6053 : 16-channel digital input module
- NuDAM-6054 : 15-channel isolated digital input module
- NuDAM-6056 : 15-channel isolated digital output module
- NuDAM-6058 : 28 programmable digital I/O module
- NuDAM-6060 : relay output and isolated digital input module
- NuDAM-6063 : 8-channel relay output module

1. 2. Overview of NuDAM-6050

What is NuDAM-6050 ?

NuDAM-6050 is a digital input and output module. The digital input channels can monitor active TTL signals, and sense passive switch on/off signal because of the internal pull high resistors. The convenient open collector output channels can sink up to 50 mA current. Combining with the relay devices, it is possible to control the high power devices by programming output channel of the NuDAM-6050.

Features of NuDAM-6050

- 7 bits digital input
- 8 bits open collector digital output
- Programmable host watchdog timer for host failure protection
- Internal watchdog timer for device failure protection
- Easy programming by software
- Easy installation and wiring

Specifications of NuDAM-6050

✧ Interface

- Interface : RS-485, 2 wires
- Speed (bps) : 1200, 2400, 4800, 9600, 19.2K, 38.4K, 115.2K (115.2K only for firmware reversion above A4.00)

✧ Digital Input

- Channel numbers : 7
- Logical level 0 : +1V maximum
- Logical level 1: +3.5V~30V
- Pull up resister : 10KΩ
- Maximum current : 0.5mA

✧ Digital Output

- Channel numbers : 8
- Output characteristic : open collector transistor
- Maximum current sink : 50mA
- Max. power dissipation : 300mW

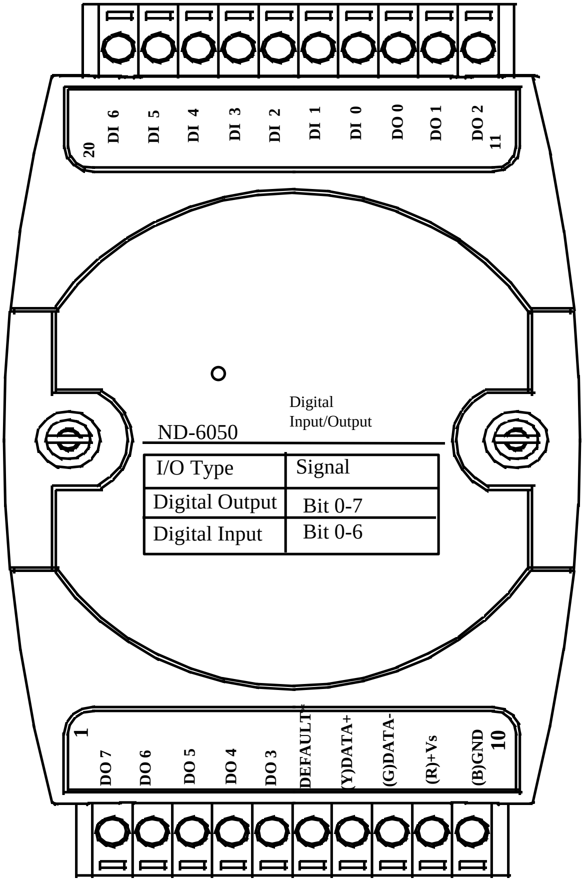
✧ Watchdog Function

- Module internal watchdog timer: 150 ms
- Power failure threshold : 4.65 V
- Safety value : 8 output channels
- Host programmable watchdog :
  100 ms ~ 25.500 sec

✧ Power

- Power supply : +10V to +30V
- Current consumption : 0.5 W

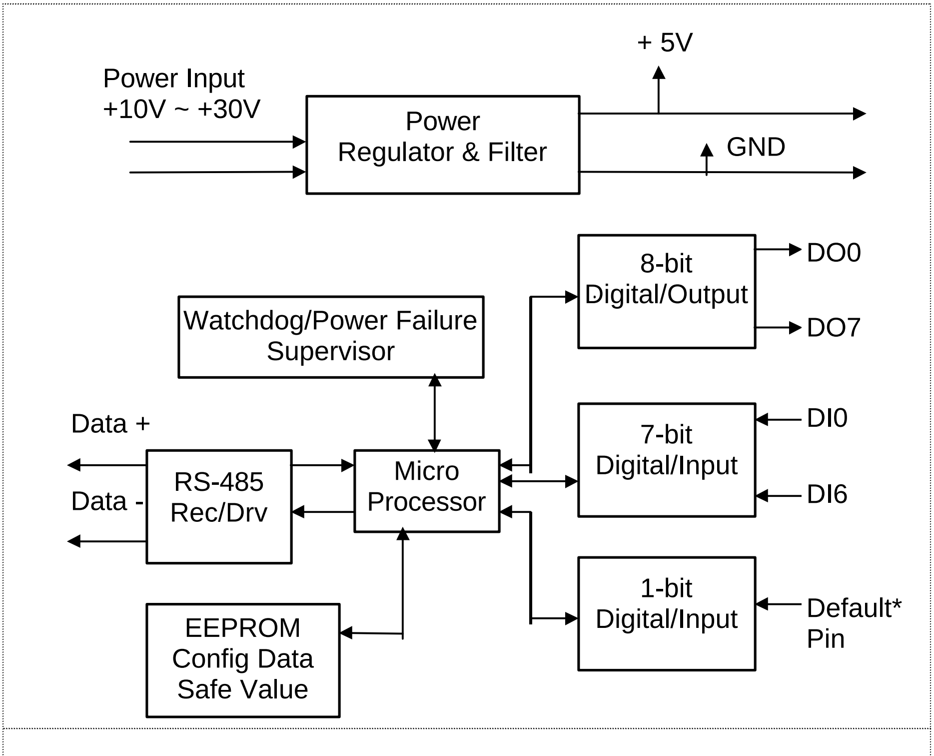
A Look at ND-6050 & Pin Assignment



Pin Definitions of NuDAM-6050

Pin #	Signal Name	Description
1	DO 7	Digital output channel 7
2	DO 6	Digital output channel 6
3	DO 5	Digital output channel 5
4	DO 4	Digital output channel 4
5	DO 3	Digital output channel 3
6	Default*	Initial state setting
7	(Y) DATA+	RS-485 series signal, positive
8	(G) DATA-	RS-485 series signal, negative
9	(R) +Vs	Power supply, +10V~+30V
10	(B) GND	Ground
11	DO 2	Digital output channel 2
12	DO 1	Digital output channel 1
13	DO 0	Digital output channel 0
14	DI 0	Digital input channel 0
15	DI 1	Digital input channel 1
16	DI 2	Digital input channel 2
17	DI 3	Digital input channel 3
18	DI 4	Digital input channel 4
19	DI 5	Digital input channel 5
20	DI 6	Digital input channel 6

ND-6050 Functional Block Diagram



1. 3. Overview of NuDAM-6052

What is NuDAM-6052 ?

NuDAM-6052 provides 8 isolated digital input channels. Six of the input channels are differential type and two of them are single-ended with common ground. The isolation voltage is up to 5000 Vrms. It is suitable to use NuDAM-6052 in industrial environment with the dangerous of high voltage electric shock.

Features of NuDAM-6052

- 8 bits isolated input
- 5000 Vrms isolation voltage
- Programmable host watchdog timer for host failure protection
- Internal watchdog timer for device failure protection
- Easy programming by software
- Easy installation and wiring

Specifications of NuDAM-6052

✧ **Interface**

- Interface : RS-485, 2 wires
- Speed (bps) : 1200, 2400, 4800, 9600, 19.2K, 38.4K, 115.2K (115.2K only for firmware reversion above A4.00)

✧ **Input**

- Channel numbers : 6 differential channels, 2 single ended
- Logical level 0 : +1V Max.
- Logical level 1: +3.5V ~ +24V

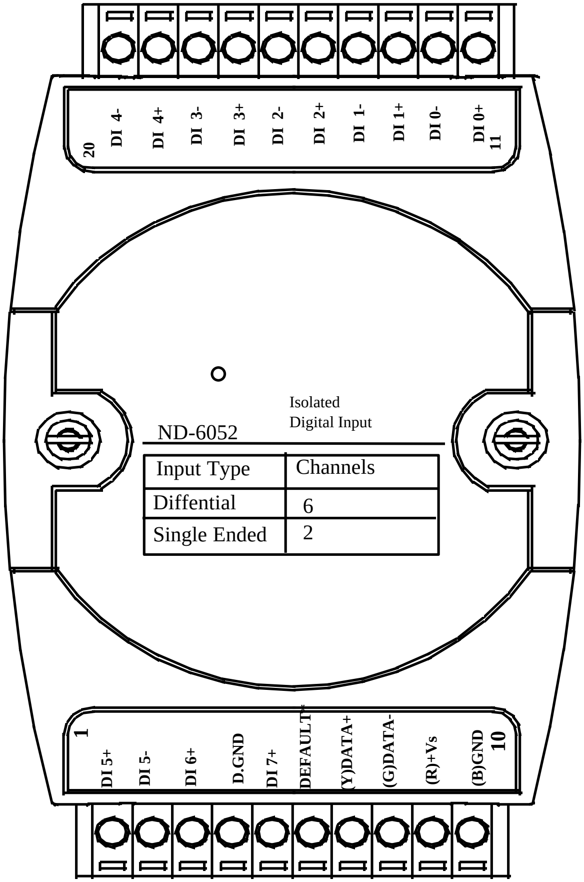
✧ **Watchdog Function**

- Module internal watchdog timer : 150ms
- Power failure threshold : 4.65 V
- Safe value : 8 output channels
- Host programmable watchdog :100 ms ~ 25.5 sec

✧ **Power**

- Power supply : +10V to +30V
- Current consumption : 0.4 W

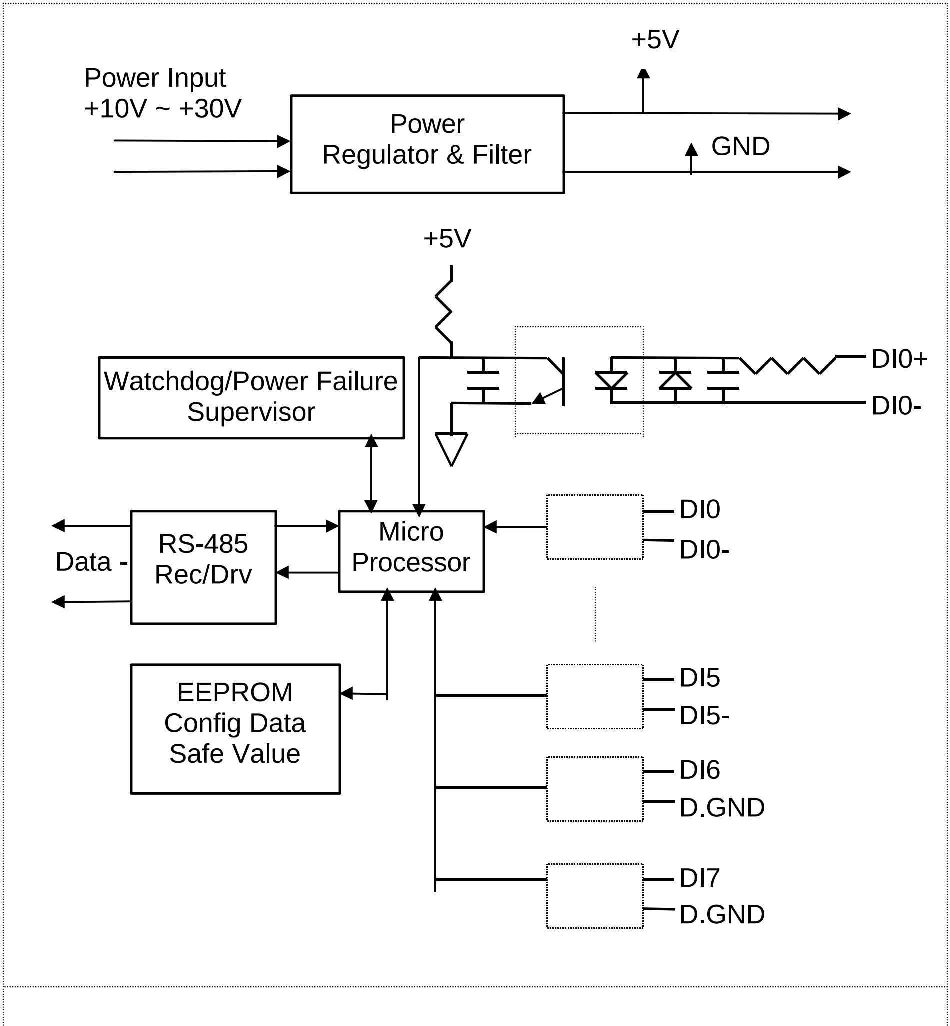
A Look at ND-6052 & Pin Assignment



Pin Definitions of NuDAM-6052

Pin #	Signal Name	Description
1	DI5+	Digital Input Channel 5+
2	DI5 -	Digital Input Channel 5 -
3	DI6+	Digital Input Channel 6+
4	D.GND	Digital Input Ground
5	DI7+	Digital Input Channel 7+
6	Default*	Initial state setting
7	(Y) DATA+	RS-485 series signal, positive
8	(G) DATA-	RS-485 series signal, negative
9	(R) +VS	Power supply, +10V~+30V
10	(B) GND	Ground
11	DI0+	Digital Input Channel 0+
12	DI0 -	Digital Input Channel 0 -
13	DI1+	Digital Input Channel 1+
14	DI1 -	Digital Input Channel 1 -
15	DI2+	Digital Input Channel 2+
16	DI2 -	Digital Input Channel 2 -
17	DI3+	Digital Input Channel 3+
18	DI3 -	Digital Input Channel 3 -
19	DI4+	Digital Input Channel 4+
20	DI4 -	Digital Input Channel 4 -

ND-6052 Functional Block Diagram



1. 4. Overview of NuDAM-6053

What is NuDAM-6053 ?

NuDAM-6053 provides 16 digital input channels for dry contact or wet contact signals. The effective distance from DI to contact point is up to 500m for dry contact input.

Features of NuDAM-6053

- 16 bits digital input
- Programmable host watchdog timer for host failure protection
- Internal watchdog timer for device failure protection
- Easy programming by software
- Easy installation and wiring

Specifications of NuDAM-6053

✧ Interface

- Interface : RS-485, 2 wires
- Speed (bps) : 1200, 2400, 4800, 9600, 19.2K, 38.4K, 115.2K (115.2K only for firmware reversion above A4.00)

✧ Input

- Channel numbers : 16
- Dry Contact:
  Logical level 0: close to GND
  Logical level 1: open
- Wet Contact:
  Logical level 0: +2V max.
  Logical level 1: +4V ~ + 30V

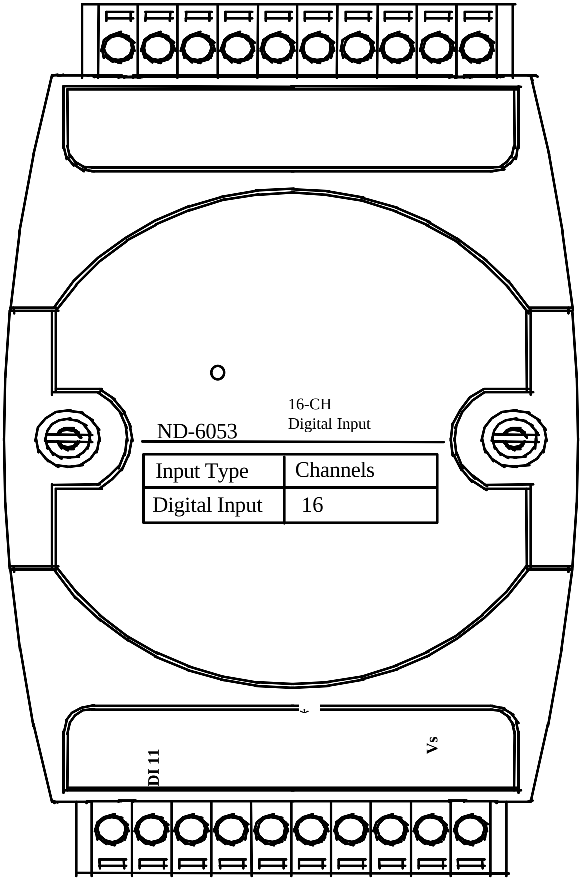
✧ Watchdog Function

- Module internal watchdog timer : 150ms
- Power failure threshold : 4.65 V
- Host programmable watchdog :100 ms ~ 25.5 sec

✧ Power

- Power supply : +10V to +30V
- Current consumption : 0.4 W

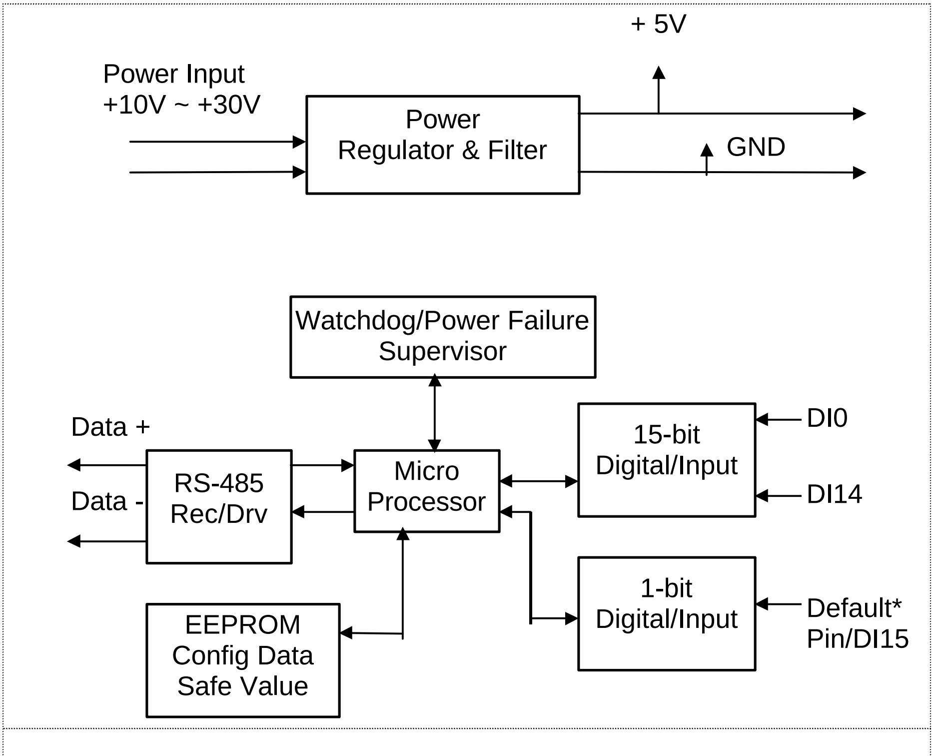
A Look at ND-6053 & Pin Assignment



Pin Definitions of NuDAM-6053

Pin #	Signal Name	Description
1	DI10	Digital Input Channel 10
2	DI11	Digital Input Channel 11
3	DI12	Digital Input Channel 12
4	DI13	Digital Input Channel 13
5	DI14	Digital Input Channel 14
6	Default* /DI15	Initial state setting / Digital Input Channel 15
7	(Y) DATA+	RS-485 series signal, positive
8	(G) DATA-	RS-485 series signal, negative
9	(R) +VS	Power supply, +10V~+30V
10	(B) GND	Ground
11	DI0	Digital Input Channel 0
12	DI1	Digital Input Channel 1
13	DI2	Digital Input Channel 2
14	DI3	Digital Input Channel 3
15	DI4	Digital Input Channel 4
16	DI5	Digital Input Channel 5
17	DI6	Digital Input Channel 6
18	DI7	Digital Input Channel 7
19	DI8	Digital Input Channel 8
20	DI9	Digital Input Channel 9

ND-6053 Functional Block Diagram



1. 5. Overview of NuDAM-6054

What is NuDAM-6054 ?

NuDAM-6054 provides 15 isolated digital input channels. All of the input channels are common power type and one of them is using the same pin with default (use jumper to choose). The isolation voltage is up to 5000 Vrms. It is suitable to use NuDAM-6054 in industrial environment with the dangerous of high voltage electric shock.

Features of NuDAM-6054

- 15 bits digital inputs with isolation protection and common power
- 5000 Vrms isolation voltage
- Programmable host watchdog timer for host failure protection
- Internal watchdog timer for device failure protection
- Easy programming by software
- Easy installation and wiring

Specifications of NuDAM-6054

✧ **Interface**

- Interface : RS-485, 2 wires
- Speed (bps) : 1200, 2400, 4800, 9600, 19.2K, 38.4K, 115.2K (115.2K only for firmware reversion above A4.00)

✧ **Input**

- Channel numbers : 15 isolation common power input channels (the fifteenth channel is the same with default pin, but can use jumper to choose).
- Input type : source type .
  Effective distance: 500 m.
- Common external voltage: 24V.

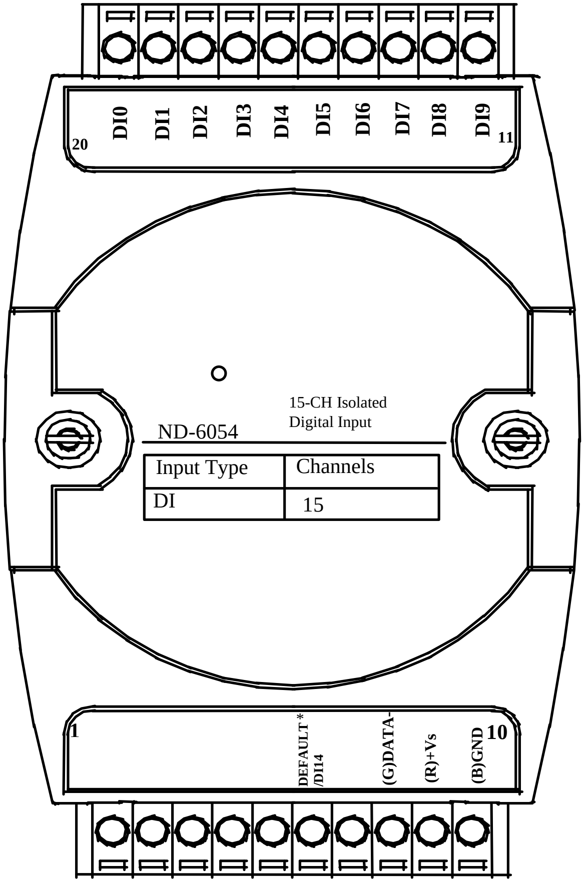
✧ **Watchdog Function**

- Module internal watchdog timer : 150msec
- Power failure threshold : 4.65 V
- Host programmable watchdog :100 ms ~ 25.5 sec

✧ **Power**

- Power supply : +10V to +30V
- Power consumption : 0.4 W

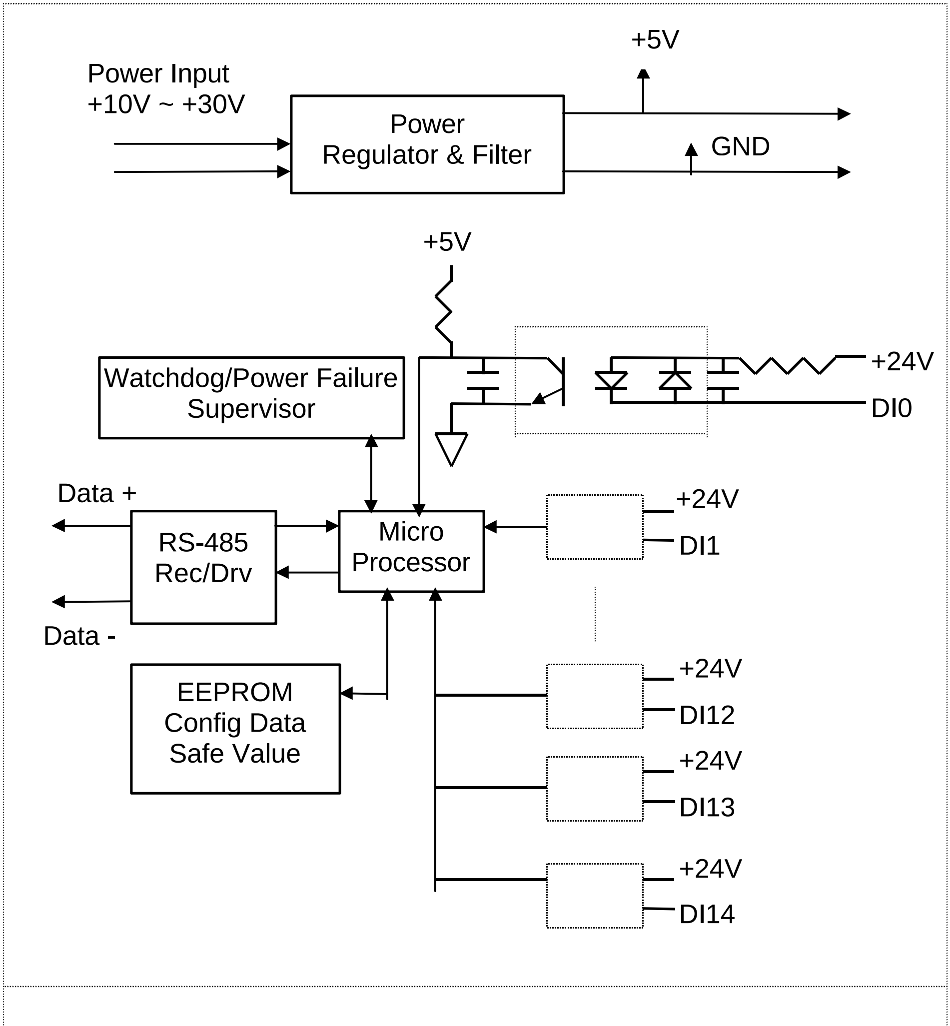
A Look at ND-6054 & Pin Assignment



Pin Definitions of NuDAM-6054

Pin #	Signal Name	Description
1	DI10	Digital input channel 10
2	DI11	Digital input channel 11
3	DI12	Digital input channel 12
4	DI13	Digital input channel 13
5	Ext24V	External common +24V
6	Default*/DI14	Initial state setting or digital input channel 14
7	(Y) DATA+	RS-485 series signal, positive
8	(G) DATA-	RS-485 series signal, negative
9	(R) +VS	Power supply, +10V~+30V
10	(B) GND	Ground
11	DI9	Digital input channel 9
12	DI8	Digital input channel 8
13	DI7	Digital input channel 7
14	DI6	Digital input channel 6
15	DI5	Digital input channel 5
16	DI4	Digital input channel 4
17	DI3	Digital input channel 3
18	DI2	Digital input channel 2
19	DI1	Digital input channel 1
20	DI0	Digital input channel 0

ND-6054 Functional Block Diagram



1. 6. Overview of NuDAM-6056

What is NuDAM-6056 ?

NuDAM-6056 provides 15 isolated digital output channels. All of the output channels are common ground type and one of them is use the same pin with default (use jumper to choose). The isolation voltage is up to 5000 Vrms. It is suitable to use NuDAM-6056 in industrial environment with the dangerous of high voltage electric shock.

Features of NuDAM-6056

- 15 bits digital open collector output with isolation protection and common ground
- 5000 Vrms isolation voltage
- Programmable host watchdog timer for host failure protection
- Internal watchdog timer for device failure protection
- Easy programming by software
- Easy installation and wiring

Specifications of NuDAM-6056

✧ **Interface**

- Interface : RS-485, 2 wires
- Speed (bps) : 1200, 2400, 4800, 9600, 19.2K, 38.4K, 115.2K (115.2K only for firmware reversion above A4.00)

✧ **Digital Output**

- Channel numbers : 15 isolation common ground output channels(the fifteenth channel is the same with default pin,but could use jumper to choose).
- Output characteristic:open collector transistor.
- Maximum current sink:50mA
  Max.power dissiation:200mW
  Isolation Voltage:5000Vrms

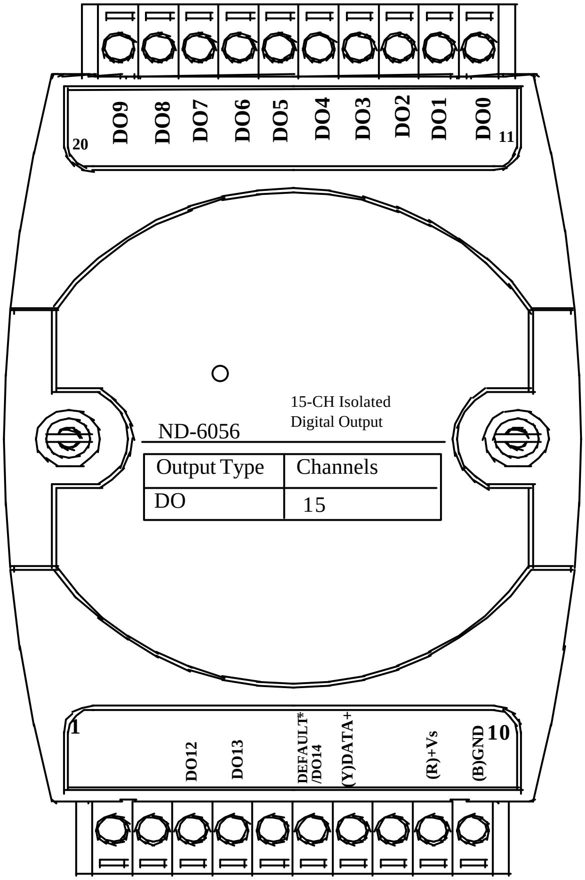
✧ **Watchdog Function**

- Module internal watchdog timer : 150msec
- Power failure threshold : 4.65 V
- Safe value : 15 output channels
- Host programmable watchdog :100 ms ~ 25.5 sec

✧ **Power**

- Power supply : +10V to +30V
- Current consumption : 0.3 W

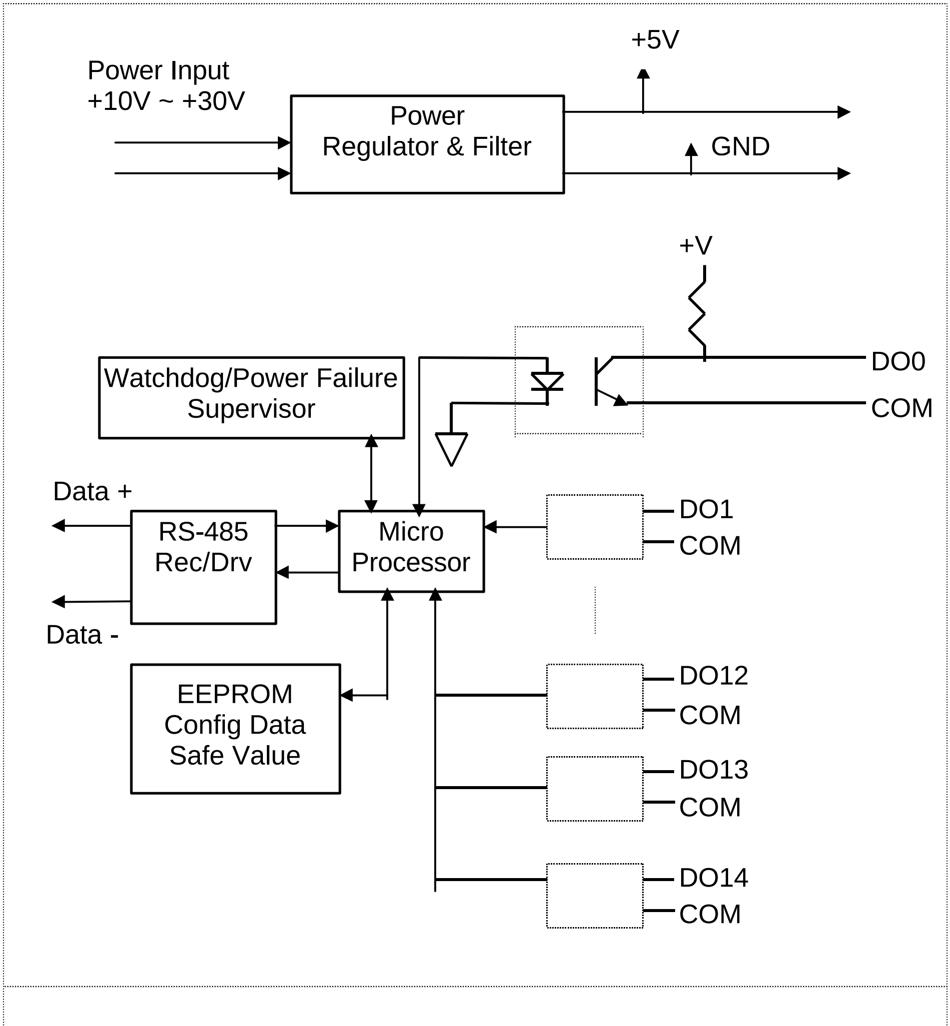
A Look at ND-6056 & Pin Assignment



Pin Definitions of NuDAM-6056

Pin #	Signal Name	Description
1	DO10	Digital output channel 10
2	DO11	Digital output channel 11
3	DO12	Digital output channel 12
4	DO13	Digital output channel 13
5	ExtGND	
6	Default*/ DO14	Initial state setting Digital output channel 14
7	(Y) DATA+	RS-485 series signal, positive
8	(G) DATA-	RS-485 series signal, negative
9	(R) +VS	Power supply, +10V~+30V
10	(B) GND	Ground
11	DO0	Digital output channel 0
12	DO1	Digital output channel 1
13	DO2	Digital output channel 2
14	DO3	Digital output channel 3
15	DO4	Digital output channel 4
16	DO5	Digital output channel 5
17	DO6	Digital output channel 6
18	DO7	Digital output channel 7
19	DO8	Digital output channel 8
20	DO9	Digital output channel 9

ND-6056 Functional Block Diagram



1. 7. Overview of NuDAM-6058

What is NuDAM-6058 ?

NuDAM-6058 provides 28 digital I/O channels. It emulates industry standard mode zero configuration of 8255 programmable peripheral interface (PPI) chip. The PPI offers 3 ports A, B and C, the C port can also be subdivided into 2 nibble-wide (4-bit) port – C upper and C lower. A 50 pin SCSI connector equipped with ND-6058 which is corresponding to PPI chip with 24 DIO points.

Features of NuDAM-6058

- Industry standard 8255 programmable peripheral interface mode 0 emulation
- 24 Programmable I/O channels
- 4 dedicated input channels
- Completely TTL compatible I/O lines
- Status read-back capability
- Direct bit set/reset capability
- Buffered circuits for higher driving capability
- Direct interface with OPTO-22 compatible I/O module
- Programmable host watchdog timer for host failure protection
- Internal watchdog timer for device failure protection
- On board resetable fuse to protect power supply form external devices
- Easy programming by software
- Easy installation and wiring

Specifications of NuDAM-6058

✧ **Interface**

- Interface : RS-485, 2 wires
- Speed (bps) : 1200, 2400, 4800, 9600, 19.2K, 38.4K, 115.2K (115.2K only for firmware reversion above A4.00)

✧ **Programmable Digital Input/Output**

- Channel numbers : 24
- Input Signal:

Logical level 0 : -0.5 ~ 0.8 V
Logical level 1: 2.0 ~ 5.25 V

- Output Signal:
  Logical level 0: 0.5 V Maximum
  Logical level 1: 2.4 V Minimum Digital Output

✧

✧ **Watchdog Function**

- Module internal watchdog timer : 150msec
- Power failure threshold : 4.65 V
- Safe value : 15 output channels
- Host programmable watchdog :100 ms ~ 25.5 sec

✧

✧ **Dedicated Digital Input**

- Channel numbers : 4
- Input Signal:
  Logical level 0: 2 V max.
  Logical level 1: 3 V ~ 5.25 V

✧

✧ **Connector**

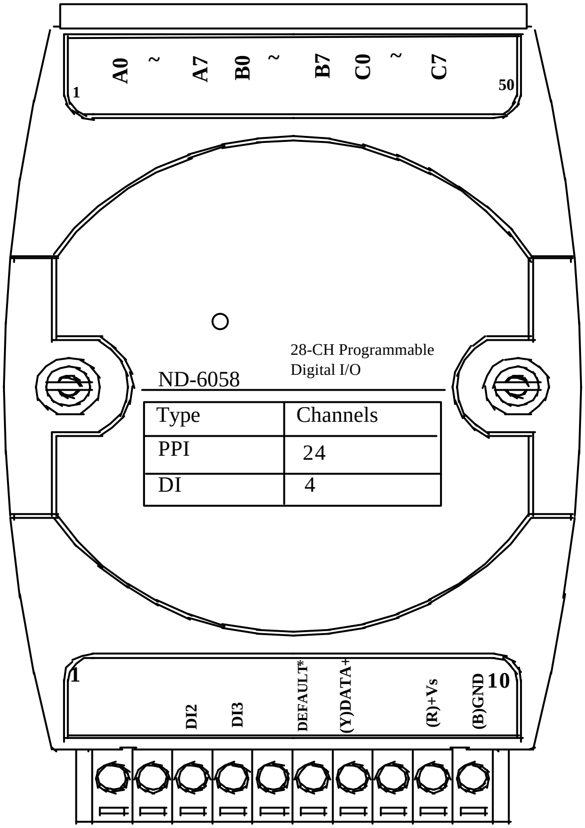
- 10-pin skew terminal block
- 50-pin SCSI II connector

✧

✧ **Power**

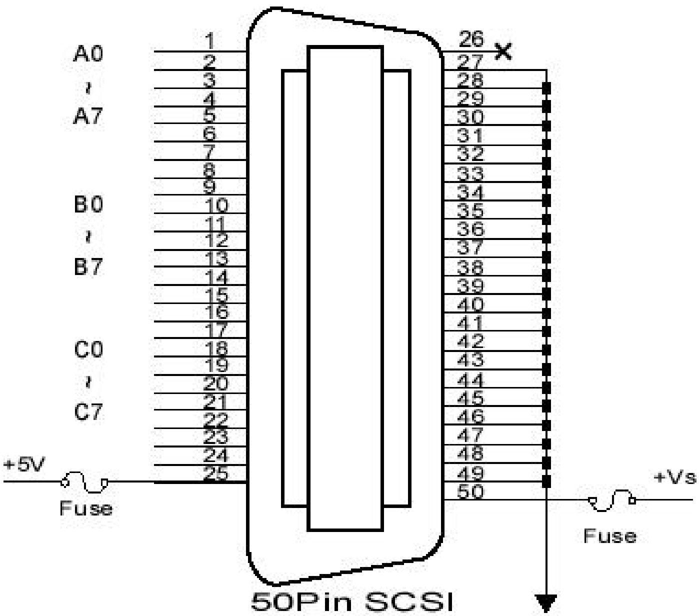
- Power supply : +10V to +30V
- Current consumption: 1.7 W

A Look at ND-6058 & Pin Assignment

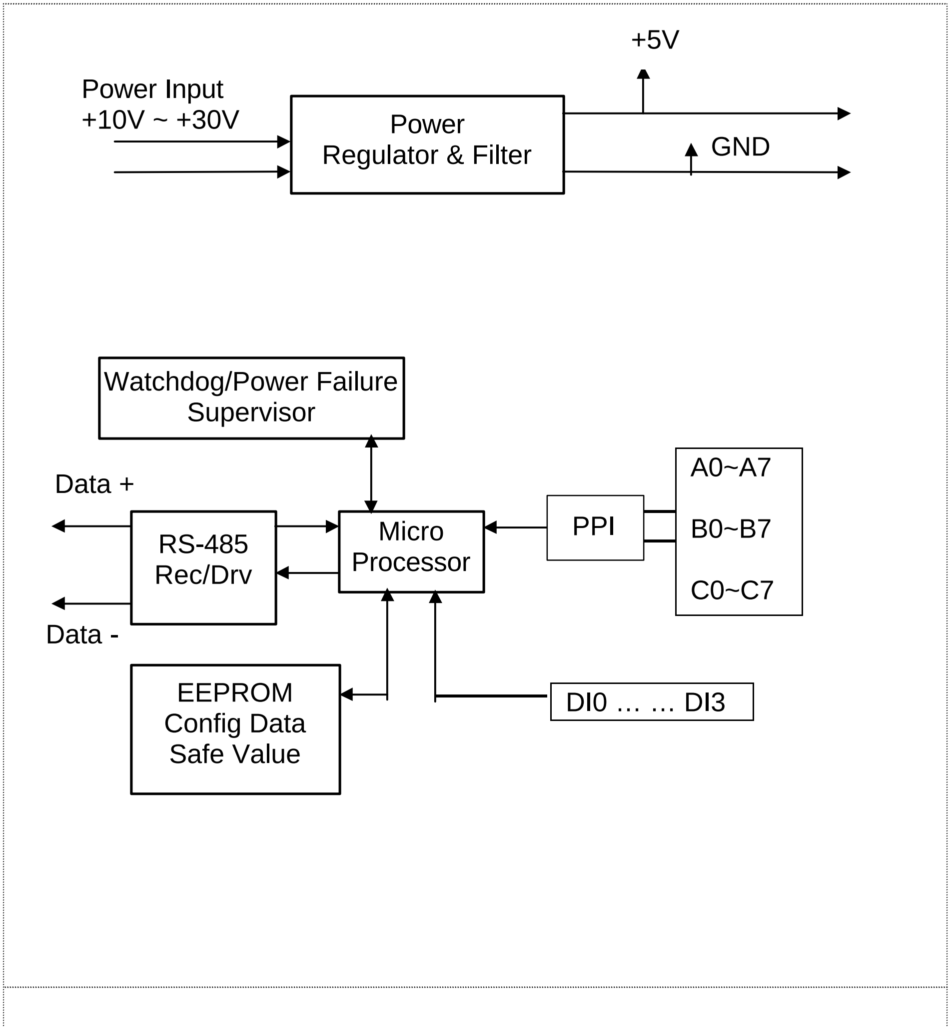


Pin Definitions of NuDAM-6058

Pin #	Signal Name	Description
1	DI0	Digital input channel 0
2	DI1	Digital input channel 1
3	DI2	Digital input channel 2
4	DI3	Digital input channel 3
5		
6	Default*	Initial state setting
7	(Y) DATA+	RS-485 series signal, positive
8	(G) DATA-	RS-485 series signal, negative
9	(R) +VS	Power supply, +10V~+30V
10	(B) GND	Ground



ND-6058 Functional Block Diagram



1. 8. Overview of NuDAM-6060

What is NuDAM-6060 ?

NuDAM-6060 provides four relay output channels, two are form A and two are form C. It can control high power devices without external circuits. The isolation guarantees the industrial safety.

Features of NuDAM-6060

- 4 channels relay output
- 4 channels isolated digital input
- Programmable host watchdog timer for host failure protection
- Internal watchdog timer for device failure protection
- Easy programming by software
- Easy installation and wiring

Specifications of NuDAM-6060

✧ **Interface**

- Interface : RS-485, 2 wires
- Speed (bps) : 1200, 2400, 4800, 9600, 19.2K, 38.4K, 115.2K (115.2K only for firmware reversion above A4.00)

✧ **Input**

- Channel numbers : 4
- Common External Voltage : +24 V
- Input Type : Source Type

✧ **Output**

- Channel numbers : 4 relay output
- Output type : 2 form C channels, 2 form A channels
- Contact rating : AC 0.6A /125 V, 0.3A / 250V
  DC 2A / 30V, 0.6A / 110V
- Relay ON/OFF time interval : 3 ms / 1ms
- Breakdown voltage : 500 V
- Expected life : 10^8 times
- Insulation resistance : 1000 MΩ minimum

✧ Watchdog Function

- Module internal watchdog timer : 150ms
- Power failure threshold : 4.65 V
- Safety value : 4 output channels
- Host programmable watchdog : 100 ms ~ 25.5 sec

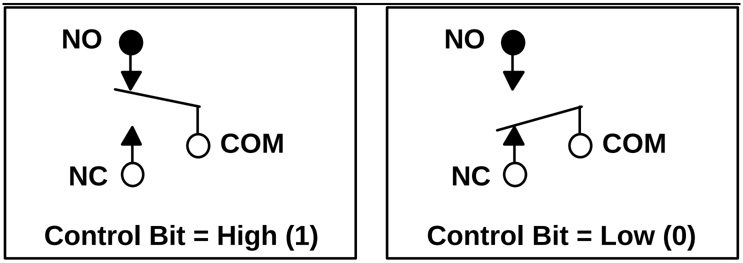
✧ Power

- Power supply : +10V to +30V
- Current consumption : 0.8 W

Using Relay Output

The ND-6060 contains two types of relay : Form C and Form A. The relay R3 and R4 are form C relays, and R1 and R2 are plain form A type. The difference between these two types of relay are:

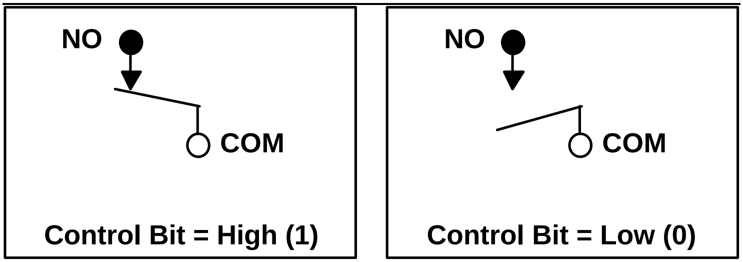
1. Form C Relay : (R3, R4)



Form C relay has three contacts : NC (Normal Close), NO (Normal Open), and COM(Common). The CM post, located at the middle, can make contact either NO post or NC post. When the control bit is high (1), the COM post and NO post are contacted. If the control bit is low (0), the COM post and NC post make contact.

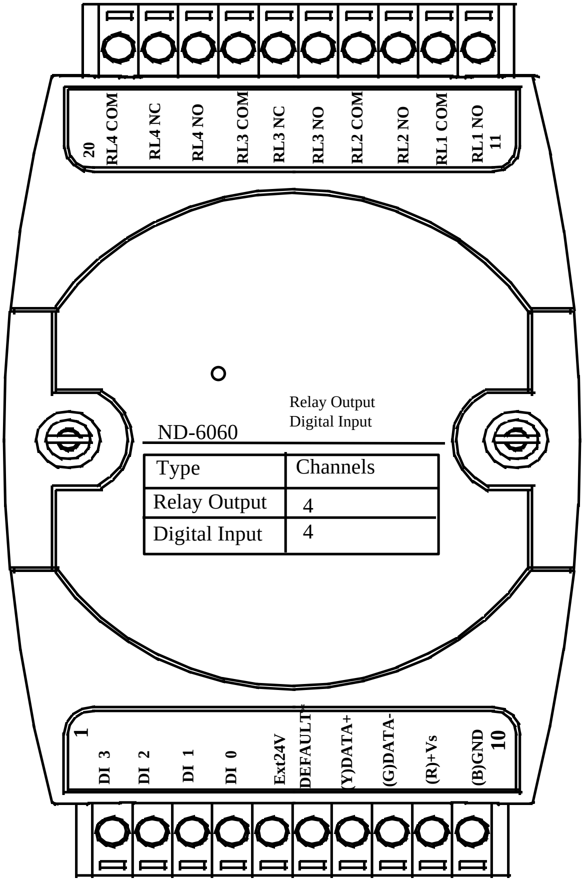
In normal power-up and reset, the relay is in ***low*** status.

2. Form A Relay : (R1, R2)



Form A relay only has two contacts : NO (Normal Open) and COM(Common). The COM post can make contact either NO post or not contact NO post. When the control bit is high (1), the COM post and NO post are contacted. If the control bit is low (0), the COM post and NO post does not make contact.
In normal power-up and reset, the relay is in ***low*** status.

A Look at ND-6060 & Pin Assignment

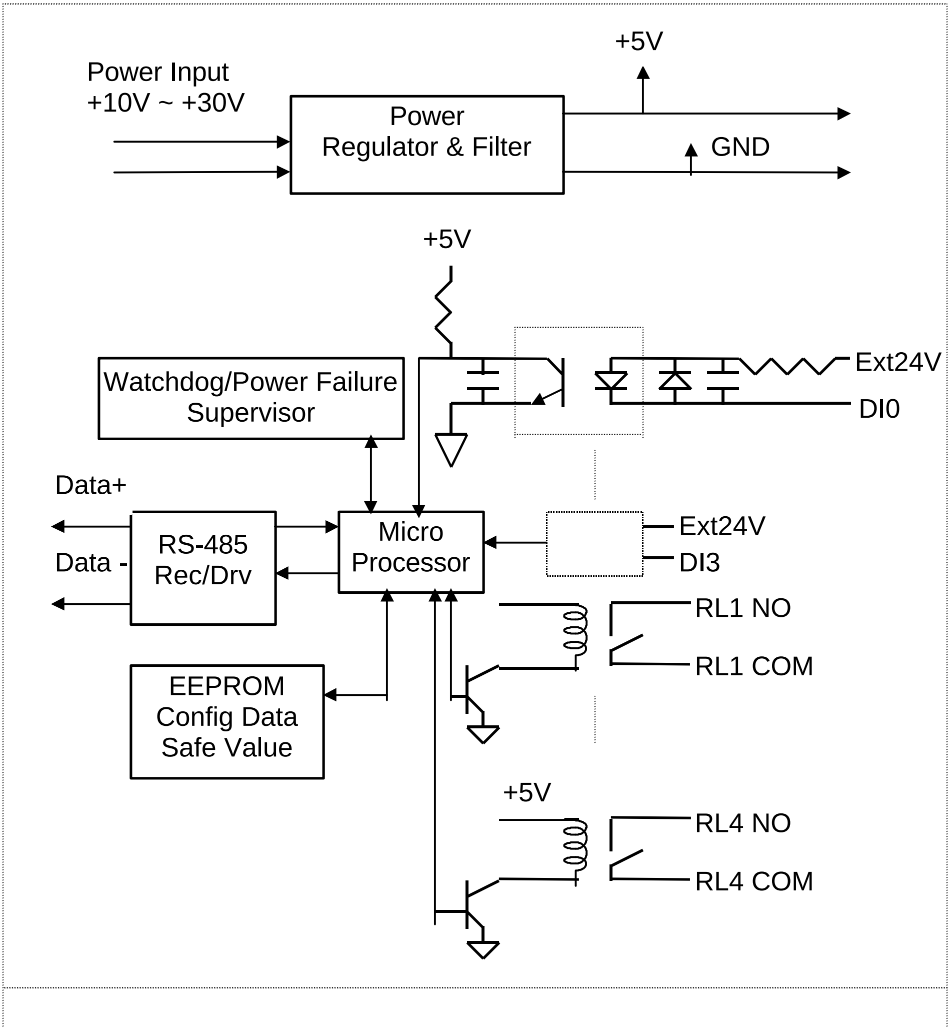


Type	Channels
Relay Output	4
Digital Input	4

Pin Definitions of NuDAM-6060

Pin #	Signal Name	Description
1	DI3	Digital Input Channel 3
2	DI2	Digital Input Channel 2
3	DI1	Digital Input Channel 1
4	DI0	Digital Input Channel 0
5	Ext24	External Common +24V
6	Default*	Initial state setting
7	(Y) DATA+	RS-485 series signal, positive
8	(G) DATA-	RS-485 series signal, negative
9	(R) +VS	Power supply, +10V~+30V
10	(B) GND	Ground
11	RL1 NO	Relay 1, normal open
12	RL1 COM	Relay 1, common ground
13	RL2 NO	Relay 2, normal open
14	RL2 COM	Relay 2, common ground
15	RL3 NO	Relay 3, normal open
16	RL3 NC	Relay 3, normal close
17	RL3 COM	Relay 3, common ground
18	RL4 NO	Relay 4, normal open
19	RL4 NC	Relay 4, normal close
20	RL4 COM	Relay 4, common ground

ND-6060 Functional Block Diagram



1. 9. Overview of NuDAM-6063

What is NuDAM-6063 ?

NuDAM-6063 provides eight from A relay output channels. It can control high power devices without external circuits.

Features of NuDAM-6063

- 8 channel relay output
- Programmable host watchdog timer for host failure protection
- Internal watchdog timer for device failure protection
- Easy programming by software
- Easy installation and wiring

Specifications of NuDAM-6063

✧ **Interface**

- Interface : RS-485, 2 wires
- Speed (bps) : 1200, 2400, 4800, 9600, 19.2K, 38.4K, 115.2K (115.2K only for firmware reversion above A4.00)

✧ **Digital Output**

- Channel numbers : 8
- Output Type: 8 form A channels
  Contact rating: AC 0.5A / 125V
  DC 1A / 30V
  Relay ON/OFF time interval:
  3ms / 3ms
  Breakdown voltage: 1000Vrms
  Expected life: 10^7

✧ **Insulation Resistance: 1,000 MΩ**

✧ **Watchdog Function**

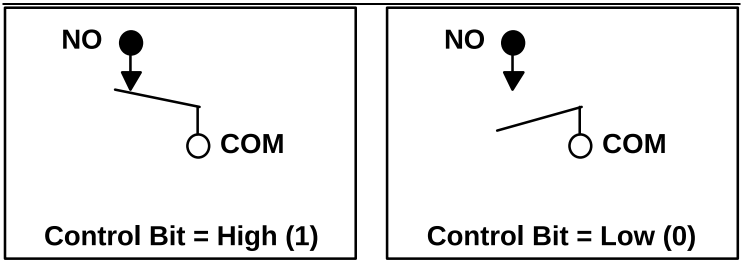
- Module internal watchdog timer : 150ms
- Power failure threshold : 4.65 V
- Safety value : 8 output channels
- Host programmable watchdog : 100 ms ~ 25.5 sec

✧ Power

- Power supply : +10V to +30V
- Current consumption : 1.2 W

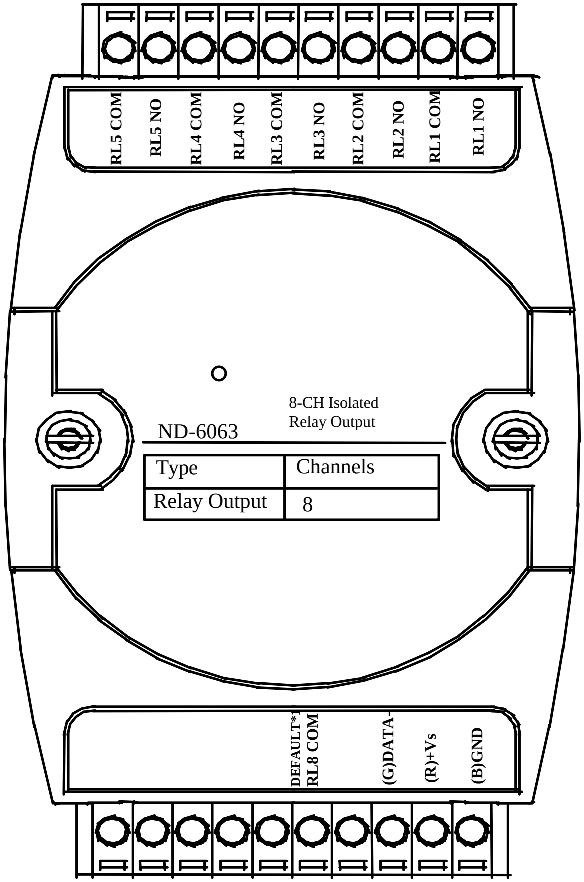
Using Relay Output

Form A Relay :



Form A relay only has two contacts : NO (Normal Open) and COM(Common). The COM post can make contact either NO post or not contact NO post. When the control bit is high (1), the COM post and NO post are contacted. If the control bit is low (0), the COM post and NO post does not make contact.
In normal power-up and reset, the relay is in ***low*** status.

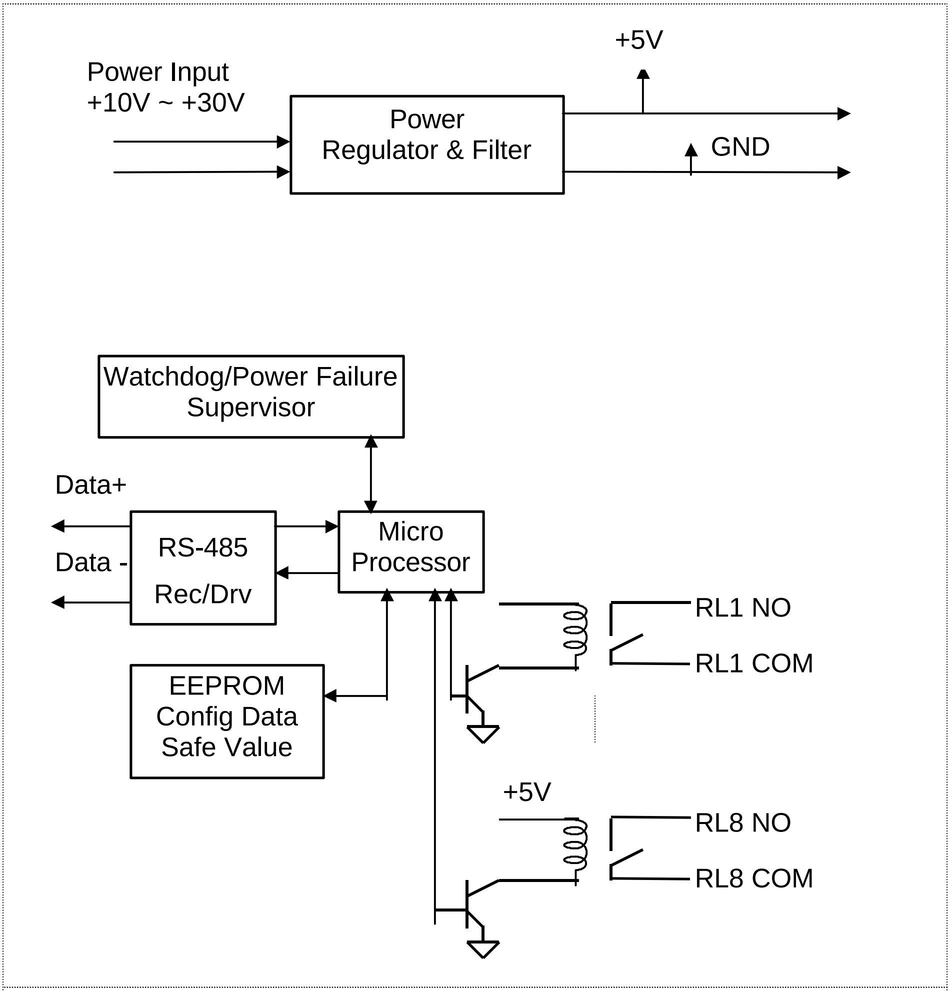
A Look at ND-6063 & Pin Assignment



Pin Definitions of NuDAM-6063

Pin #	Signal Name	Description
1	RL6 NO	Relay 6, normal open
2	RL6 COM	Relay 6, common ground
3	RL7 NO	Relay 7, normal open
4	RL7 COM	Relay 7, common ground
5	RL8 NO	Relay 8, normal open
6	Default*	Initial state setting
	/ RL8 NO	Relay 8, normal open
7	(Y) DATA+	RS-485 series signal, positive
8	(G) DATA-	RS-485 series signal, negative
9	(R) +VS	Power supply, +10V~+30V
10	(B) GND	Ground
11	RL1 NO	Relay 1, normal open
12	RL1 COM	Relay 1, common ground
13	RL2 NO	Relay 2, normal open
14	RL2 COM	Relay 2, common ground
15	RL3 NO	Relay 3, normal open
16	RL3 COM	Relay 3, common ground
17	RL4 NO	Relay 4, normal open
18	RL4 COM	Relay 4, common ground
19	RL5 NO	Relay 5, normal open
20	RL5 COM	Relay 5, common ground

ND-6063 Functional Block Diagram



2. Initialization & Installation

2. 1. Software Installation

1. If you have already installed “NuDAM Administration” then skip other steps.
2. Backup your software diskette.
3. Insert “NuDAM Administration” disc into CD-ROM:
4. Change drive to the path of CD-ROM. For example, your drive of CD-ROM is F:, then change the drive to F:
5. Find the setup of NuDAM Administration and run it.
6. Please follow the steps of setup program then you can successful to install the nudism Administration.

2. 2. Initializing a Brand-New Module

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:

- Address ID is 01.
- Baud rate is 9600 bps
- Check-sum disable
- Host Watchdog timer is disable

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

The following sections show how to initialize a brand-new module, which is applicable for initializing NuDAM-6050, NuDAM-6052, NuDAM-6053, NuDAM-6054, NuDAM-6056, NuDAM-6058, NuDAM-6060, and NuDAM-6063.

Default State

The NuDAM I/O modules must be set at *Default State* when you want to change the default settings, 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 in *Default State* if the **DEFAULT*** pin is shorted to ground when power ON. Under this state, the default configuration is set as following:

- Address ID is 00.
- Baud rate is 9600 bps.
- Check-sum disable.

Therefore, the communication between host and the module will can be easily set as the same configuration, the initialization of a module will be possible no matter what configuration is set under operating state.
For ND-6053, ND-6054 and ND-6056, the pin 6 is used for both DI15(DO15) and DEFAULT, and also the ND-6063, the pin 6 is used for both RL8 COM and DEFAULT*. The jumper setting is as below, and the default setting is DI15(D015) or RL8 COM. When you want to use ND-6053, ND-6054, ND-6056 or ND-6063 as Default*, you should open the module case to set the JP2.*

DI15, DO15, RL8 COM **INIT***

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
- Administration utility software

Note1: Never Connect the DRFAULT* pin to Vs or power source just left it open or wired to GND.

Initialization Procedure

1. Power off the host computer and the installed NuDAM-6520. Be sure of the baud rate of the NuDAM-6520 is 9600 bps.
2. Connect a brand new NuDAM module with the RS-485. Set the module in *Default State* by shorting the **DEFAULT*** pin. Refer to Figure 2.1 for detailed 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 Wiring

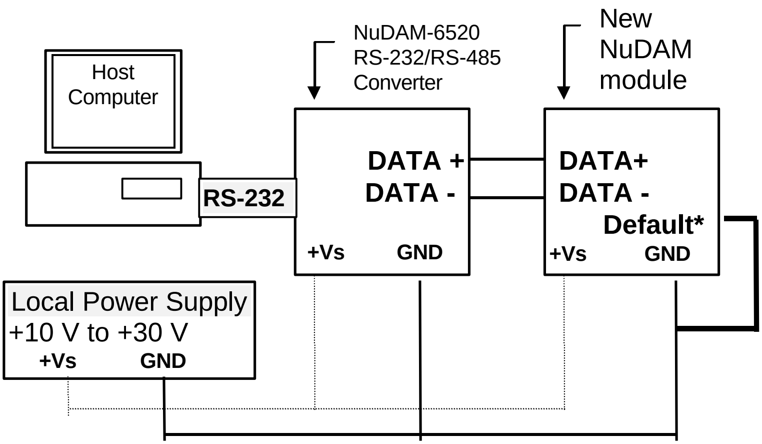


Figure 2-1 Layout for Configuring the NuDAM module

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

Equipments for Install a New Module

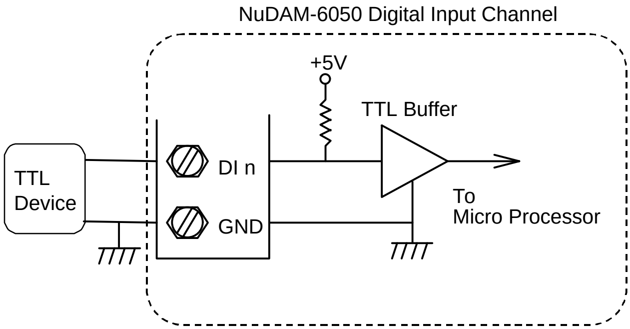
- A existing NuDAM network
- New NuDAM modules.
- Power supply (+10 to +30 V_{DC}).

Installing Procedures

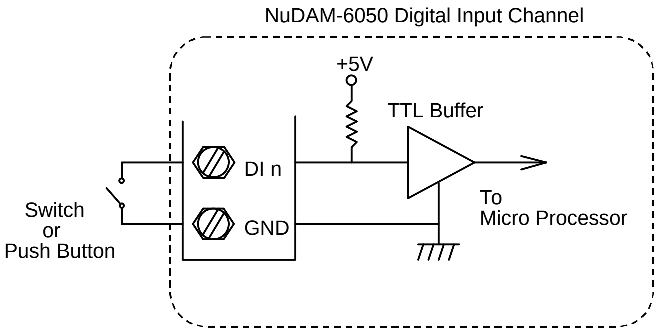
1. Configure the new NuDAM module according to the initialization procedure in section 2.2.
2. The baud rate and check-sum status of the new module must be identity with the existing RS-485 network. The address ID must not be conflict with other NuDAM modules on the network.
3. Power off the NuDAM power supply of the existing RS-485 network.
4. Power off the host computer.
5. Wire the power lines for the new NuDAM with the existing network. Be careful about the signal polarity as wiring.
6. Wire the RS-485 data lines for the new NuDAM with the existing network. Be careful about the signal polarity as wiring.
7. Wire to the input or output devices. Refer to section 2.4 for illustrations.
8. Power on the host computer.
9. Power on the NuDAM local power supply.
10. Use the NuDAM administration utility to check entire network.

2. 4. Application Wiring for NuDAM-6050

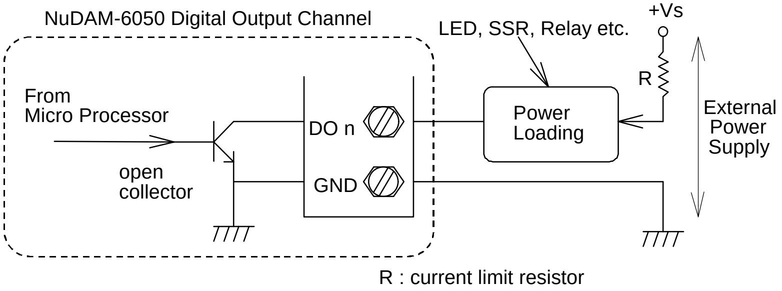
Digital Input Connect with TTL Signal



Digital Input Connect with Switch or Push Button

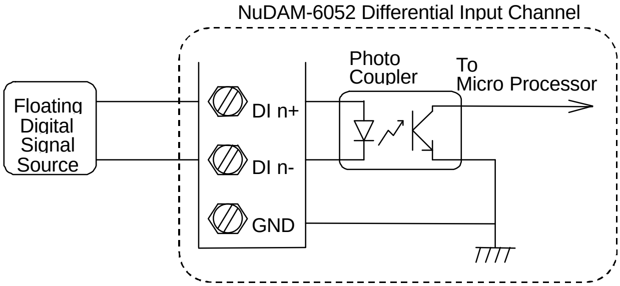


Digital Output Connect with Power Loading

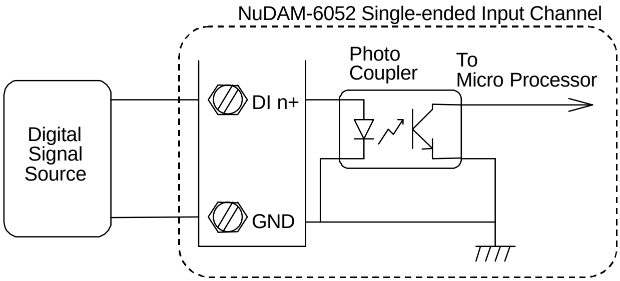


2. 5. Application Wiring for NuDAM-6052

Isolated Differential Input

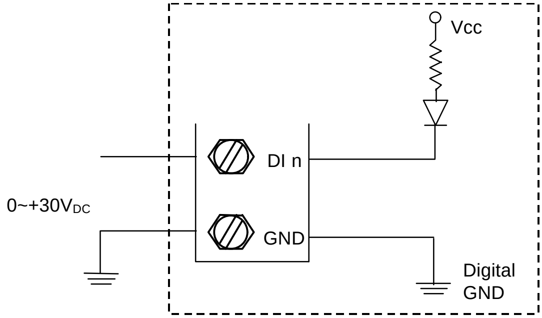


Isolated Single Ended Input

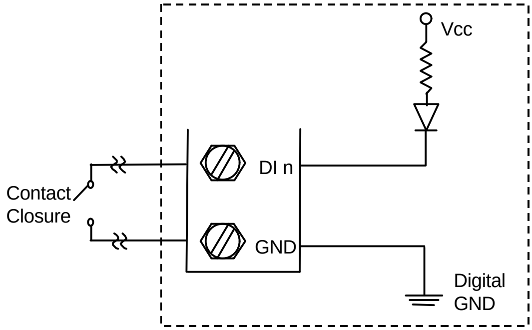


2. 6. Application Wiring for NuDAM-6053

Wet Contact Input

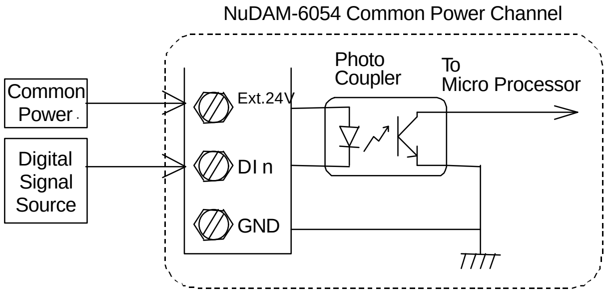


Contact Closure Input



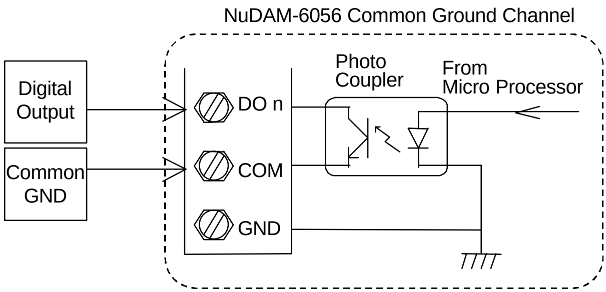
2. 7. Application Wiring for NuDAM-6054

Isolated Common Power Input



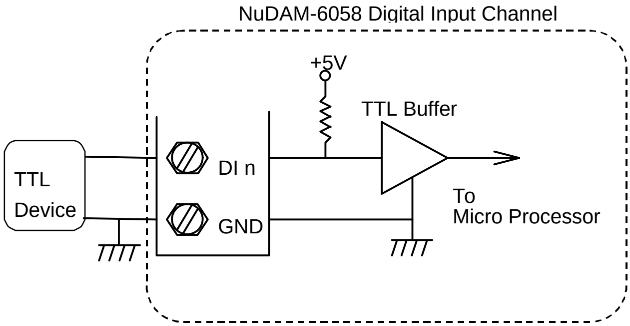
2. 8. Application Wiring for NuDAM-6056

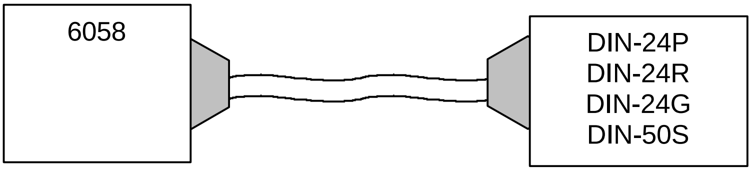
Isolated Common Ground Output



2. 9. Application Wiring for NuDAM-6058

Digital Input Connect with TTL Signal

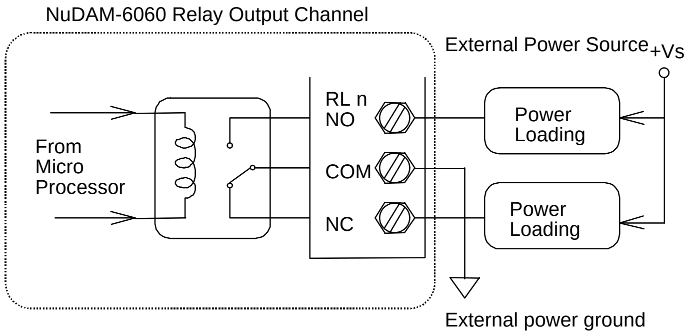




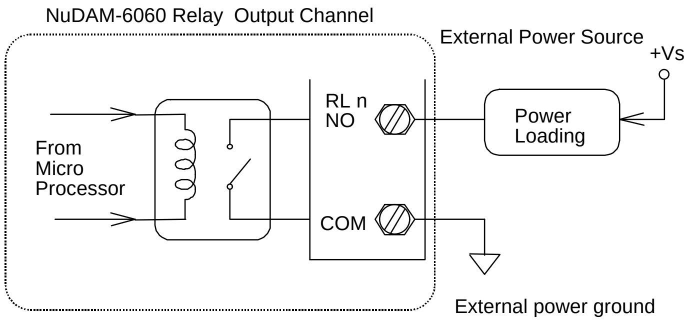
DIN-24P
24-CH Opt-Isolated Digital Input Termination Board with DIN Socket
DIN-24R
24-CH Relay Output Termination Board with DIN Socket
DIN-24G
24-CH Grayhill I/O Modules Termination Board with DIN Socket
DIN-50S
50-Pin SCSI Connector Termination Board with DIN Socket

2. 10. Application Wiring for NuDAM-6060

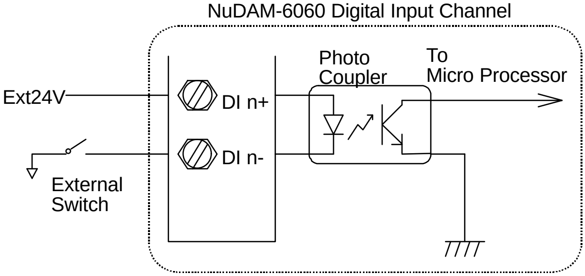
Form C Relay Output



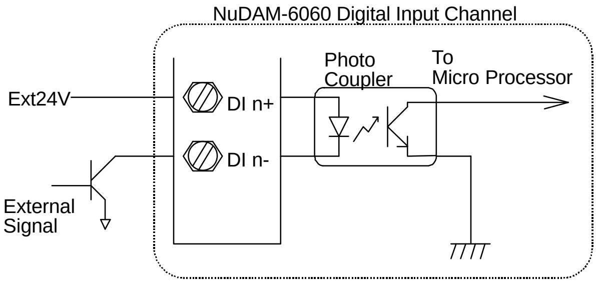
Form A Relay Output



Digital Input : Contact Mode

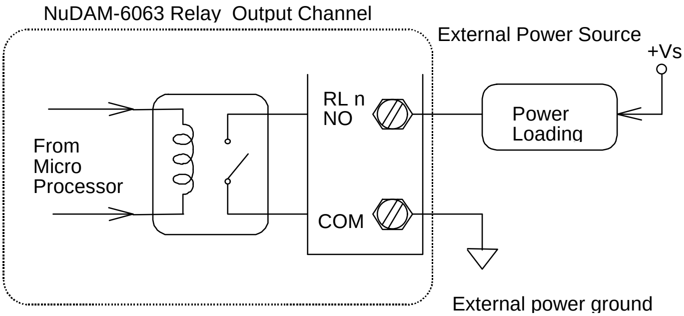


Digital Input : Transistor Mode



2. 11. Application Wiring for NuDAM-6063

Form A Relay Output



3. Command Set

3. 1. Command and Response

Introduction

The NuDAM command is composed by numbers of characteristics, including the leading code, address ID, the variables, the optional check-sum byte, and a carriage return to indicate the end of a command. The host computer can only command only one NuDAM module except those syncronized commands with wildcard address "**". The NuDAM may or may not give response to the command. The host should check the response to handshake with the modules.

Document Conventions

The following syntax conventions are used to describe the NuDAM commands in this manual.

(Leading Code)	Leading Code is the first characteristic of the NuDAM command. All NuDAM commands need a command leading code, such as %,$,#,@,...etc. **1- character**
(Addr)	Module's address ID, the value is in the range of 00 - FF (Hexadecimal) if no specified in the following. **2- character**
(Command Variable)	Items indicate command codes or value of variables. **Variable length**
[Data]	Some output command need data. **Variable length**
[Checksum]	Checksum in brackets indicate optional parameter, only checksum is enable then this field is required. **2- character**
< >	Identifies a control code character, such as <CR> for carriage return, its value is 0x0D. **1- character**

Format of NuDAM Commands

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

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

How to calculate checksum value ?

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

Example 1: checksum is **disable**

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

$	: LeadingCode
01	: Address
2	: Command (Read Configuration)
<CR>	: Carriage return 0x0D

Example 2: checksum is **enable**

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

$	: LeadingCode
01	: Address
2	: Command (Read Configuration)
B7	: Checksum value
<CR>	: Carriage return 0x0D

‘$’ = 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**

Note : 1. There is no spacing between characters.
2. At end of command need a <CR> carriage return 0x0D.
3. Checksum is optional parameter.

Response of NuDAM Commands

The response message depends on NuDAM command. The response is also composed with several characteristics, including leading code, variables, and carriage return for ending. There are two kinds of leading code for response message, ”!“ or ”>“ means valid command and ”?“ means invalid. By checking the response message, user can monitor the command is valid or invalid.

Note : Under the following conditions, there will have **no response** message.
1. The specified address ID is not exist.
2. Syntax error.
3. Communication error.
4. Some special commands does not have response .

---

3. 2. Summary of Command Set

There are three categories of NuDAM commands. One is the general commands, including set configuration command, read configuration, reset, read module's name or firmware version, etc. Every NuDAM can response to the general commands.

The second category is the functional commands, which depends on functions of each module, not every module can execute all functions.

The third category is the special commands, including functions about the programmable watchdog timer, safe values, and the programmable leading code.

Command Set of Digital I/O Modules		
Command	**Syntax**	**Module**
General Commands		
Set Configuration	**%(OldAddr)(NewAddr)(TypeCode)(BaudRate)(CheckSumFlag)**	ALL
Read Configuration	**$(Addr)2**	ALL
Read Module Name	**$(Addr)M**	ALL
Read Firmware Version	**$(Addr)F**	ALL
Reset Status	**$(Addr)5**	ALL
Functional Commands		
Synchronized Sampling	**#****	6050, 6052, 6053, 6054, 6058, 6060
Read Synchronized Data	**$(Addr)4**	6050, 6052, 6053, 6054, 6058, 6060
Digital Output	**#(Addr)(ChannelNo)(OutData)**	6050, 6060, 6063
	#(Addr)(Port)(Odata)	6056, 6058
	#(Addr)(Port)(ChannelNo)(BitData)	6056,6058
	#(Addr)T(OdataA)(OdataB)(OdataC)	6058
Digital Input	**$(Addr)6**	ALL
Set Programmable I/O Mode	**$(Addr)S(IOSts)**	6058
Special Commands		
Read Command Leading Code Setting	**~(Addr)0**	ALL
Change Command Leading Code Setting	**~(Addr)10(C1)(C2)(C3)(C4)(C5)(C6)**	ALL
Set Host Watchdog / Safety Value	**~(Addr)2(Flag)(TimeOut)(SafeValue)**	ALL
Read Host WatchDog / Safe Value	**~(Addr)3**	ALL
Host is OK	**~****	ALL

@Description

Configure the basic setting about address ID, baud rate, and checksum.

@Syntax

%(OldAddr)(NewAddr)(TypeCode)(BaudRate)(CheckSumFlag)<CR>

%	Command leading code. **(1-character)**
(OldAddr)	NuDAM module original address ID. The default address ID of a brand new module is 01. The value range of address ID is 00 to FF in hexadecimal. **(2-character)**
(NewAddr)	New address ID, if you don't want to change address ID, let new address ID equals to the old one. **(2-character)**
(TypeCode)	Type Code is fixed *40H* for Digital I/O modules**. (2-character)**
(BaudRate)	Communication baud rate, refer to Table 3-1 for details. **(2-character)**
(CheckSumFlag)	Define check-sum status, refer to Table 3-2 for details. **(2-character)**

@Response

!(Addr)<CR>
or
?(Addr)<CR>

(Addr)	Address ID.
!	Command is valid.
?	Command is invalid. Invalid parameter values, When you wanted to change the setting without grounding the DEFAULT* pin.

Note : When you want to change the checksum or baud rate then the DEFAULT* pin should be grounded at first.

@Example

User command:	%0130400600<CR>
Response:	!30<CR>

Item	Meaning	Description
%	(Leading Code)	Command leading code.
01	(OldAddr)	Original address ID is 01H.
30	(NewAddr)	New address ID is 30H (Hexadecimal).
40	(TypeCode)	Digital I/O module.
06	(BaudRate)	Baud rate is 9600.
00	(CheckSumFlag)	00 means checksum is disable.
<CR>	Carriage return	0x0D.

Code	Baudrate
03	1200 bps
04	2400 bps
05	4800 bps
06	9600 bps
07	19200 bps
08	38400 bps
09	115200 bps

Table 3. -1 Baud rate setting code

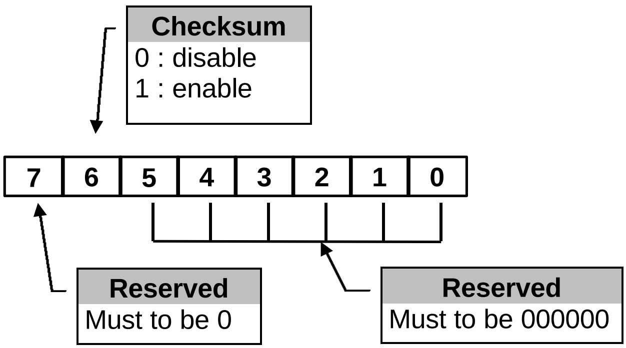


Table 3. -2 Check sum flag setting

3. 4. Read Configuration (6050, 6052, 6053, 6054, 6056, 6058, 6060, 6063)

@Description

Read the configuration of module on a specified address ID.

@Syntax

$(Addr)2<CR>

$	Command leading code
(Addr)	Address ID.
2	Command code for reading configuration

@Response

!(Addr)(TypeCode)(BaudRate)(CheckSumFalg)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(TypeCode)	It always be 40 (Hex) for digital I/O modules.
(BaudRate)	Current setting of communication baud rate, refer to Table 3-1 for details.
(CheckSumFlag)	Current setting of check-sum flag, refer to Table 3-3. for details.

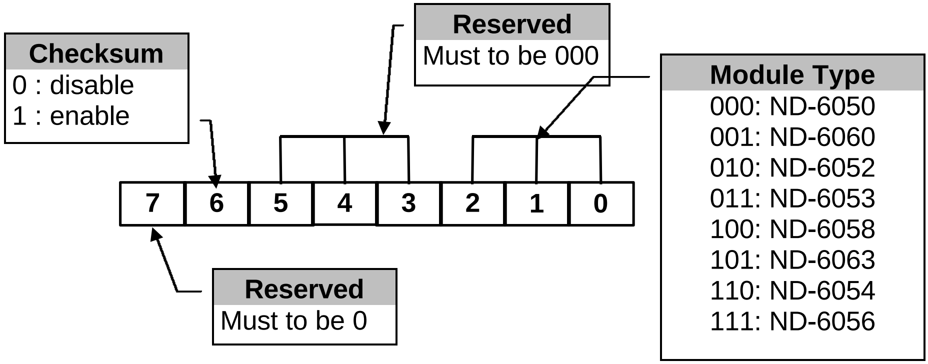


Table 3. -3 Response of check sum flag

@Example

User command:	$302<CR>
Response:	!30400600<CR>

!	Command is valid.
30	Address ID.
40	Digital I/O module.
06	Baud rate is 9600 bps.
00	checksum is disable.

3. 5. Read Module Name (6050, 6052, 6053, 6054, 6056, 6058, 6060, 6063)

@Description

Read NuDAM module's name.

@Syntax

$(Addr)M<CR>

$	Command leading code.
(Addr)	Address ID
M	Read module name

@Response

!(Addr)(ModuleName) <CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(ModuleName)	NuDAM module's name.

@Example

User command:	$30M<CR>
Response:	!306050<CR>

!	Command is valid.
30	Address
6050	ND-6050 (Digital I/O module)

3. 6. Read Firmware Version (6050, 6052, 6053, 6054, 6056, 6058, 6060, 6063)

@Description

Read NuDAM module's firmware version.

@Syntax

$(Addr)F<CR>

$	Command leading code.
(Addr)	Address ID
F	Read module firmware version.

@Response

!(Addr)(FirmRev) <CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(FirmRev)	NuDAM module's firmware version.

@Example

User command:	$30F<CR>
Response:	!30A1.50<CR>

!	Command is valid.
30	Address
A1.50	Firmware Version

3. 7. Reset Status (6050, 6052, 6053, 6054, 6056, 6058, 6060, 6063)

@Description

Checks the reset status of module at specified address to see whether it has been reset since the last reset status command was issued to the module.

@Syntax

$(Addr)5<CR>

$	Command leading code.
(Addr)	Address ID
5	Reset Status Command

@Response

!(Addr)(Status)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(Status)	0 : It has not been reset since the last reset status command was issued. 1 : It has been reset since the last reset status command was issued

@Example

User command:	$305<CR>
Response:	!300<CR>

Status is 0 means this digital I/O module has not been reset, since the last reset status command was issued.

@Description

Set digital output channel value at specified address. This command is only available to modules involving the digital output function.

@Syntax

#(Addr)(ChannelNo)(OutData)<CR> (6050,6060,6063 Only)

#	Command leading code. **(1-character)**
(Addr)	Address ID **(2-character)**
(ChannelNo)	00 : Set value to all channels 1X : Set value to single channel First character is 1, Second character is channel number. **(2-character)**
(OutData)	Set value to all channels : Each bit is mapping to each channel number Set value to single channel : First character is 0, second character is set to value 0 or 1. **(2-character)**

@Response

><CR>
or
?(Addr)<CR>

>	Command is valid
?	Command is invalid.
(Addr)	Address ID.

@Example

User command: #300003<CR>
Response: ><CR>

30	Address ID
00	Set output to all channels
03	03 (00000011), Channel 0 and 1 are set ON other channels are set to OFF

User command: #2F1201<CR>
Response: ><CR>

2F	Address ID
12	**1** : Set output to single channel **2** : Output single channel is channel 2
01	Set single channel to ON

@Description

Set digital output channel value at specified address. This command is only available to modules involving the multiport digital output function.

@Syntax

#(Addr)T(OutDataH)(OutDataL)<CR> (6056 only)
#(Addr)T(OutDataA)(OutDataB)(OutDataC) (6058 only)

#	Command leading code. **(1-character)**
(Addr)	Address ID **(2-character)**
T	Set value to all channels
(OutDataH)	Each bit is mapping to each channel number from 14 to 8. (2-character)
(OutDataL)	Each bit is mapping to each channel number from 7 to 0. (2-character)
(OutDataA)	Output data for port A. Each bit is mapping to each channel number from 7 to 0. (2-character)
(OutDataB)	Output data for port B. Each bit is mapping to each channel number from 7 to 0. (2-character)
(OutDataC)	Output data for port C. Each bit is mapping to each channel number from 7 to 0. (2-character)

**** if the port of ND-6058 is in input mode, output data to this port will be ignore.***

@Response

><CR>
or
?(Addr)<CR>

>	Command is valid
?	Command is invalid.
(Addr)	Address ID.

@Example

User command:	#30T0303<CR> (for ND-6056)
Response:	><CR>

30	Address ID
T	Set output to all port
0303	0303 (0000001100000011), Channel 0, 1, 8 and 9 are set ON other channels are set to OFF

User command:	#2FT010203<CR> (for ND-6058)
Response:	><CR>

2F	Address ID
T	Set output to all port
01	Set channel 0 of port A ON
02	Set channel 1 of port B ON
03	Set channel 0 and 1 of port C ON

@Description

Set digital output port channel value at specified address. This command is only available to modules involving the multiport digital output function.

@Syntax

#(Addr)(Port)(OutData)<CR> (6056, 6058 only)

#	Command leading code. **(1-character)**
(Addr)	Address ID **(2-character)**
(Port)	Set value to indivisual port **0H:** for 6056 channel 14 to 8 **0L:** for 6056 channel 7 to 0 **0A:** for 6058 port A **0B:** for 6058 port B **0C:** for 6058 port C (2-character)
(OutData)	Each bit is mapping to each channel number (2-character)

**** if the port of ND-6058 is in input mode, output data to this port will be ignore.***

@Response

><CR>
or
?(Addr)<CR>

>	Command is valid
?	Command is invalid.
(Addr)	Address ID.

@Example

User command:	#30H03<CR> (for ND-6056)
Response:	><CR>

30	Address ID
0H	Set output to high byte
03	03 (00000011), Channel 8 and 9 are set ON other channels are set to OFF

User command:	#2F0A10<CR>
Response:	><CR>

2F	Address ID
0A	Set output to port A
10	Set channel 4 of port A ON

@Description

Set direct digital output channel value at specified address. This command is only available to modules involving the multiport digital output function.

@Syntax

#(Addr)(Port)(ChNo)(OutData)<CR> (6056,6058 only)

#	Command leading code. **(1-character)**
(Addr)	Address ID **(2-character)**
(Port)	Set direct channel value to indivisual port **H:** for 6056 channel 14 to 8 **L:** for 6056 channel 7 to 0 **A:** for 6058 port A **B:** for 6058 port B **C:** for 6058 port C (1-character)
(ChNo)	Channel value 7 ~ 0
(OutData)	1: ON 0: OFF (1-character)

**** if the port of ND-6058 is in input mode, output data to this port will be ignore.***

@Response

><CR>

or

?(Addr)<CR>

>	Command is valid
?	Command is invalid.
(Addr)	Address ID.

@Example

User command:	#30H31<CR> (for ND-6056)
Response:	><CR>

30	Address ID
H	Set output to high byte
3	Channel number is 3, that is channel 11
1	Set corresponding channel to ON

User command:	#2FA20<CR>
Response:	><CR>

2F	Address ID
A	Set output to port A
2	Channel number is 2
0	Set corresponding channel to OFF

3. 12. Synchronized Sampling

@Description

Synchronized all modules to sample input values and stored the values in the module's register at the same time and use "Read Synchronized Data" command to read the data and process it one by one.

For digital I/O module, this command is only available to modules involving the digital input function, such as NuDAM-6050, NuDAM-6052, NuDAM-6053, NuDAM-6054, NuDAM-6058 and NuDAM-6060.

@Syntax

#<CR>**

#	Command leading code.
**	Synchronized sampling command

@Response

Note : Synchronized sampling command **has NO response**.

@Example

User command: #**<CR>

Synchronized sampling command **has no response**.

3. 13. Read Synchronized Data (6050, 6052, 6053, 6054, 6058, 6060)

@Description

After a synchronized sampling command **#**** was issued, you can read the input value that was stored in the addressed module's register and use same method to process other module's data one by one.

@Syntax

$(Addr)4<CR>

$	Command leading code.
(Addr)	Address ID
4	Read synchronized data.

@Response

ND-6050 module response :

!(Status)(DataOut)(DataIn)00<CR>

ND-6052 module response :

!(Status)(DataIn)0000<CR>

ND-6053 module response :

!(Status)(DataInH)(DataInL)00<CR>

ND-6054 module response :

!(Status)(DataInH)(DataInL)00<CR>

ND-6058 module response :

!(Status)(IOFlag)(DIn)(DataInA)(DataInB)(DataInC)<CR>

ND-6060 module response :

!(Status)(DataOut)(DataIn)00<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Status)	0 : Data has been sent at least once before. 1 : Data has been sent for the first time since a synchronized sampling command was issued.**(1-character)**
(IOFlag)	Status of programmable I/O 0x00: A(O/P) B(O/P) CH(O/P) CL(O/P) 0x01: A(O/P) B(O/P) CH(O/P) CL(I/P)

0x02: A(O/P) B(O/P) CH(I/P) CL(O/P)
0x03: A(O/P) B(O/P) CH(I/P) CL(I/P)
0x04: A(O/P) B(I/P) CH(O/P) CL(O/P)
0x05: A(O/P) B(I/P) CH(O/P) CL(I/P)
0x06: A(O/P) B(I/P) CH(I/P) CL(O/P)
0x07: A(O/P) B(I/P) CH(I/P) CL(I/P)
0x08: A(I/P) B(O/P) CH(O/P) CL(O/P)
0x09: A(I/P) B(O/P) CH(O/P) CL(I/P)
0x0A: A(I/P) B(O/P) CH(I/P) CL(O/P)
0x0B: A(I/P) B(O/P) CH(I/P) CL(I/P)
0x0C: A(I/P) B(I/P) CH(O/P) CL(O/P)
0x0D: A(I/P) B(I/P) CH(O/P) CL(I/P)
0x0E: A(I/P) B(I/P) CH(I/P) CL(O/P)
0x0F: A(I/P) B(I/P) CH(I/P) CL(I/P)
I/P input mode, O/P output mode.

(DataOut) Value of digital output channel. **(2-character)**
(DataIn) Value of digital input channel. **(2-character)**
(DIn) Value of dedicated digital input channel 3-0 for ND-6058. The first character is 0 **(2-character)**
(DataInH) Value of digital input channel 15-8 **(2-character)**
(DataInL) Value of digital input channel 7-0 **(2-character)**
(DataInA) Value of port A channel 7-0 **(2-character)**
(DataInB) Value of port B channel 7-0 **(2-character)**
(DataInC) Value of port C channel 7-0 **(2-character)**

@Examples

Example for NuDAM-6050 :

User command:	$304<CR>
Response:	!1065200<CR>

!	Command is valid.
1	Data has not been sent before.
06	06 (00000110) means digital output channel 1,2 are ON, channel 0,3,4,5,6,7 are OFF.
52	52(01010010) means digital input channel 1,4, 6 are HIGH, channel 0,2,3,5,7 are LOW..

Example for NuDAM-6058 :

User command:	$304<CR>
Response:	!10C0F010203<CR>

!	Command is valid.
1	Data has not been sent before.
0C	Port A and B are input mode, high and low half byte of port C are output mode.
0F	Channel 0,1,2,3 of digital input is HIGH.
01	01 (00000001) means port A digital input channel 0 is HIGH, others are LOW.
02	02 (00000010) means port B digital input channel 1 is HIGH, others are LOW.
03	03 (00000011) mean port C digital output channel 0,1 are ON, others are OFF.

3. 14. Digital Input

@Description

Read the digital input channel value and readback the digital output channel value.

@Syntax

$(Addr)6<CR>

$	Command leading code.
(Addr)	Address ID
6	Digital data input command.

@Response

ND-6050 module response :

!(DataOut)(DataIn)00<CR>

ND-6052 module response :

!(DataIn)0000<CR>

ND-6053 module response :

!(DataInH)(DataInL)00<CR>

ND-6054 module response :

!(DataInH)(DataInL)00<CR>

ND-6056 module response :

!(DataOutH)(DataOutL)00<CR>

ND-6058 module response :

!(IoFlag)(DataIn)(DataA)(DataB)(DataC)<CR>

ND-6060 module response :

!(DataOut)(DataIn)00<CR>

ND-6063 module response :

!(DataOutH)0000<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(DataOut)	Value of digital output channel. **(2-character)**
(DataIn)	Value of digital input. **(2-character)**
(DataInH)	Value of digital input channel 15-8. **(2-character)**
(DataInL)	Value of digital input channel 7-0.**(2-character)**
(DataOutH)	Value of digital output channel 15-8. **(2-character)**
(DataOutL)	Value of digital output channel 7-0.**(2-character)**
(DataA)	Value of digital channel 7-0.**(2-character)**
(DataB)	Value of digital channel 7-0.**(2-character)**
(DataB)	Value of digital channel 7-0.**(2-character)**
(IOFlag)	Status of programmable I/O 0x00: A(O/P) B(O/P) CH(O/P) CL(O/P) 0x01: A(O/P) B(O/P) CH(O/P) CL(I/P) 0x02: A(O/P) B(O/P) CH(I/P) CL(O/P) 0x03: A(O/P) B(O/P) CH(I/P) CL(I/P) 0x04: A(O/P) B(I/P) CH(O/P) CL(O/P) 0x05: A(O/P) B(I/P) CH(O/P) CL(I/P) 0x06: A(O/P) B(I/P) CH(I/P) CL(O/P) 0x07: A(O/P) B(I/P) CH(I/P) CL(I/P) 0x08: A(I/P) B(O/P) CH(O/P) CL(O/P) 0x09: A(I/P) B(O/P) CH(O/P) CL(I/P) 0x0A: A(I/P) B(O/P) CH(I/P) CL(O/P) 0x0B: A(I/P) B(O/P) CH(I/P) CL(I/P) 0x0C: A(I/P) B(I/P) CH(O/P) CL(O/P) 0x0D: A(I/P) B(I/P) CH(O/P) CL(I/P) 0x0E: A(I/P) B(I/P) CH(I/P) CL(O/P) 0x0F: A(I/P) B(I/P) CH(I/P) CL(I/P) ***I/P input mode, O/P output mode**.

@Example

Example for NuDAM-6050 :

User command:	$306<CR>
Response:	!321100<CR>

!	Command is valid.
32	32 (00110010) means digital output channel 1, 4, 5 are ON, channel 0, 2, 3, 6, 7 are OFF.
11	11 (00000011) means digital input channel 0, 1 are HIGH and channel 2, 3, 4, 5, 6, 7 are LOW.
00	No used

Example for NuDAM-6058 :

User command:	$304<CR>
Response:	!0C0F010203<CR>

!	Command is valid.
0C	Port A and B are input mode, high and low half byte of port C are output mode.
0F	Channel 0,1,2,3 of digital input is HIGH.
01	01 (00000001) means port A digital input channel 0 is HIGH, others are LOW.
02	02 (00000010) means port B digital input channel 1 is HIGH, others are LOW.
03	03 (00000011) mean port C digital output channel 0,1 are ON, others are OFF.

3. 15. Programmable I/O Mode Setting

@Description

Set the programmable input or output mode for ND-6058.

@Syntax

$(Addr)S(IOFlag)<CR> (6058 only)

$	Command leading code.
(Addr)	Address ID
S	Set programmable I/O mode
(IOFlag)	Status of programmable I/O 0x00: A(O/P) B(O/P) CH(O/P) CL(O/P) 0x01: A(O/P) B(O/P) CH(O/P) CL(I/P) 0x02: A(O/P) B(O/P) CH(I/P) CL(O/P) 0x03: A(O/P) B(O/P) CH(I/P) CL(I/P) 0x04: A(O/P) B(I/P) CH(O/P) CL(O/P) 0x05: A(O/P) B(I/P) CH(O/P) CL(I/P) 0x06: A(O/P) B(I/P) CH(I/P) CL(O/P) 0x07: A(O/P) B(I/P) CH(I/P) CL(I/P) 0x08: A(I/P) B(O/P) CH(O/P) CL(O/P) 0x09: A(I/P) B(O/P) CH(O/P) CL(I/P) 0x0A: A(I/P) B(O/P) CH(I/P) CL(O/P) 0x0B: A(I/P) B(O/P) CH(I/P) CL(I/P) 0x0C: A(I/P) B(I/P) CH(O/P) CL(O/P) 0x0D: A(I/P) B(I/P) CH(O/P) CL(I/P) 0x0E: A(I/P) B(I/P) CH(I/P) CL(O/P) 0x0F: A(I/P) B(I/P) CH(I/P) CL(I/P) ***I/P input mode, O/P output mode**.

@Response

!(Addr)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID

@Example

User command:	$060C<CR>
Response:	!06<CR>

!	Command is valid.
0C	Port A and B are input mode, high and low half byte of port C are output mode.

3. 16. Read Leading Code Setting

(6050, 6052, 6053, 6054, 6056, 6058, 6060, 6063)

@Description

Read command leading code setting and host watchdog status.

@Syntax

~(Addr)0<CR>

~	Command leading code.
(Addr)	Address ID
0	Read command leading code setting.

@Response

!(Addr)(Status)(C1)(C2)(C3)(C4)(C5)(C6)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID
(Status)	**(2-character)** Bit 0 : Reserved Bit 1 : Power failure or watchdog failure Bit 2 : Host watchdog is enable Bit 3 : Host failure
(C1)	Leading code 1, for read configuration status, firmware version, etc. default is **$. (1-character)**
(C2)	Leading code 2, for read synchronize sampling, digital output ,default is **#. (1-character)**
(C3)	Leading code 3, for change configuration. default is **%. (1-character)**
(C4)	Leading code 4, for read alarm status, enable alarm, etc. default is **@. (1-character)**
(C5)	Leading code 5, for read command leading code, change command leading code, etc. default is **~. (1-character)**
(C6)	Leading code 6, this leading code is reserved. Default is ***. (1-character)**

@Example

User command:	~060<CR>
Response:	!0600$#%@~*<CR>

Command leading code setting is $#%@~* for module address ID is 06, current status is factory default setting.

3. 17. Change Leading Code Setting

(6050, 6052, 6053, 6054, 6056, 6058, 6060, 6063)

@Description

User can use this command to change command leading code setting as he desired.

@Syntax

~(Addr)10(C1)(C2)(C3)(C4)(C5)(C6)<CR>

~	Command leading code.
(Addr)	Address ID, range (00 - FF).
10	Change command leading code setting.
(C1)	Leading code 1, for read configuration status, firmware version, etc. default is **$. (1-character)**
(C2)	Leading code 2, for read synchronize sampling, digital output ,default is **#. (1-character)**
(C3)	Leading code 3, for change configuration. default is **%. (1-character)**
(C4)	Leading code 4, for read alarm status, enable alarm, etc. default is **@. (1-character)**
(C5)	Leading code 5, for read command leading code, change leading code, etc. default is **~. (1-character)**
(C6)	Leading code 6, this leading code is reserved. default is ***. (1-character)**

@Response

!(Addr)< CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Examples

User command:	~060<CR>
Response:	!0600**$**#%@~*<CR>
User command:	~0610**A**#%@~*<CR>
Response:	!06<CR>
User command:	**A**06F
Response:	!06A1.8<CR>

Read leading code setting is $#%@~* for module address 06 and change leading code **$** to **A**, then use A06F to read firmware version of module on address 06.

***** WARNING *****

- We do not recommend users to change the default setting of leading code, because it will make you confuse .....
- The leading code change only use the command conflicts other devices on the network.

3. 18. Set Host Watchdog Timer & Safety Value

(6050, 6052, 6053, 6054, 6056, 6058, 6060, 6063)

@Description

Set host watchdog timer, module will change to safety state when host is failure. Define the output value in this command.

@Syntax

~(Addr)2(Flag)(TimeOut)(SafeValue)<CR>
~(Addr)2(Flag)(TimeOut)(SafeH)(SafeL)<CR> (6056 only)
~(Addr)2(Flag)(TimeOut)(SafeA)(SafeB)(SafeC)<CR> (6058only)

~	Command leading code.
(Addr)	Address ID, range (00 - FF).
2	Set host watchdog timer and safe state value.
(Flag)	0 : Disable host watchdog timer 1 : Enable host watchdog timer **(1-character)**
(TimeOut)	Host timeout value, between this time period host must send (Host is OK) command to module, otherwise module will change to safety state. Range 01 - FF. **(2-character)** **One unit is 100 ms** 01 = 1 * 100 = 100 ms FF = 255 * 100 = 25.5 sec
(SafeValue)	8 channels safety value of digital output channels when host is failure. **(2-character)**
(SafeH)	Safety value of digital output channels 14 ~ 8 when host is failure. **(2-character)**
(SafeL)	Safety value of digital output channels 7 ~ 0 when host is failure. **(2-character)**
(SafeA)	Safety value of port A channels 7 ~ 0 when host is failure while A in output mode. **(2-character)**
(SafeB)	Safety value of port B channels 7 ~ 0 when host is failure while B in output mode. **(2-character)**
(SafeC)	Safety value of port C channels 7 ~ 0 when host is failure while C in output mode. **(2-character)**

@Response

!(Addr)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID

@Example

Example for NuDAM-6050 :

User command:	~0621121C<CR>
Response:	!06<CR>

06	Address ID
2	Set host watchdog timer and safe state value.
1	Enable host watchdog timer.
12	Timeout value. 0x12 = 18 18 * 100 = 1800 ms
1C	1C (00011100) Digital output channel DO2, DO3 and DO4 are high, the others are low.

Example for NuDAM-6056 :

User command:	~0621121C1C<CR>
Response:	!06<CR>

06	Address ID
2	Set host watchdog timer and safe state value.
1	Enable host watchdog timer.
12	Timeout value. 0x12 = 18 18 * 53.3 = 959 ms 18 * 100 = 1800 ms
1C1C	1C1C (0001110000011100) Digital output channel DO2, DO3, DO4, DO10, DO11, DO12 are high, the others are low.

Example for NuDAM-6058 :

User command:	~0621121C1C1C<CR>
Response:	!06<CR>

06	Address ID
2	Set host watchdog timer and safe state value.
1	Enable host watchdog timer.
12	Timeout value. 0x12 = 18 18 * 100 = 1800 ms
1C1C1C	1C (00011100) port A, B and C channel 2, 3 and 4 are high, the other are low.

3. 19. Read Host Watchdog Timer & Safety Value (6050, 6052, 6053, 6054, 6056, 6058, 6060, 6063)

@Description

Read host watchdog timer setting and the safety value.

@Syntax

~(Addr)3<CR>

~	Command leading code.
(Addr)	Address ID
3	Read host watchdog setting and module safety state value.

@Response

!(Addr)(Flag)(TimeOut)(SafeValue)<CR>
!(Addr)(Flag)(TimeOut)(SafeH)(SafeL)<CR> (6056 only)
!(Addr)(Flag)(TimeOut)(SafeA)(SafeB)(SafeC)<CR> (6058only)
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID, range (00 - FF).
(Flag)	0 : Host watchdog timer is disable 1 : Host watchdog timer is enable**(1-character)**
(TimeOut)	Host timeout value. Range 01 - FF. **(2-character)** **One unit is 100 ms** 01 = 1 * 100 = 100 ms FF = 255 * 100 = 25.5 sec
(SafeValue)	8 channels safety state digital output value when host is failure. **(2-character)**

@Example

User command:	~063<CR>
Response:	!061121C<CR>

06	Address ID
1	Host watchdog timer is enable.
12	Timeout value. 0x12 = 18 18 * 100 = 1800 ms
1C	1C (00011100) Digital output channel DO3, DO4 and DO5 are high, the others are low.

Between 1800 ms time period, if host does not send (Host is OK) then digital output will change to safety state 1C (00011100) means digital output DO3 , DO4 and DO5 is high, others are low.

3. 20. Host is OK

@Description

When host watchdog timer is enable, host computer must send this command to every module before timeout otherwise **“host watchdog timer enable”** module‘s output value will go to safety state output value.

Timeout value and safety state output value is defined in 3.14. “Set Host Watchdog Timer & Safety Value”

@Syntax

~<CR>**

~	Command leading code.
**	Host is OK.

@Response

Note : Host is OK command **has NO response.**

@Example

User command:	~**<CR>

4. Product Warranty/Service

Seller warrants that equipment furnished will be free form defects in material and workmanship for a period of one year from the confirmed date of purchase of the original buyer and that upon written notice of any such defect, Seller will, at its option, repair or replace the defective item under the terms of this warranty, subject to the provisions and specific exclusions listed herein.

This warranty shall not apply to equipment that has been previously repaired or altered outside our plant in any way as to, in the judgment of the manufacturer, affect its reliability. Nor will it apply if the equipment has been used in a manner exceeding its specifications or if the serial number has been removed.

Seller does not assume any liability for consequential damages as a result from our products uses, and in any event our liability shall not exceed the original selling price of the equipment.

The equipment warranty shall constitute the sole and exclusive remedy of any Buyer of Seller equipment and the sole and exclusive liability of the Seller, its successors or assigns, in connection with equipment purchased and in lieu of all other warranties expressed implied or statutory, including, but not limited to, any implied warranty of merchant ability or fitness and all other obligations or liabilities of seller, its successors or assigns.

The equipment must be returned postage-prepaid. Package it securely and insure it. You will be charged for parts and labor if you lack proof of date of purchase, or if the warranty period is expired.

NuDAM-6080

Counter/Frequency
Input Module

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Contents

1. Introduction

1. 1. About the NuDAM Counter/Frequency Modules

The NuDAM provides a counter / frequency input module, which has two 32 bit counter input channels with built in programmable timer for frequency measure function.
NuDAM-6080: counter/frequency input module with digital output.

1. 2. Overview of NuDAM-6080

What is NuDAM-6080?

ND-6080 is a counter / frequency input module. It has two 32-bit counter input channels with built in programmable timer for frequency measurement and supports both photo isolated and non-isolated input mode. The maximum counting value is 4,294,967,295 for counter input channel and the frequency-input range is from 1 Hz to 100 kHz. A programmable digital filter can be enable for both high and low level minimum signal width to reduce noise spike. Besides the programmable threshold for non-isolated input can further reject noise on the input signal level.

The module provides the counter comparator or the alarm function. The alarm limit of two counters can be set independently by programming. The alarm status can be send to digital output channels if this function is ON. The supervisor of a factory can ‘see’ or ‘hear’ the alarm if the digital output channel control a real alarm device. The two digital output channel can be set for general purpose used if the alarm is disable. For example, connecting relay devices to DO channels, the NuDAM-6080 can be used to control the high power devices.

Features of NuDAM-6080

- Two 32 bit counter / frequency input channel
- Two digital output channels of open collector type
- 5000 Vrms isolation voltage for isolated input mode
- External gate control for counter input
- Alarm function with alarm output
- Programmable digital filter for noise rejection
- Programmable threshold setting of trigger level for non-isolated input mode
- Programmable host watchdog timer for host failure protection
- Internal watchdog timer for device failure protection
- Easy programming by software
- Easy installation and wiring

Specifications of NuDAM-6080

✧ **Interface**

- Interface : RS-485, 2 wires
- Speed (bps) : 1200, 2400, 4800, 9600, 19.2K, 38.4K

✧ **Counter Input**

- Two independent 32 bit counters
- Input frequency: 100 kHz max.
- Input mode: Isolated or non-isolated
- Isolated input level:
  Logic level 0: +1V max.
  Logic level 1: +3.5V to +30V
- Isolation voltage: 5000 Vrms
- Non-isolated input level (programmable threshold):
  Logic level 0: 0 to +5V (default = 0.8V)
  Logic level 1: 0 to +5V (default = 2.4V)
- Input pulse width > 5 μsec.
- Programmable digital noise filter:
  4 μsec. to 1.02 msec.
- Alarm comparator on each counter

✧ **Frequency measurement Input**

- Range: 1 Hz to 100 kHz
- Programmable built in gate time: 0.1/1.0 sec.

✧ **Digital Output**

- Channels: Two open collector to 30 V, 30 mA max. load

✧ **Watchdog Function**

- Module internal watchdog timer : 150 ms
- Power failure threshold : 4.65 V
- Safety value : 2 digital output channels
- Host programmable watchdog: 100 ms ~ 25.500 sec.

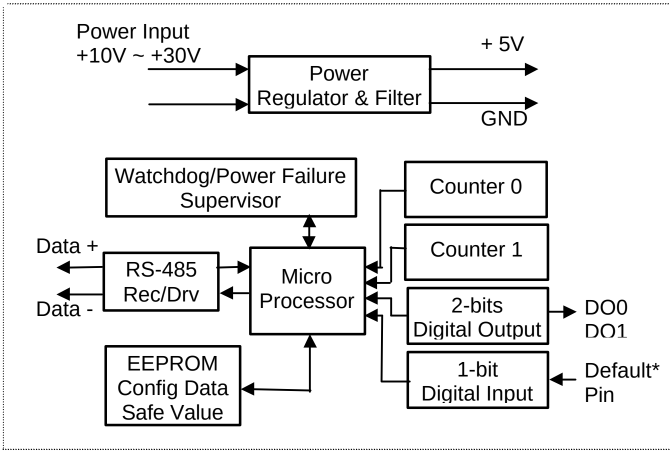
✧ **Power**

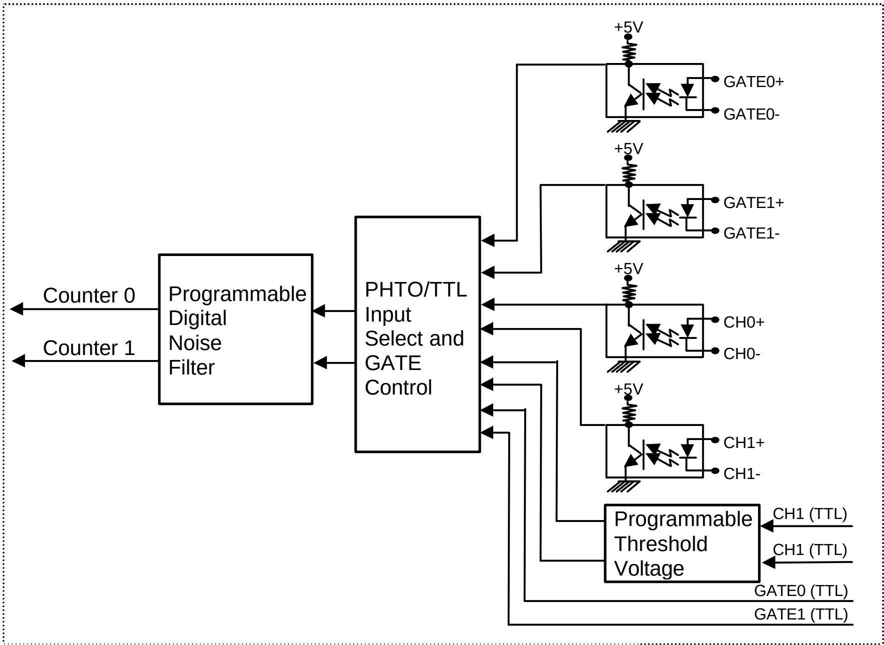
- Power supply : +10V to +30V
- Power consumption: 2.0W

Pin Definitions of ND-6080

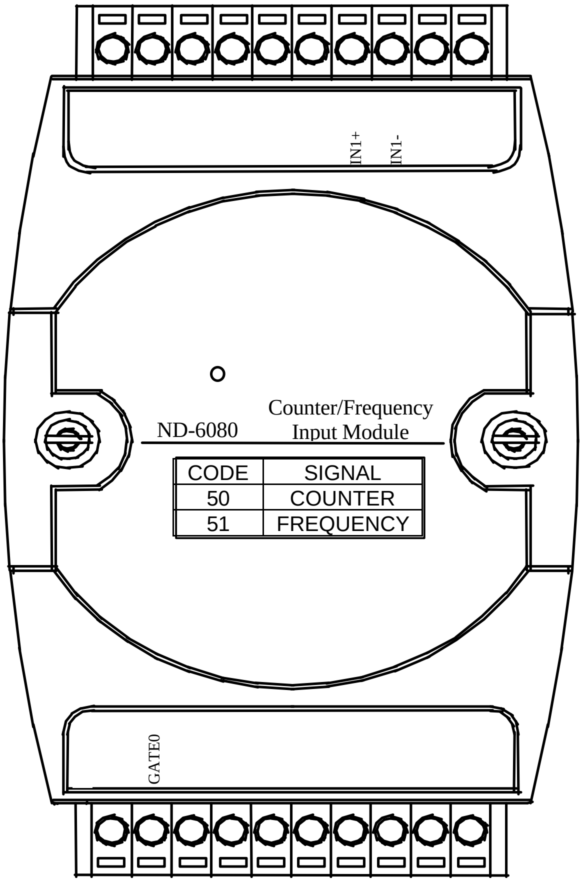
Pin #	Signal Name	Description
1	IN0	Non-isolated input of counter 0
2	GATE0	External gate control of counter 0
3	GND	Ground for non-isolated input
4	IN1	Non-isolated input of counter 1
5	GATE1	External gate control of counter 1
6	DEFAULT*	Initial state setting
7	(Y) DATA+	RS-485 series signal, positive
8	(G) DATA-	RS-485 series signal, negative
9	(R) +Vs	Power supply, +10V~+30V
10	(B) GND	Ground
11	GATE1-	Differential negative external gate control of counter 1
12	GATE1+	Differential positive external gate control of counter 1
13	IN1-	Differential negative input of counter 1
14	IN1+	Differential positive input of counter 1
15	GATE0-	Differential negative external gate control of counter 0
16	GATE0+	Differential positive external gate control of counter 0
17	IN0-	Differential negative input of counter 0
18	IN0+	Differential positive input of counter 0
19	DO0	Digital output of channel 0 or counter 0 alarm output
20	DO1	Digital output of channel 1 or counter 1 alarm output

A Look at ND-6080 & Pin Assignment





Functional Block Diagram of ND-6080



2. Initialization & Installation

2. 1. Software Installation

1. If you had installed “NuDAM Administration” then skip other steps.
2. Backup your software diskette
3. Insert “NuDAM Administration” diskette into floppy drive A:
4. Change drive to A:
5. 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:**

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

2. 2. Initializing a Brand-New Module

Objective of Initializing a Brand-New NuDAM

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

- Address ID is 01.
- Baud rate is 9600 bps
- Check-sum disable
- Host Watchdog timer is disable

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

The following sections show how to initialize a brand-new module, which is applicable for initializing NuDAM-6080.

Default State

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

- Address ID is 00.
- Baud rate is 9600 bps.
- Check-sum is disable.

Therefore, the communication between host and the module can be easily set as the same default configuration, the initialization of a module will be possible no matter what configuration is set under operating state.

Initialization Equipment

- 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
- Administration utility software

Initialization Procedure

1. Power off the host computer and the installed NuDAM-6520. Be sure of the baud rate of the NuDAM-6520 is 9600 bps.
2. Connect a brand new NuDAM module with the RS-485. Set the module in *Default State* by shorting the **DEFAULT*** pin. Refer to Figure 2.1 for detailed wiring.
3. Power on the host computer.
4. Power on the power supply for NuDAM modules.
5. Use the NuDAM Administration utility to configure the address ID, Baud rate and check-sum status of the module.

Initialization Wiring

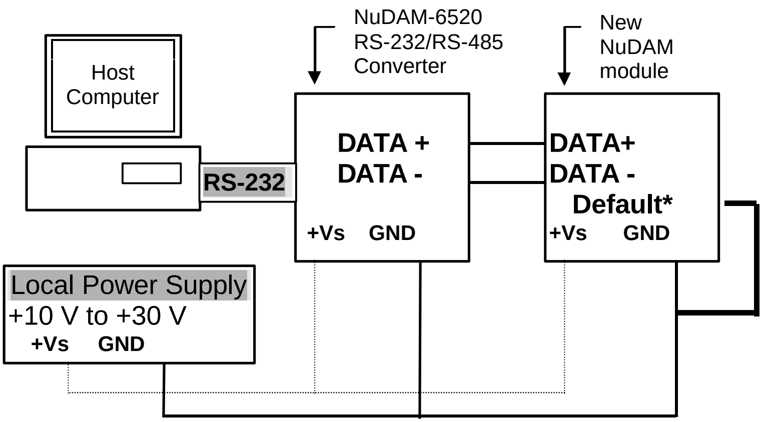


Figure 2-1 Layout for Initialization the NuDAM module

2. 3. 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 Procedures

1. Configure the new NuDAM module according to the initialization procedures in section 2.2.
2. The baud rate and check-sum status of the new module must be identity with the existing RS-485 network. The address ID must not be conflict with other NuDAM modules on the network.
3. Power off the NuDAM power supply of the existing RS-485 network.
4. Power off the host computer.
5. Wire the power lines for the new NuDAM with the existing network. Be careful about the signal polarity as wiring.
6. Wire the RS-485 data lines for the new NuDAM with the existing network. Be careful about the signal polarity as wiring.
7. Wire to the input or output devices. Refer to section 2.4 for illustrations.
8. Power on the host computer.
9. Power on the NuDAM local power supply.
10. Use the NuDAM administration utility to check entire network.

2. 4. Application Wiring for NuDAM-6080

Non-isolated Input

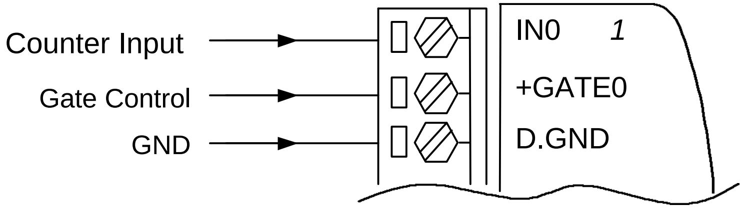
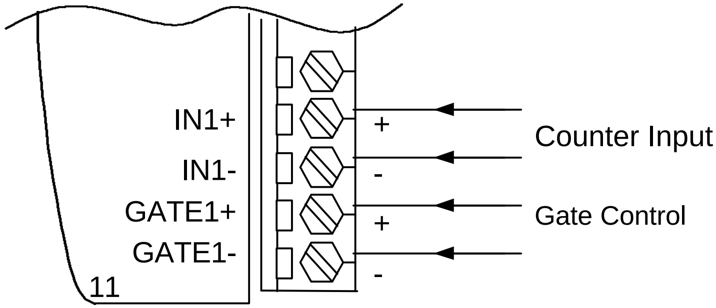


Photo-isolated Input



3. Command Set

3. 1. Command and Response

Introduction

The NuDAM command is composed by numbers of characteristics, including the leading code, address ID, the variables, the optional check-sum bytes, and a carriage return to indicate the end of a command. The host computer can only command only one NuDAM module except those synchronized commands with wildcard address “**”. The NuDAM may or may not give response to the command. The host should check the response to handshake with the modules.

Document Conventions

The following syntax conventions describes the NuDAM commands in this manual.

(Leading Code)	Leading Code is the first characteristic of the NuDAM command. All NuDAM commands need a command leading code, such as %,$,#,@,...etc. **1- character**
(Addr)	Module’s address ID, the value is in the range of 00 - FF (Hex). **2- character**
(Command Variable)	Command codes or value of variables. **Variable length**
[Data]	Some commands need additional data. **Variable length**
[Checksum]	Checksum in brackets indicate optional parameter, only checksum is enable then this field is required. **2- character**
< >	Identifies a control code character, such as <CR> for carriage return, its value is 0x0D. **1- character**

Format of NuDAM Commands

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

When checksum is enable then **[Checksum]** is needed, it is 2-character. Both command and response must append the checksum characters.

How to calculate checksum value ?

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

Example 1: checksum is **disable**

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

$	: LeadingCode
01	: Address
2	: Command (Read Configuration)
<CR>	: Carriage return 0x0D

Example 2: checksum is **enable**

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

$	: LeadingCode
01	: Address
2	: Command (Read Configuration)
B7	: Checksum value
<CR>	: Carriage return 0x0D

'$' = 0x24 '0' = 0x30 '1' = 0x31 '2' = 0x32

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**

Note : 1. There is no spacing between the command words and the checksum characters.
2. Every command follows a <CR> carriage return for ending.
3. The checksum characters are optional.

Response of NuDAM Commands

The response message depends on versatile NuDAM command. The response is composed with a few characteristics, including leading code, variables, and carriage return for ending. There are two categories of leading code for response message, "!" or ">" means valid command and "?" means invalid. By checking the response message, user can monitor the command is valid or not.

Note : Under the following conditions, there will have **no response** message.
1. The specified address ID is not exist.
2. Syntax error.
3. Communication error.
4. Some special commands do not have response.

---

3. 2. Summary of Command Set

There are three categories of NuDAM commands. The first is the ***general commands***, including set configuration command, read configuration, reset, read module's name or firmware version, etc. Every NuDAM can response to the general commands. The second is the ***functional commands***, which depends on functions of each module. Not every module can execute all function commands. The third is the ***special commands*** including functions about the programmable watchdog timer, safe values, and the programmable leading code. All the commands used in the NuDAM analog input module are list in the following table.

Command Set of NuDAM 6080	
Command	**Syntax**
Configuration, Counter Input & Display Commands	
Set Configuration	**%(OldAddr)(NewAddr)(TypeCode)(BaudRate)(CheckSumFlag)**
Read Configuration	**$(Addr)2**
Read Module Name	**$(Addr)M**
Read Firmware Version	**$(Addr)F**
Set Input Signal Mode	**$(Addr)B(InType)**
Read Input Signal Mode	**$(Addr)B**
Read Counter/Frequency Value in Hexadecimal	**#(Addr)(CounterNo)**
Read Counter/Frequency Value in Decimal	**#(Addr)(CounterNo)D**

Command	Syntax
Counter Setup Commands	
Set Gate Mode	**$(Addr)A(Gmode)**
Read Gate Mode	**$(Addr)A**
Set Maximum Counter Value	**$(Addr)3(CounterNo) (MaxData)**
Read Maximum Counter Value	**$(Addr)3(CounetrNo)**
Set Initial Count Value	**@(Addr)P(CounterNo) (IniData)**
Read Initial Count Value	**@(Addr)G(CounetrNo)**
Start/Stop Counter	**$(Addr)5(CounterNo) (SStatus)**
Read Counter Start/Stop Status	**$(Addr)5(CounterNo)**
Clear Counter	**$(Addr)6(CounterNo)**
Read then Clear the Overflow Flag	**$(Addr)7(CounterNo)**

Command	Syntax
Digital Filter & Programmable Threshold Commands	
Enable/Disable Digital Filter	**$(Addr)4(FStatus)**
Read Filter Status	**$(Addr)4**
Set Minimum Input Signal Width at High Level	**$(Addr)0H(MinFData)**
Read Minimum Input Signal Width at High Level	**$(Addr)0H**
Set Minimum Input Signal Width at Low Level	**$(Addr)0L(MinFData)**
Read Minimum Input Signal Width at Low Level	**$(Addr)0L**
Set TTL Input High Trigger Level	**$(Addr)1H(ThData)**
Read TTL Input High Trigger Level	**$(Addr)1H**
Set TTL Input Low Trigger Level	**$(Addr)1L(ThData)**
Read TTL Input Low Trigger Level	**$(Addr)1L**

Command	Syntax
Digital Output & Alarm Commands	
Enable Alarm	**@(Addr)EA(CounterNo)**
Disable Alarm	**@(Addr)DA(CounterNo)**
Set Alarm Limit Value of Counter 0	**@(Addr)PA(ArmData)**
Set Alarm Limit Value of Counter 1	**@(Addr)SA(ArmData)**
Read Alarm Limit Value of Counter 0	**@(Addr)RP**
Read Alarm Limit Value of Counter 1	**@(Addr)RA**
Set Digital Output Values	**@(Addr)DO(DoData)**
Read Digital Output and Alarm Status	**@(Addr)DI**

Command	Syntax
Special Commands	
Read Command Leading Code Setting	**~(Addr)0**
Change Command Leading Code Setting	**~(Addr)10(C1)(C2)(C3)(C4)(C5)(C6)**
Set Host Watchdog / Safety Value	**~(Addr)2(Flag)(TimeOut)(SafeValue)**
Read Host WatchDog / Safe Value	**~(Addr)3**
Host is OK	**~****

3. 3. Set Configuration

@Description

Configure the basic setting about address ID, baud rate, and checksum.

@Syntax

%(OldAddr)(NewAddr)(TypeCode)(BaudRate)(CheckSumFlag)<CR>

%	Command leading code. **(1-character)**
(OldAddr)	NuDAM module original address ID. The default address ID of a brand new module is 01. The value range of address ID is 00 to FF in hexadecimal. **(2-character)**
(NewAddr)	New address ID, if you don't want to change address ID, let new address ID equals to the old one. **(2-character)**
(TypeCode)	Type Code represents the input mode. **(2-character)** 50: counter input mode 51: frequency input mode
(BaudRate)	Communication baud rate, refer to Table 3-1 for details. **(2-character)**
(CheckSumFlag)	Define check-sum status and frequency gate time, refer to Table 3-2 for details. **(2-character)**

@Response

!(Addr)<CR>

or

?(Addr)<CR>

(Addr)	Address ID.
!	Command is valid.
?	Command is invalid. Invalid parameter values, When you wanted to change the setting without grounding the DEFAULT* pin.

Note : When you want to change the checksum or baud rate then the DEFAULT* pin should be grounded at first.

@Example

User command: %0130500600<CR>
Response: !30<CR>

Item	**Meaning**	**Description**
%	(Leading Code)	Command leading code.
01	(OldAddr)	Original address ID is 01H.
30	(NewAddr)	New address ID is 30H (Hexadecimal).
50	(TypeCode)	Counter input mode.
06	(BaudRate)	Baud rate is 9600.
00	(CheckSumFlag)	00 means checksum is disable, and frequency gate is 0.1 second.
<CR>	Carriage return	0x0D.

Code	**Baudrate**
03	1200 bps
04	2400 bps
05	4800 bps
06	9600 bps
07	19200 bps
08	38400 bps

Table -1 Baud rate setting code

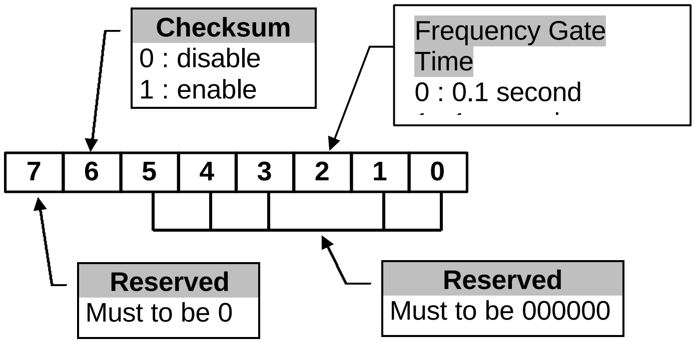


Table -2 Check sum flag setting

3. 4. Read Configuration

@Description

Read the configuration of module on a specified address ID.

@Syntax

$(Addr)2<CR>

$	Command leading code
(Addr)	Address ID.
2	Command code for reading configuration

@Response

!(Addr)(TypeCode)(BaudRate)(CheckSumFalg)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(TypeCode)	Input mode
(BaudRate)	Current setting of communication baud rate, refer to Table 3-1 for details.
(CheckSumFlag)	Current setting of check-sum flag, refer to Table 2. for details.

@Example

User command:	$302<CR>
Response:	!30500600<CR>

!	Command is valid.
30	Address ID.
50	Counter Input Mode.
06	Baud rate is 9600 bps.
00	checksum is disable, frequency gate is 0.1 second.

3. 5. Read Module Name

@Description

Read NuDAM module‘s name.

@Syntax

$(Addr)M<CR>

$	Command leading code.
(Addr)	Address ID
M	Read module name

@Response

!(Addr)(ModuleName) <CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(ModuleName)	NuDAM module‘s name.

@Example

User command:	$30M<CR>
Response:	!306080<CR>

!	Command is valid.
30	Address
6080	ND-6080 (Counter/Frequency module)

3. 6. Read Firmware Version

@Description

Read NuDAM module's firmware version.

@Syntax

$(Addr)F<CR>

$	Command leading code.
(Addr)	Address ID
F	Read module firmware version.

@Response

!(Addr)(FirmRev) <CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(FirmRev)	NuDAM module's firmware version.

@Example

User command:	$30F<CR>
Response:	!30A1.50<CR>

!	Command is valid.
30	Address
A1.50	Firmware Version

3. 7. Set Input Mode

@Description

Set the input signal mode of counter/frequency to either TTL or photo isolated mode.

@Syntax

$(Addr)B(InType)<CR>

$	Command leading code.
(Addr)	Address ID
B	Set input mode Command
(InType)	0: TTL input 1: photo isolated input

@Response

!(Addr)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Example

User command: $30B0<CR>
Response: !30<CR>

Item	Meaning	Description
$	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
B		Set Input mode.
0	(InType)	TTL input.

3. 8. Read Input Mode

@Description

Read the input signal mode of counter/frequency module.

@Syntax

$(Addr)B<CR>

$	Command leading code.
(Addr)	Address ID
B	Read input mode Command

@Response

!(Addr)(InType)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(InType)	0: TTL input mode. 1: Photo isolated input mode.

@Example

User command:	$30B<CR>
Response:	!301<CR>

!	Command is valid.
30	Address
1	Photo isolated input.

3. 9. Read Counter/Frequency Value in HEX Format

@Description

Read the Counter/Frequency module of counter 0 or 1 and return the acquired data in hexadecimal format.

@Syntax

#(Addr)(CounterNo)<CR>

#	Command leading code. **(1-character)**
(Addr)	Address ID **(2-character)**
(CounterNo)	0: Counter 0. 1: Counter 1. **(1-character)**

@Response

>Data<CR>
or
?(Addr)<CR>

>	Command is valid
?	Command is invalid.
(Addr)	Address ID.

@Example

User command:	#300<CR>
Response:	>0000FFFF<CR>

30	Address ID
0	Read counter 0 value
0000FFFF	Return value 0x0000FFFF = 65,535

User command:	#2F1<CR>
Response:	>00001234<CR>

2F	Address ID
1	Read Counter 1 Value
00001234	Return value 0x00001234 = 4,660

3. 10. Read Counter/Frequency Value in DEC Format

@Description

Read the Counter/Frequency module of counter 0 or 1 and return the acquired data in decimal format.

@Syntax

#(Addr)(CounterNo)D<CR>

#	Command leading code. **(1-character)**
(Addr)	Address ID **(2-character)**
(CounterNo)	0: Counter 0. 1: Counter 1. **(1-character)**
D	Decimal command code.

@Response

>Data<CR>
or
?(Addr)<CR>

>	Command is valid
?	Command is invalid.
(Addr)	Address ID.

@Example

User command: #300<CR>
Response: >0000065535<CR>

30	Address ID
0	Read counter 0 value
0000065535	Return value 65535

User command: #2F1<CR>
Response: >0000001234<CR>

2F	Address ID
1	Read Counter 1 Value
0000001234	Return value 1234

3. 11. Set Gate Mode

@Description

Set the counter input module's gate control to either high, low or disable.

@Syntax

$(Addr)A(Gmode)<CR>

$	Command leading code.
(Addr)	Address ID **(2-character)**
A	Gate command code
(Gmode)	0: the gate is low 1: the gate is high 2: the gate is disable

@Response

!(Addr)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Example

User command: $30A0<CR>
Response: !30<CR>

Item	Meaning	Description
$	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
A		Set gate mode.
0	(Gmode)	The gate is low.

3. 12. Read Gate Mode

@Description

Read the counter input module's gate status.

@Syntax

$(Addr)A<CR>

$	Command leading code.
(Addr)	Address ID **(2-character)**
A	Gate command code

@Response

!(Addr)(Gmode)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(Gmode)	0: the gate is low 1: the gate is high 2: the gate is disable

@Example

User command: $30A<CR>
Response: !301<CR>

Item	Meaning	Description
$	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
A		Set gate mode.

!	Command is valid.
30	Address of counter/frequency module.
1	The gate is high.

3. 13. Set Maximum Counter Value

@Description

Set the maximum counter value of counter 0 or counter 1.

@Syntax

$(Addr)3(CounterNo)(MaxData)<CR>

$	Command leading code.
(Addr)	Address ID **(2-character)**
3	Maximum counter value command.
(CounterNo)	0: counter 0 1: counter 1
(MaxData)	The maximum counter value which consists of 8 hexadecimal digits. When counting value exceeds the maximum counter value, an overflow flag status will set.

@Response

!(Addr)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Example

User command: $303000010000<CR>
Response: !30<CR>

Item	Meaning	Description
$	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
3		Set maximum counter value.
0	(CounterNo)	Counter 0.
0001000 0	(MaxData)	65536(0x00010000)

3. 14. Read Maximum Counter Value

@Description

Read the maximum counter value of counter 0 or counter 1.

@Syntax

$(Addr)3(CounterNo)<CR>

$	Command leading code.
(Addr)	Address ID **(2-character)**
3	Maximum counter value command code
(CounterNo)	0: counter 0 1: counter 1

@Response

!(Addr)(MaxData)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(MaxData)	The maximum counter value which consists of 8 hexadecimal digits.

@Example

User command: $3031<CR>
Response: !3000001234<CR>

Item	Meaning	Description
$	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
3		Read maximum counter value.
1	(CounterNo)	Counter 1.

!	Command is valid.
30	Address of counter/frequency module.
00001234	4660(0x00001234).

3. 15. Set Initial Count Value

@Description

Set the initial count value of counter 0 or counter 1.

@Syntax

$(Addr)P(CounterNo)(IniData)<CR>

$	Command leading code.
(Addr)	Address ID **(2-character)**
P	Set initial count value command code.
(CounterNo)	0: counter 0 1: counter 1
(IniData)	The initial count value which consists of 8 hexadecimal digits.

@Response

!(Addr)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Example

User command: $30P000000100<CR>
Response: !30<CR>

Item	Meaning	Description
$	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
P		Set initial count value.
0	(CounterNo)	Counter 0.
00000100	(IniData)	256(0x00000100)

3. 16. Read Initial Count Value

@Description

Read the initial count value of counter 0 or counter 1.

@Syntax

$(Addr)G(CounterNo)<CR>

$	Command leading code.
(Addr)	Address ID **(2-character)**
G	Read initial counter value command code
(CounterNo)	0: counter 0 1: counter 1

@Response

!(Addr)(IniData)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(IniData)	The initial count value which consists of 8 hexadecimal digits.

@Example

User command: $30G1<CR>
Response: !30000000FF<CR>

Item	Meaning	Description
$	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
G		Read initial count value.
1	(CounterNo)	Counter 1.

!	Command is valid.
30	Address of counter/frequency module.
000000FF	255(0x000000FF).

3. 17. Start/Stop Counter

@Description

Start or stop counting of counter 0 or counter 1.

@Syntax

$(Addr)5(CounterNo)(SStatus)<CR>

$	Command leading code.
(Addr)	Address ID **(2-character)**
5	Start/stop counter command code.
(CounterNo)	0: counter 0 1: counter 1
(SStatus)	0: stop counting 1: start counting

@Response

!(Addr)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Example

User command:	$30501<CR>
Response:	!30<CR>

Item	Meaning	Description
$	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
5		Start/stop counting command.
0	(CounterNo)	Counter 0.
1	(SStatus)	Start counting.

3. 18. Read Start/Stop Counter Status

@Description

Read the status of counter 0 or counter 1 for its active or inactive condition.

@Syntax

$(Addr)5(CounterNo)<CR>

$	Command leading code.
(Addr)	Address ID **(2-character)**
5	Start/stop counter command code.
(CounterNo)	0: counter 0 1: counter 1

@Response

!(Addr)(SStatus)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(Sstatus)	0: stop counting 1: start counting

@Example

User command:	$3050<CR>
Response:	!301<CR>

!	Command is valid.
30	Address of counter/frequency module.
1	Counter 0 is counting.

3. 19. Clear Counter

@Description

Clear the value of counter 0 or counter 1.

@Syntax

$(Addr)6(CounterNo)<CR>

$	Command leading code.
(Addr)	Address ID **(2-character)**
6	Clear counter command code.
(CounterNo)	0: counter 0 1: counter 1

@Response

!(Addr)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Example

User command: $3060<CR>
Response: !30<CR>

Item	Meaning	Description
$	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
6		Clear counter command code.
0	(CounterNo)	Counter 0.

3. 20. Read then Clear Overflow Flag

@Description

Read the status of the overflow flag of counter 0 or counter 1, and then clear the flag afterward.

@Syntax

$(Addr)7(CounterNo)<CR>

$	Command leading code.
(Addr)	Address ID **(2-character)**
7	Read then clear overflow command code.
(CounterNo)	0: counter 0 1: counter 1

@Response

!(Addr)(OFlag)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(OFlag)	0: the overflow flag has not been set 1: the counting value has exceeded the maximum count, the overflow flag has been set.

*** After executing the command, the overflow flag will clear to zero if it has been set.**

@Example

User command:	$3070<CR>
Response:	!301<CR>

Item	Meaning	Description
$	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
7		Read counter overflow command code.
0	(CounterNo)	Counter 0.

!	Command is valid.
30	Address of counter/frequency module.
1	Counter 0 is overflowed.

3. 21. Enable/Disable Digital Filter

@Description

Enable or disable the digital filter function.

@Syntax

$(Addr)4(FStatus)<CR>

$	Command leading code.
(Addr)	Address ID **(2-character)**
4	Enable/Disable filter command code.
(FStatus)	0: disable filter 1: enable filter

@Response

!(Addr)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Example

User command: $3040<CR>
Response: !30<CR>

Item	Meaning	Description
$	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
4		Enable/Disable filter command.
0	(FStatus)	Disable filter.

3. 22. Read Filter Status

@Description

Read the digital filter enable/disable status.

@Syntax

$(Addr)4<CR>

$	Command leading code.
(Addr)	Address ID **(2-character)**
4	Enable/Disable filter command code.

@Response

!(Addr)(FStatus)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(FStatus)	0: disable filter 1: enable filter

@Example

User command: $304<CR>
Response: !301<CR>

Item	Meaning	Description
$	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
4		Enable/Disable filter command.

!	Command is valid.
30	Address of counter/frequency module.
1	Digital filter is enable.

3. 23. Set Minimum Input Signal Width at High Level

@Description

Set the minimum input signal width at high level, for signal level high less then this value will be filtered out as noise.

@Syntax

$(Addr)0H(MinFData)<CR>

$	Command leading code.
(Addr)	Address ID **(2-character)**
0H	Set minimum input signal width at high level command code.
(MinFData)	The minimum width data at high level. The unit is µs and its resolution is 1 µs. This value range from 4 µs to 1020 µs, which is a 4-digit integer. **(4-character)**

@Response

!(Addr)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Example

User command: $300H0100<CR>
Response: !30<CR>

Item	Meaning	Description
$	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
0H		Set minimum input signal width.
0100	(MinFData)	100 µs

3. 24. Read Minimum Input Signal Width at High Level

@Description

Read the minimum input signal width at high level.

@Syntax

$(Addr)0H<CR>

$	Command leading code.
(Addr)	Address ID **(2-character)**
0H	Set minimum input signal width at high level command code.

@Response

!(Addr)(MinFData)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(MinFData)	The minimum width data at high level. The unit is μs and its resolution is 1 μs. This value range from 4 μs to 1020 μs, which is a 4-digit integer.

@Example

User command: $300H<CR>
Response: !300100<CR>

Item	Meaning	Description
$	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
0H		Set minimum input signal width.

!	Command is valid.
30	Address of counter/frequency module.
0100	Digital filter value of minimum signal width at high level is 100 μs.

3. 25. Set Minimum Input Signal Width at Low Level

@Description

Set the minimum input signal width at low level, for signal level low less then this value will be filtered out as noise.

@Syntax

$(Addr)0L(MinFData)<CR>

$	Command leading code.
(Addr)	Address ID **(2-character)**
0L	Set minimum input signal width at low level command code.
(MinFData)	The minimum width data at low level. The unit is μs and its resolution is 1 μs. This value range from 4 μs to 1020 μs, which is a 4-digit integer. **(4-character)**

@Response

!(Addr)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Example

User command: $300L0010<CR>
Response: !30<CR>

Item	Meaning	Description
$	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
0L		Set minimum input signal width.
0010	(MinFData)	10 μs

3. 26. Read Minimum Input Signal Width at Low Level

@Description

Read the minimum input signal width at low level.

@Syntax

$(Addr)0L<CR>

$	Command leading code.
(Addr)	Address ID **(2-character)**
0L	Set minimum input signal width at low level command code.

@Response

!(Addr)(MinFData)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(MinFData)	The minimum width data at low level. The unit is µs and its resolution is 1 µs. This value range from 4 µs to 1020 µs, which is a 4-digit integer.

@Example

User command: $300L<CR>
Response: !300010<CR>

Item	Meaning	Description
$	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
0L		Set minimum input signal width.

!	Command is valid.
30	Address of counter/frequency module.
0010	Digital filter value of minimum signal width at low level is 10 µs.

3. 27. Set TTL Input High Trigger Level

@Description

Set the TTL input high trigger level, for voltage level higher than this value is recognized as logic high.

@Syntax

$(Addr)1H(ThData)<CR>

$	Command leading code.
(Addr)	Address ID **(2-character)**
1H	TTL input high trigger level command code.
(ThData)	The high trigger level for TTL input. The unit is 0.1 V and its resolution is 0.1 V too. This value range from 0.1 to 5V, which is a 2-digit integer.

@Response

!(Addr)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Example

User command: $301H30<CR>
Response: !30<CR>

Item	Meaning	Description
$	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
1H		Set TTL input high trigger level.
30	(ThData)	3 V

3. 28. Read TTL Input High Trigger Level

@Description

Read the TTL input high trigger level.

@Syntax

$(Addr)1H<CR>

$	Command leading code.
(Addr)	Address ID **(2-character)**
1H	TTL input high trigger level command code.

@Response

!(Addr)(ThData)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(ThData)	The high trigger level for TTL input. The unit is 0.1 V and its resolution is 0.1 V too. This value range from 0.1 to 5V, which is a 2-digit integer.

@Example

User command: $301H<CR>
Response: !3024<CR>

Item	Meaning	Description
$	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
1H		Read TTL input high trigger level.

!	Command is valid.
30	Address of counter/frequency module.
24	The high trigger level is 2.4 V.

3. 29. Set TTL Input Low Trigger Level

@Description

Set the TTL input low trigger level, for voltage level lower than this value is recognized as logic low.

@Syntax

$(Addr)1L(ThData)<CR>

$	Command leading code.
(Addr)	Address ID **(2-character)**
1L	TTL input low trigger level command code.
(ThData)	The low trigger level for TTL input. The unit is 0.1 V and its resolution is 0.1 V too. This value range from 0.1 to 5V, which is a 2-digit integer.

@Response

!(Addr)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Example

User command: $301L10<CR>
Response: !30<CR>

Item	Meaning	Description
$	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
1L		Set TTL input low trigger level.
10	(ThData)	1 V

3. 30. Read TTL Input Low Trigger Level

@Description

Read the TTL input low trigger level.

@Syntax

$(Addr)1L<CR>

$	Command leading code.
(Addr)	Address ID **(2-character)**
1L	TTL input low trigger level command code.

@Response

!(Addr)(ThData)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(ThData)	The high trigger level for TTL input. The unit is 0.1 V and its resolution is 0.1 V too. This value range from 0.1 to 5V, which is a 2-digit integer.

@Example

User command: $301L<CR>
Response: !3008<CR>

Item	Meaning	Description
$	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
1L		Read TTL input low trigger level.

!	Command is valid.
30	Address of counter/frequency module.
08	The low trigger level is 0.8 V.

3. 31. Enable Alarm

@Description

Enables alarm function of counter 0 or counter 1. The digital output will assert if the counter value reaches the alarm limit while the alarm is enable.

@Syntax

@(Addr)EA(CounterNo)<CR>

@	Command leading code.
(Addr)	Address ID **(2-character)**
EA	Enable alarm command code.
(CounterNo)	0: counter 0 1: counter 1

@Response

!(Addr)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Example

User command: @30EA0<CR>
Response: !30<CR>

Item	Meaning	Description
@	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
EA		Enable alarm command code.
0	(CounterNo)	Counter 0.

3. 32. Disable Alarm

@Description

Disables alarm function of counter 0 or counter 1.

@Syntax

@(Addr)DA(CounterNo)<CR>

@	Command leading code.
(Addr)	Address ID **(2-character)**
DA	Enable alarm command code.
(CounterNo)	0: counter 0 1: counter 1

@Response

!(Addr)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Example

User command: @30DA0<CR>
Response: !30<CR>

Item	Meaning	Description
@	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
DA		Disable alarm command code.
0	(CounterNo)	Counter 0.

3. 33. Set Alarm Limit Value of Counter 0

@Description

Set the alarm limit value of counter 0.

@Syntax

@(Addr)PA(ArmData)<CR>

@	Command leading code.
(Addr)	Address ID **(2-character)**
PA	Set alarm limit value command code.
(ArmData)	The alarm limit value which consists of 8 hexadecimal digits.

@Response

!(Addr)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Example

User command: @30PA00020000<CR>
Response: !30<CR>

Item	Meaning	Description
@	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
PA		Set alarm limit value of counter 0.
00020000	(ArmData)	131072(0x00020000)

3. 34. Set Alarm Limit Value of Counter 1

@Description

Set the alarm limit value of counter 1.

@Syntax

@(Addr)SA(ArmData)<CR>

@	Command leading code.
(Addr)	Address ID **(2-character)**
SA	Set alarm limit value command code.
(ArmData)	The alarm limit value which consists of 8 hexadecimal digits.

@Response

!(Addr)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Example

User command:	@30SA0002FFFF<CR>
Response:	!30<CR>

Item	Meaning	Description
@	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
SA		Set alarm limit value of counter 1.
0002FFFF	(ArmData)	196607(0x0002FFFF)

3. 35. Read Alarm Limit Value of Counter 0

@Description

Read the alarm limit value of counter 0.

@Syntax

@(Addr)RP<CR>

@	Command leading code.
(Addr)	Address ID **(2-character)**
RP	Read alarm limit value command code

@Response

!(Addr)(ArmData)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(ArmData)	The alarm limit value which consists of 8 hexadecimal digits.

@Example

User command:	@30RP<CR>
Response:	!300000FFFF<CR>

Item	**Meaning**	**Description**
@	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
RP		Read alarm limit value of counter 0.

!	Command is valid.
30	Address of counter/frequency module.
0000FFFF	65535(0x0000FFFF).

3. 36. Read Alarm Limit Value of Counter 1

@Description

Read the alarm limit value of counter 1.

@Syntax

@(Addr)RA<CR>

@	Command leading code.
(Addr)	Address ID **(2-character)**
RA	Read alarm limit value command code

@Response

!(Addr)(ArmData)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(ArmData)	The alarm limit value which consists of 8 hexadecimal digits.

@Example

User command: @30RA<CR>
Response: !300001FFFF<CR>

Item	**Meaning**	**Description**
@	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
RA		Read alarm limit value of counter 0.

!	Command is valid.
30	Address of counter/frequency module.
0001FFFF	131071(0x0001FFFF).

3. 37. Set Digital Output Values

@Description

Set the value (ON or OFF) of the 2 channel digital outputs.

@Syntax

@(Addr)DO(DoData)<CR>

@	Command leading code.
(Addr)	Address ID
DO	Set digital data output command code.
(DoData)	00: DO0 is OFF, DO1 is OFF 01: DO0 is ON, DO1 is OFF 02: DO0 is OFF, DO1 is ON 03: DO0 is ON, DO1 is ON

@Response

!(Addr)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Example

User command: @30DO01<CR>
Response: !30<CR>

Item	Meaning	Description
@	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
DO		Set digital data output.
01	(D0Data)	DO0 is ON, DO1 is OFF

3. 38. Read Digital Output and Alarm Status

@Description

Read the current digital output channel values and the status of alarm function.

@Syntax

@(Addr)DI<CR>

@	Command leading code.
(Addr)	Address ID
DI	Read digital data output and alarm status command code.

@Response

!(Addr)(AStatus)(DoData)00<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.
(AStatus)	0: counter 0 alarm is disabled, counter 1 alarm is disabled. 1: counter 0 alarm is enabled, counter 1 alarm is disabled. 2: counter 0 alarm is disabled, counter 1 alarm is enabled. 3: counter 0 alarm is enabled, counter 1 alarm is enabled.
(DoData)	00: DO0 is OFF, DO1 is OFF 01: DO0 is ON, DO1 is OFF 02: DO0 is OFF, DO1 is ON 03: DO0 is ON, DO1 is ON

@Example

User command: @30DI<CR>
Response: !3030200<CR>

Item	Meaning	Description
@	(Leading Code)	Command leading code.
30	(Addr)	Address ID is 30H.
DI		Set digital data output.

! Command is valid.
30 Address of counter/frequency module.
3 Counter 0 alarm is enabled, counter 1 alarm is enabled.
02 DO0 is OFF, DO1 is ON.

3. 39. Read Command Leading Code Setting

@Description

Read command leading code setting and host watchdog status.

@Syntax

~(Addr)0<CR>

~	Command leading code.
(Addr)	Address ID
0	Read command leading code setting.

@Response

!(Addr)(Status)(C1)(C2)(C3)(C4)(C5)(C6)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID
(Status)	**(2-character)** Bit 0 : Reserved Bit 1 : Power failure or watchdog failure Bit 2 : Host watchdog is enable Bit 3 : Host failure
(C1)	Leading code 1, for read configuration status, firmware version, etc. default is **$. (1-character)**
(C2)	Leading code 2, for read synchronize sampling, digital output ,default is **#. (1-character)**
(C3)	Leading code 3, for change configuration. default is **%. (1-character)**
(C4)	Leading code 4, for read alarm status, enable alarm, etc. default is **@. (1-character)**
(C5)	Leading code 5, for read command leading code, change command leading code, etc. default is **~.** **(1-character)**
(C6)	Leading code 6, this leading code is reserved. default is ***. (1-character)**

@Example

User command:	~060<CR>
Response:	!0600$#%@~*<CR>

Command leading code setting is $#%@~* for module address ID is 06, current status is factory default setting.

3. 40. Change Command Leading Code Setting

@Description

User can use this command to change command leading code setting as he desired.

@Syntax

~(Addr)10(C1)(C2)(C3)(C4)(C5)(C6)<CR>

~	Command leading code.
(Addr)	Address ID, range (00 - FF).
10	Change command leading code setting.
(C1)	Leading code 1, for read configuration status, firmware version, etc. default is **$. (1-character)**
(C2)	Leading code 2, for read synchronize sampling, digital output ,default is **#. (1-character)**
(C3)	Leading code 3, for change configuration. default is **%. (1-character)**
(C4)	Leading code 4, for read alarm status, enable alarm, etc. default is **@. (1-character)**
(C5)	Leading code 5, for read command leading code, change leading code, etc. default is **~. (1-character)**
(C6)	Leading code 6, this leading code is reserved. default is ***. (1-character)**

@Response

!(Addr)< CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID.

@Examples

User command:	~060<CR>
Response:	!0600**$**#%@~*<CR>
User command:	~0610**A**#%@~*<CR>
Response:	!06<CR>
User command:	**A**06F
Response:	!06A1.8<CR>

Read leading code setting is $#%@~* for module address 06 and change leading code **$** to **A**, then use A06F to read firmware version of module on address 06.

***** WARNING *****

- We do not recommend users to change the default setting of leading code, because it will make you confuse .....
- The leading code change only use the command conflicts other devices on the network.

3. 41. Set Host Watchdog Timer & Safety Value

@Description

Set host watchdog timer, module will change to safety state when host is failure. Define the output value in this command.

@Syntax

~(Addr)2(Flag)(TimeOut)(SafeValue)<CR>

~	Command leading code.
(Addr)	Address ID, range (00 - FF).
2	Set host watchdog timer and safe state value.
(Flag)	0 : Disable host watchdog timer 1 : Enable host watchdog timer **(1-character)**
(TimeOut)	Host timeout value, between this time period host must send (Host is OK) command to module, otherwise module will change to safety state. Range 01 - FF. **(2-character)** **One unit is 53.3 ms (Firmware version 1.x)** 01 = 1 * 53.3 = 53.3 ms FF = 255 * 53.3 = 13.6 sec **One unit is 100 ms (Firmware version 2.x)** 01 = 1 * 100 = 100 ms FF = 255 * 100 = 25.5 sec
(SafeValue)	8 channels safety value of digital output channels when host is failure. **(2-character)**

@Response

!(Addr)<CR>
or
?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID

@Example

User command:	~0621121C<CR>
Response:	!06<CR>

06	Address ID
2	Set host watchdog timer and safe state value.
1	Enable host watchdog timer.
12	Timeout value. 0x12 = 18 18 * 53.3 = 959 ms (Firmware Version 1.x) 18 * 100 = 1800 ms (Firmware Version 2.x)
1C	1C (00011100) Digital output channel DO3, DO4 and DO5 are high, the others are low.

3. 42. Read Host Watchdog Timer & Safety Value

@Description

Read host watchdog timer setting and the safety value.

@Syntax

~(Addr)3<CR>

~	Command leading code.
(Addr)	Address ID
3	Read host watchdog setting and module safety state value.

@Response

!(Addr)(Flag)(TimeOut)(SafeValue)<CR>

or

?(Addr)<CR>

!	Command is valid.
?	Command is invalid.
(Addr)	Address ID, range (00 - FF).
(Flag)	0 : Host watchdog timer is disable 1 : Host watchdog timer is enable**(1-character)**
(TimeOut)	Host timeout value. Range 01 - FF. **(2-character)** **One unit is 53.3 ms (Firmware version 1.x)** 01 = 1 * 53.3 = 53.3 ms FF = 255 * 53.3 = 13.6 sec **One unit is 100 ms (Firmware version 2.x)** 01 = 1 * 100 = 100 ms FF = 255 * 100 = 25.5 sec
(SafeValue)	8 channels safety state digital output value when host is failure. **(2-character)**

@Example

User command:	~063<CR>
Response:	!061121C<CR>

06	Address ID
1	Host watchdog timer is enable.
12	Timeout value. 0x12 = 18 18 * 53.3 = 959 ms (Firmware Version 1.x) 18 * 100 = 1800 ms (Firmware Version 2.x)
1C	1C (00011100) Digital output channel DO3, DO4 and DO5 are high, the others are low.

Between 959 ms (Fireware Version 1.x) or 1800 ms (Fireware Version 2.x) time period, if host does not send (Host is OK) then digital output will change to safety state 1C (00011100) means digital output DO3 , DO4 and DO5 is high, others are low.

3. 43. Host is OK

@Description

When host watchdog timer is enable, host computer must send this command to every module before timeout otherwise **“host watchdog timer enable”** module‘s output value will go to safety state output value.

Timeout value and safety state output value is defined in 3.14. “Set Host Watchdog Timer & Safety Value”

@Syntax

~<CR>**

~	Command leading code.
******	Host is OK.

@Response

Note : Host is OK command **has NO response.**

@Example

User command: ~**<CR>

NuDAM®

ND-6520 RS-232 to RS-422/RS-485 Converter

ND-6510 RS-422/RS-485 Repeater

User's Guide

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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 remotely control up to 256 NuDAM modules on RS-485 netowrk. 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 115.2K 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 NuDAM 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 NuDAM. 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-6510 : RS-422/RS-485 Repeater
- NuDAM-6520 : RS-232 to RS-422/RS-485 Converter
- NuDAM-6530 : USB to RS-422/RS-485 Converter

Analog Input Modules

- NuDAM-6011 : Multifunction High Gain Analog Input Module(with DI/O)
- NuDAM-6011D: Multifunction High Gain Analog Input with 5 ½ digit LED Display(with DI/O)
- NuDAM-6012 : Analog Input Module(with DI/O)
- NuDAM-6012D : Analog Input Module with 5 1/2 digit LED Display(with DI/O)
- NuDAM-6013 : 3-channel RTD Input Module
- NuDAM-6014D : Analog (Transmitter) Input Module with 5 1/2digit LED Display
- NuDAM-6017 : 8-channel Analog Input Module
- NuDAM-6018 : 8-channel Thermocouple Input Module

Analog Output Modules

- NuDAM-6021 : Single Channel Analog Output Module
- NuDAM-6024 : 4-channel Analog Output Module(with DI)

Digital I/O Modules

- NuDAM-6050 : Module with 7 DI channels and 8 DO channels
- NuDAM-6052 : Isolated Digital Input Module
- NuDAM-6053 : 16-channel digital Input Module
- NuDAM-6054 : 15-channel digital Input Module
- NuDAM-6056 : 15-channel digital Output Module
- NuDAM-6058 : 28-channel programable digital I/O Module

- NuDAM-6060 : 4-channel Relay Output & Digital Input Module
- NuDAM-6063 : 8-channel Relay Output 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 high input impedance of each NuDAM receiver allows up to ***128*** NuDAM modules on the same RS-485 bus without using a signal repeater.

The maximum transfer rate of NuDAM is 115.2Kbps 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/RS-422 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.

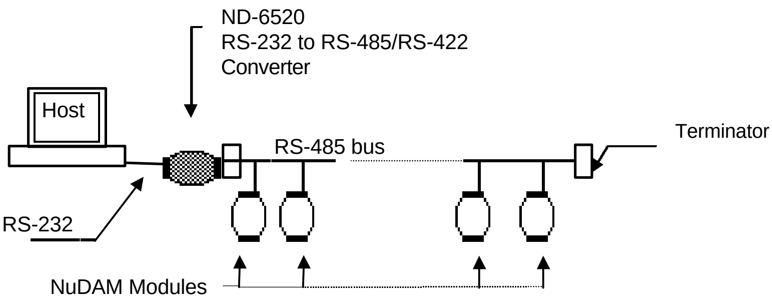


Figure 1-1 Simple Topology

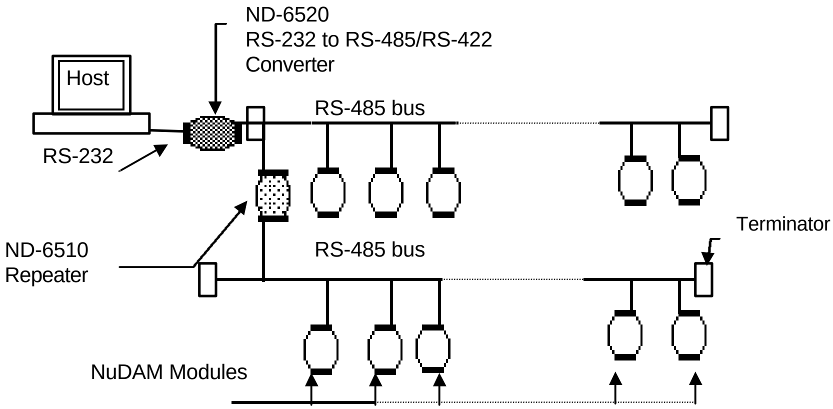


Figure 1-2 Branch Topology

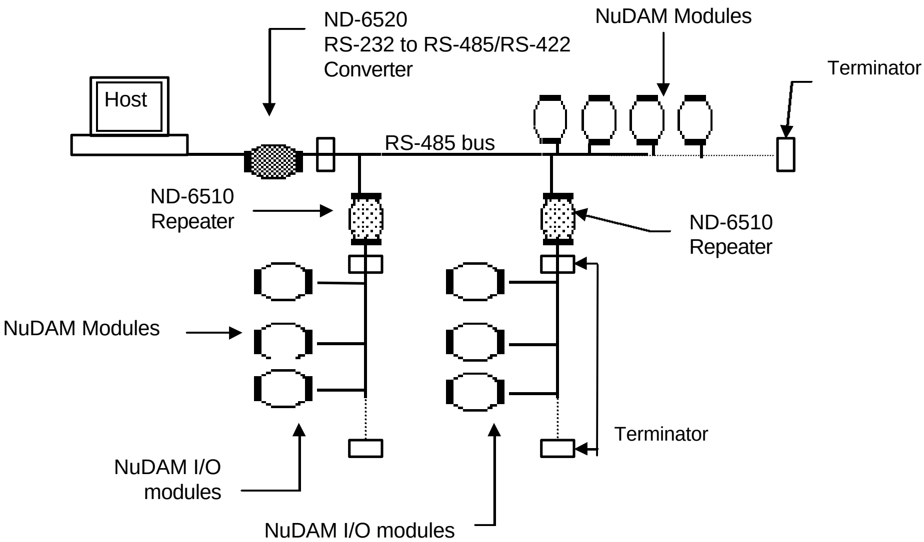


Figure 1-3 Free Topology

1.7 Constructing a NuDAM Network

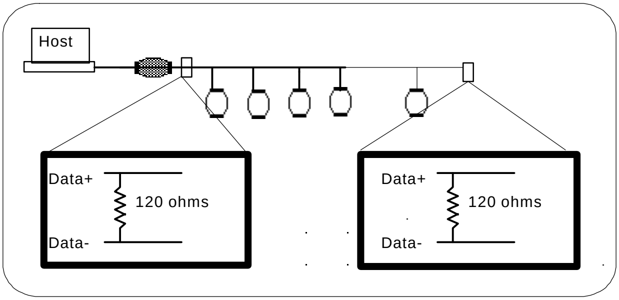
Go through the following steps, the user can construct a NuDAM network easily.

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

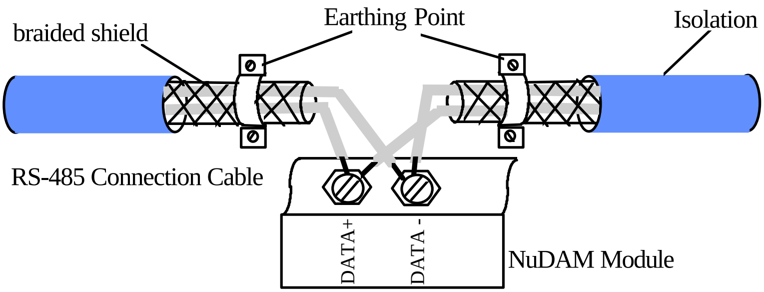
In case of increased interference, a shielded bus cables is recommended to use for wiring between module and modules. In addition, a shielding also should be done for the cable of power supply and for the signal cables.

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-422/RS-485 converter, it converts the RS-232 signal to the RS-422/RS-485 signals. The ND-6520 can be considered as an extension RS-422/RS-485 serial port for the host computer. A standard 9-pin 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-422/RS-485 transceiver
- Differenial 2-wire half-duplex RS-485
- Easily setup and installation
- Auto direction flow control
- Maximum 128 NuDAM on a bus without using repeaters
- 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 female D-type connector
- Speed (bps) : 1200(115.2K[1]), 2400, 4800, 9600, 19.2K, 38.4K, RTS
- Data Format : 9 bits, 10 bits, 11 bits, or 12 bits

✧ **Output**

- Interface : RS-485, differential, 2 half-duplex wires
  RS-422, differential, 4 full-duplex wires
- Speed (bps) : 1200(115.2K[1]), 2400, 4800, 9600, 19.2K, 38.4K, RTS
- Max RS-485 network bus distance : 4000 ft. (1200m)

✧ **Isolation**

- Isolation voltage :5000 Vrms(between RS-422/RS-485 network and host computer)

✧ **Bus**

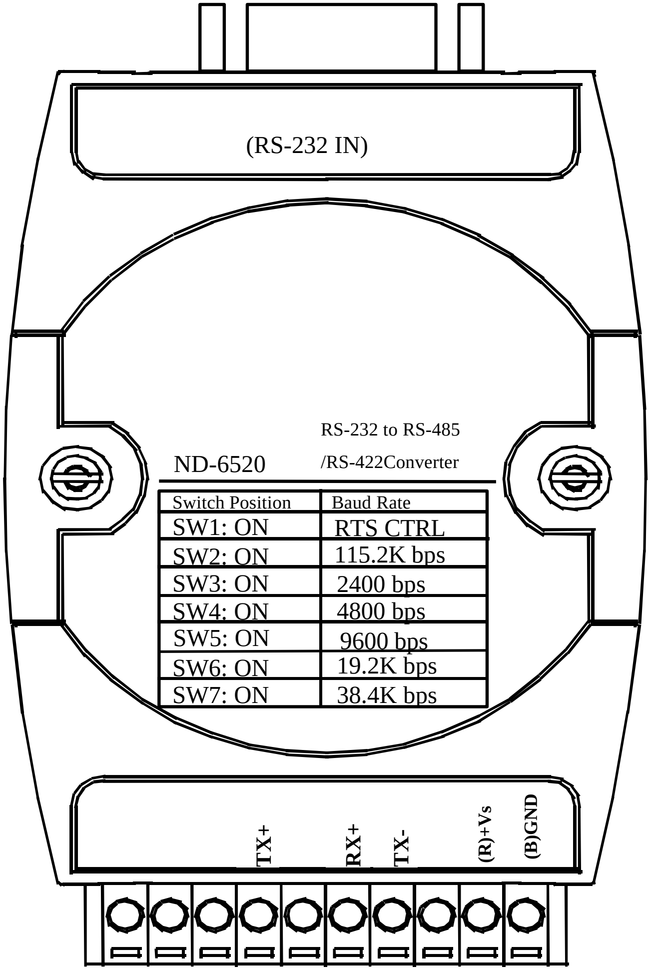
- Max loading : 128 NuDAMs on a RS-485 network
- Max modules : 256 NuDAMs with one ND-6510 repeater

✧ **Power**

- Power Supply : +10V to +30V
- Power Consumption : 0.95 W

Note 1: 115.2K is supported by version A1.2 or later.

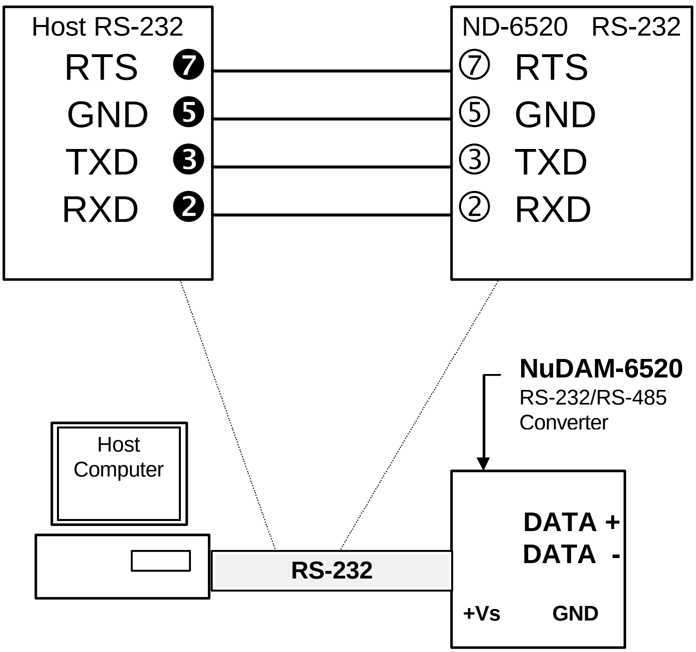
A Look at NuDAM-6520 & Pin Assignment



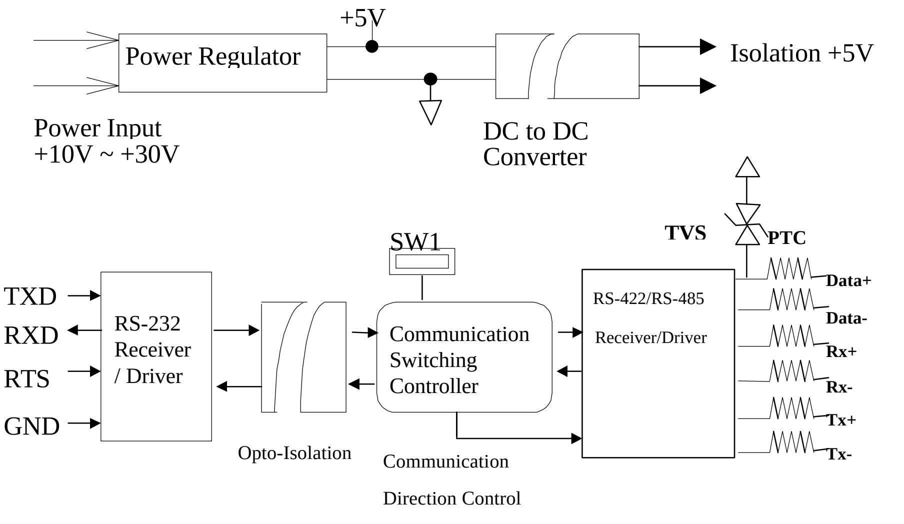
Pin Definitions

Pin #	Signal Name	Description
1	(Y)DATA+	RS-485 transmission line, positive
2	(G)DATA-	RS-485 transmission line, negative
4	TX+	RS-422 transmission line, positive
5	TX-	RS-422 transmission line, negative
6	RX+	RS-422 receiving line, positive
7	RX-	RS-422 receiving 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



TVS : Transient Voltage Suppresser
PTC : Positive Temperature Coefficient

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 applications' 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 ND-6520. The user can set the speed of the serial interface (RS-232 and RS-422/RS-485), and the serial data format. The speed and the data format on the whole RS-485 network must be identity otherwise the communication will be not correct.

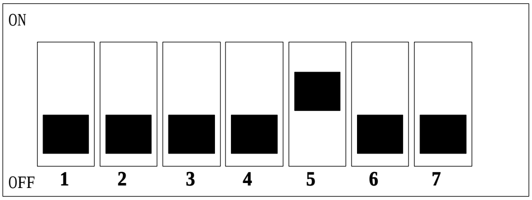
To setup the ND-6520, use the screw driver to open the case, then change the switch setting. The new setting is available after power on. The case must be put back and locked carefully. Note that do not scratch the surface of the circuit while setting up, otherwise the surface coating or even the circuits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

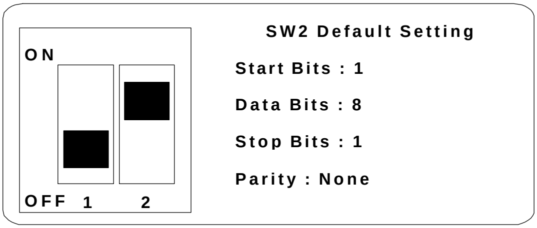
SW1 Default Setting (9600 bps)



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 or 115.2k[1] 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

Note 1: 115.2kbps is supported by version A1.2 or later.

SW2 Setting



1	2	Start Bit	Data Bits	Stop Bit	Parity	Packet Data Bits
OFF	OFF	1	7	1	0	9
		1	6	1	1	
OFF	ON	1	8	1	0	10
		1	7	1	1	
ON	OFF	1	9	1	0	11
		1	8	1	1	
ON	ON	1	10	1	0	12
		1	9	1	1	

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 (DB-9 female)
DC Power supply (+10V~+30V) (NDP-243u is recommended)
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.

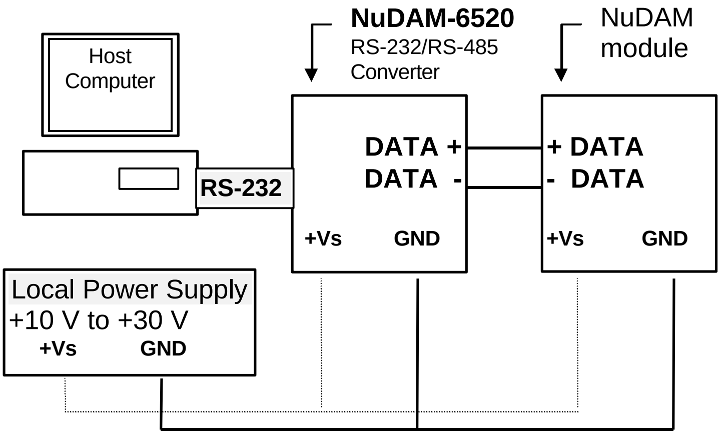


Figure 2-1 Application wiring of NuDAM-6520

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-422/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-422/RS-485 signal transceiver & repeater
- Bi-directions signal transmission for both RS-422/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
- Surge protection
- Lower power consumption

Specifications of NuDAM-6510

✧ **Input / Output**

- Interface : RS-485, differential 2 half-duplex wires
RS-422, differential, 4 full-duplex wires
- Speed (bps) : 1200(115.2K[1]), 2400, 4800, 9600, 19.2K, 38.4K
- Data Format : 9 bits, 10 bits, 11 bits, or 12 bits
- Max RS-485 network bus distance : 4000 ft. (1200m)

Note 1: 115.2k is supported by version A1.2 or later.

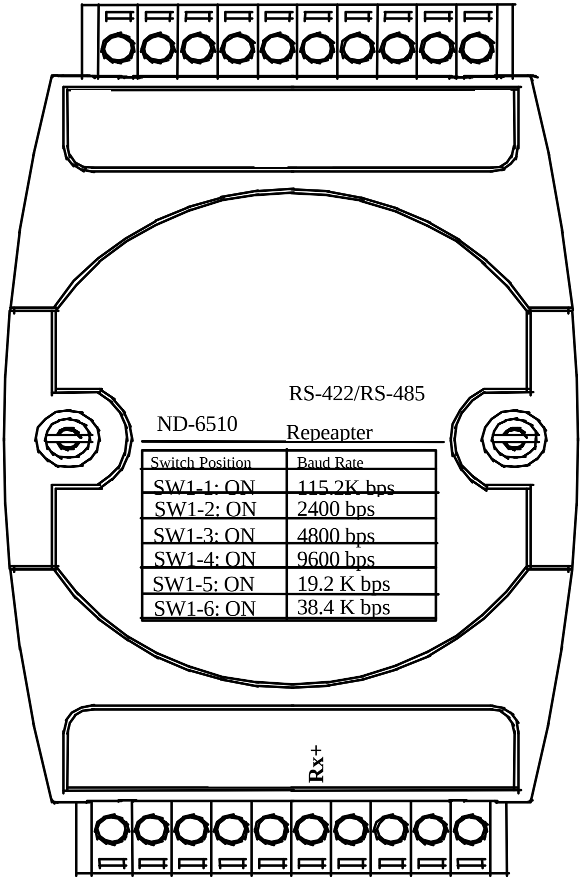
✧ **Bus**

- Max Loading : 128 NuDAMs on a bus

✧ **Power**

- DC Power Supply : +10V to +30V
- Power Consumption : 0.9 W

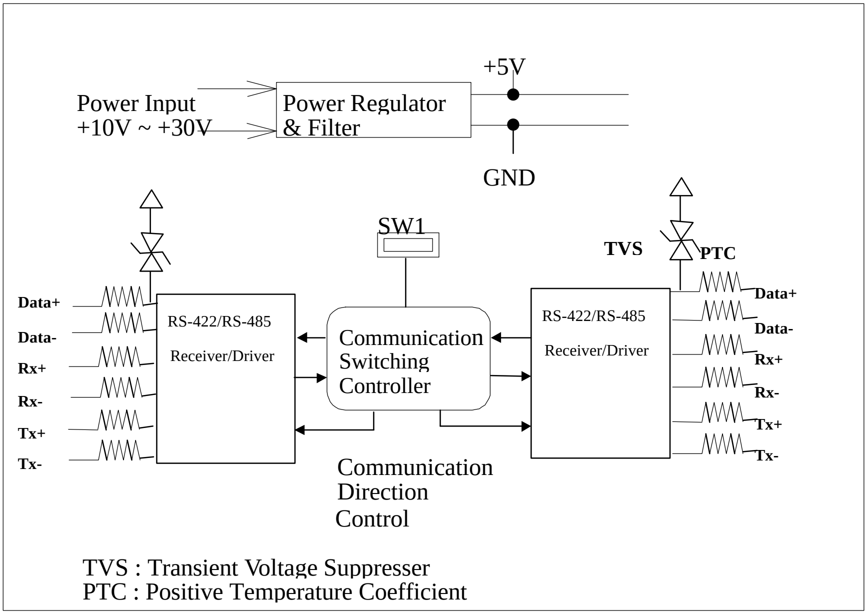
A Look at NuDAM-6510 & Pin Assignment



Pin Definitions

Pin #	Signal Name	Description
1	(Y)DATA+	RS-485 transmission line, positive
2	(G)DATA-	RS-485 transmission line, negative
4	TXIN+	RS-422 transmission input line, positive
5	TXIN-	RS-422 transmission input line, negative
6	RXOUT+	RS-422 receiving output line, positive
7	RXOUT-	RS-422 receiving output line, negative
9	(R)+VS	NuDAM power supply, +10V~+30V
10	(B)GND	NuDAM ground
14	RXIN-	RS-422 receiving input line, negative
15	RXIN+	RS-422 receiving input line, positive
16	TXOUT-	RS-422 transmission output line, negative
17	TXOUT+	RS-422 transmission output line, positive
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 only needs to setup the NuDAM-6510 when the NuDAM bus with more than 128 modules or the distance exceeds 4000 feet long. 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 ND-6510. The user can set the speed and the data format of the RS-422/RS-485 interface. The speed and the data format on the whole network must be identity otherwise the communication may be not correct.

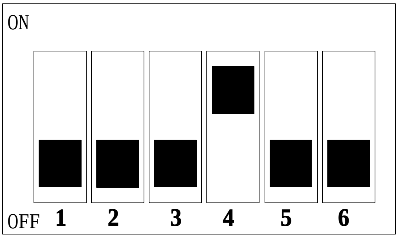
To setup the ND-6510, use the screw driver to open the case, then change the switch setting. The new setting is available after power on. The case must be put back and locked carefully. Note that do not scratch the surface of the circuit while setting up, otherwise the surface coating or even the circuits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

Default Setting

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

SW1 Setting

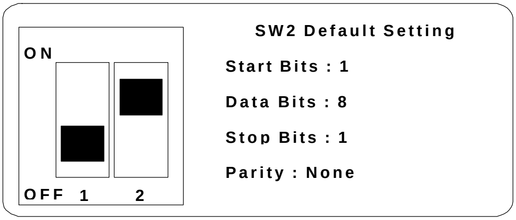
SW1 Default Setting (9600 bps)



1	2	3	4	5	6	Baud Rate
ON	OFF	OFF	OFF	OFF	OFF	1200 or 115.2k[1] 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

Note 1: 115.2kbps is supported by version A1.2 or later.

SW2 Setting



1	2	Start Bit	Data Bits	Stop Bit	Parity	Packet Data Bits
OFF	OFF	1	7	1	0	9
		1	6	1	1	
OFF	ON	1	8	1	0	10
		1	7	1	1	
ON	OFF	1	9	1	0	11
		1	8	1	1	
ON	ON	1	10	1	0	12
		1	9	1	1	

3.3 Installation

Software Utility

Software is not necessary.

Equipments for Installation

A 2-wire RS-485 network or 4-wire RS-422 network.
DC Power supply (+10V~+30V)
Wires

Installation Procedure

1. Make sure the original RS-422/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

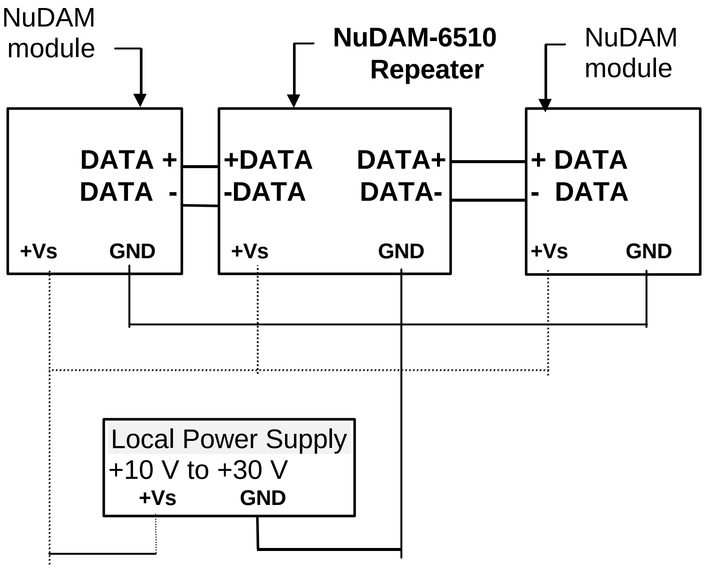


Figure 3-1 NuDAM-6510 wiring.

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 ND-6520 and ND-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***. "<u>The module will be set as *Initial State* if the **Default*** pin is shorted to ground</u>." 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
- DC 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 ND-6520. Be suring the baud rate of the ND-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 ND-6520.
2. Connect a brand new NuDAM module with the RS-485. Refer to Figure 4.1 for detail wiring.
3. Configure the ND-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 ND-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

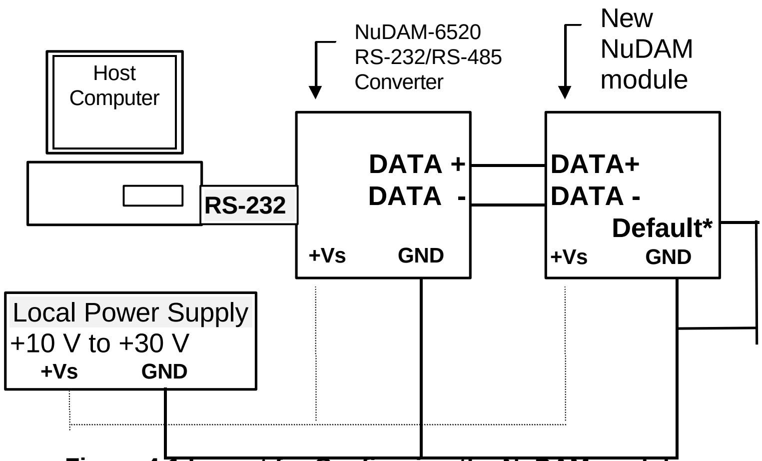


Figure 4-1 Layout for Configuring the NuDAM module

4.2 Install a New NuDAM to a Existing Network

Equipments for Install a New Module

- A existing NuDAM network
- New NuDAM modules.
- DC 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. Insert “ADLink All-in-one CD” into your CDROM driver.
2. Move cursor on NuDAM and click.
3. Move cursor on NuDAM 6000 Admin Utility and click.
4. Select the driver you want to install and follow the setup instructions on screen.

5.2 How to Execute the NuDAM Administration

What environment you needed ?

1. At least one RS-232 communication port.
2. Microsoft Windows(version 3.1, 95/98/NT)
3. At least 2MB Hard Drive Space
4. A VGA monitor(optional)
5. Mouse (optional)

Execute the NuDAM Administration Utility

- Run “NuDAM Administration Utility” Icon.

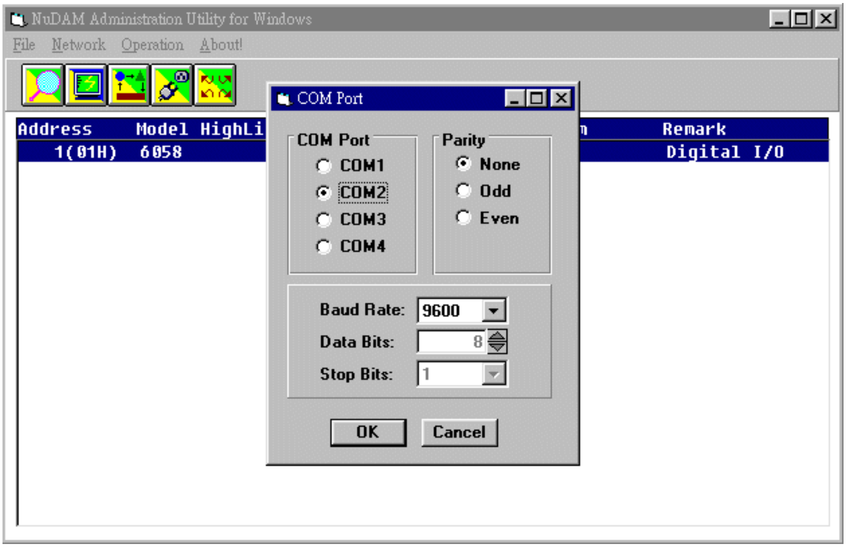
5.3 NuDAM Administration Function Overview

Default RS-232 Communication Port Setting.

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

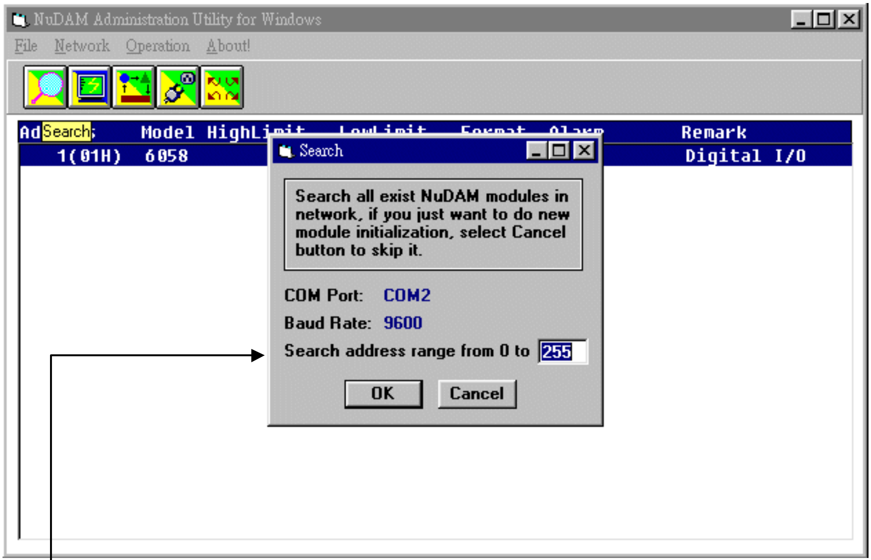
5.3.1 Change RS-232 Communication Port Setting.

Choose “Network-ComPort” to change setting.



5.3.2 Search all exist Nudam modules

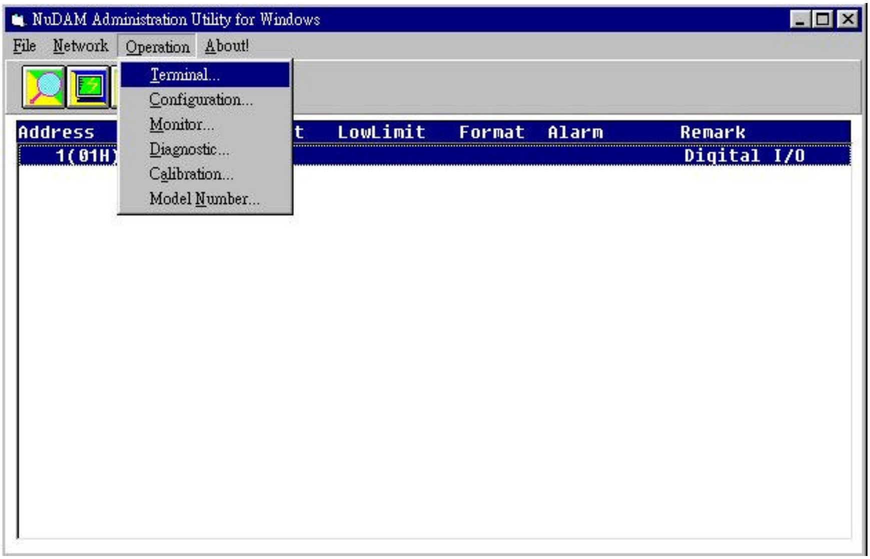
Choose “Network-Search” to search all exist Nudam modules in the current RS-485 network.



You can change search addresses range from here.

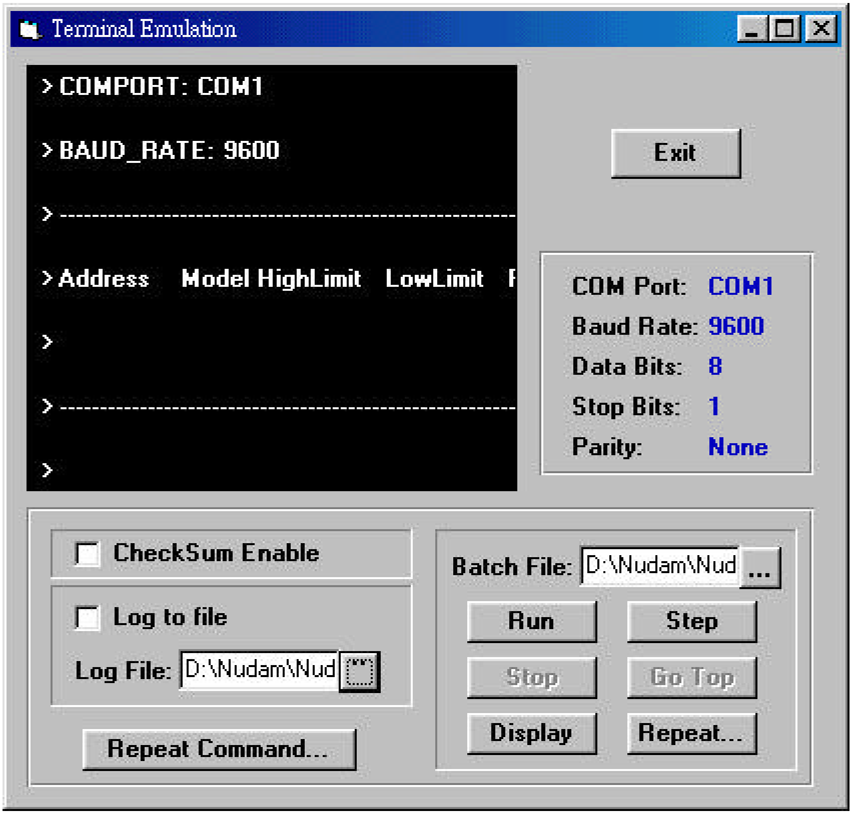
5.3.3 Using Operations

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
Operation-Model Number:	Select Model Number



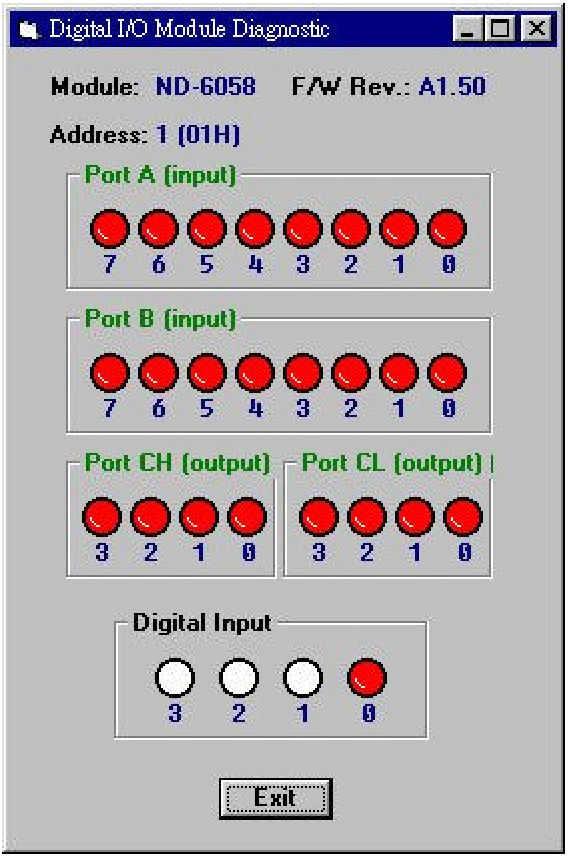
Term ICON for Operation-Terminal

You can remote control all moudles by directly using command mode, or testing your from this Terminal.

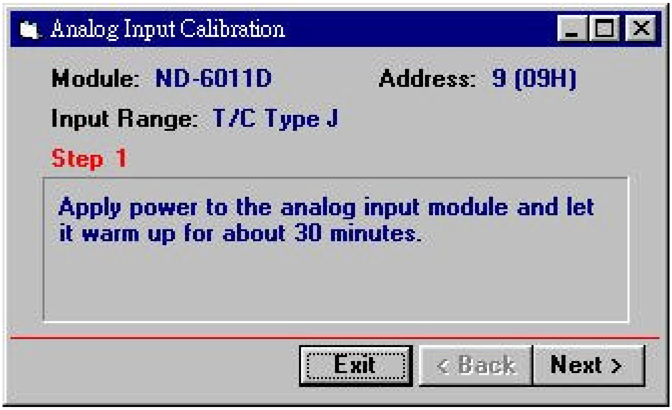


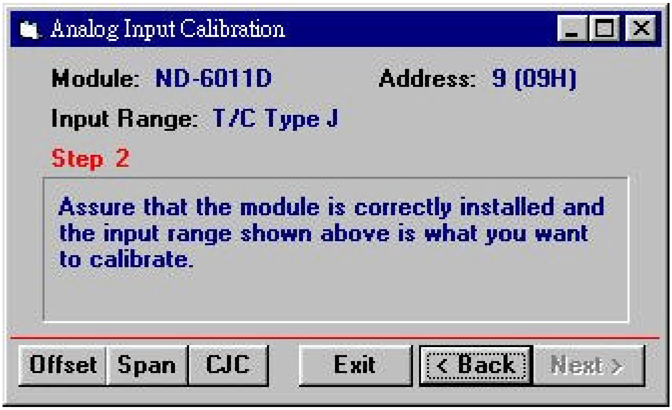
Operation-Run Batch	:	Run batch command file in BATCH.CMD user can edit this text file.
Operation-Step Batch	:	Run the batch command step by step.
Operation-Display Batch	:	Display content of BATCH.CMD
Operation-Repeat	:	Repeat one command n times

Diag ICON for Operation-Diagnostic
This dialog is different by different-fuction modules.


Digital I/O Module Diagnostic
Module: ND-6058
F/W Rev.: A1.50
Address: 1 (01H)
Port A (input)
7 6 5 4 3 2 1 0
Port B (input)
7 6 5 4 3 2 1 0
Port CH (output)
3 2 1 0
Port CL (output)
3 2 1 0
Digital Input
3 2 1 0
Exit

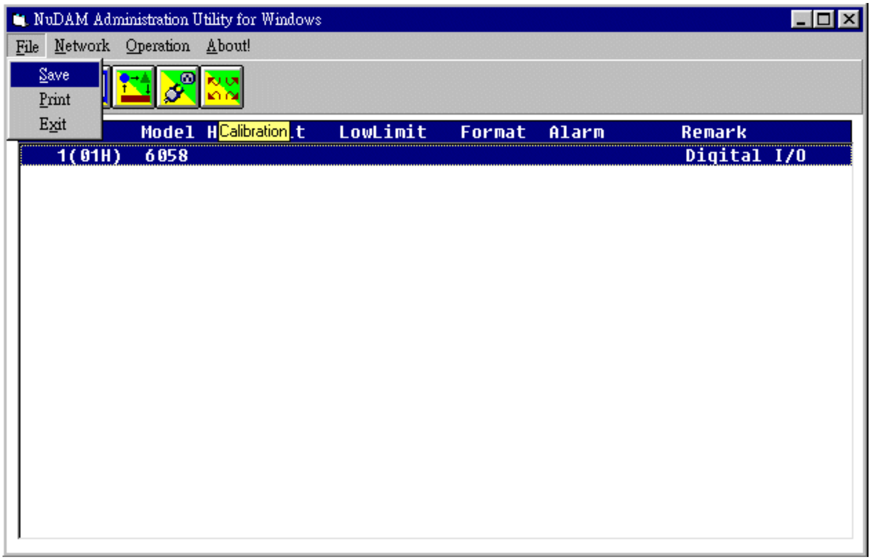
Cal ICON for Operation-Calibration
This dialog is different by different-fuction modules.





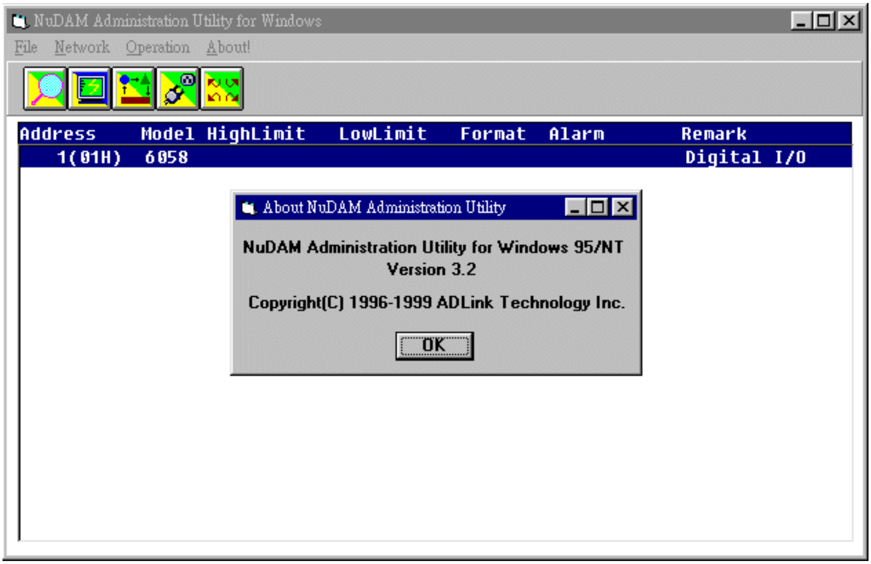
5.3.4 Save and Print Nudam modules' information

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.



5.3.5 Version Information

Help-About Version information



6. Troubleshooting and Maintenance

Preventive Maintain

- Periodic check for loose connection

ATTENTION: To avoid electircal shock or unintended operation of the module, remove incoming power before checking connections.

Using the LED Indication

The LED provides status information on Modules operation. The troubleshooting about shows LED indicator. It also shows how to use the LED to detect and correct common operating problems.

LED	What it Means:	What to do:
OFF	1. Module is not receiving input power by loosing wiring.	1. Check module wiring, cable connections, and cable connections on terminal block.
ON(RED)	1. Normal receiving state.	1. No action required.
Flashing	1. Normal transmitting state.	1. No action required.

Other Malfunctions

Problem	What it Means:	What to do:
Do not function	1. Loose wiring 2. Incorrect DIP switch setting	1. Check wiring and cable connection 2. Check Baudrate and data packet setting of the DIP switch.