eDAM-8000 Analog series User's manual

Web site: www.inlog.com.tw

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Chapter 1 Introduction

1.1 Overview

The eDAM-*8000* analog modules is a set of intelligent sensor to computer interface modules containing built-in microprocessor. They provide data comparison, and digital communication functions. Some modules provide analog I/O lines for controlling and monitoring analog signals.

1.2 Module Compatibility

The *eDAM-8000* series are fully compatible to Advantech® ADAM-4000 series, ADlink® NµDAM-6000 series and ICP® I-7000 series by Command "~AA2X01V"

1.3 Communication and Programming

eDAM modules can connect to and communicate with all computers and terminals. They use RS-485 transmission standards, and communicate with ASCII format commands. All communications to and from the module are performed in ASCII, which means that eDAM modules can be programmed in virtually any high-level language.
Up to 256 eDAM modules may be connected to an RS-485 multi-drop network by using the eDAM RS-485 repeater, extending the maximum communication distance to 4,000 ft.

1.4 Software Configuration and Calibration

EDAM modules contain no pots or switches to set. By merely issuing a command from the host computer, you can change an analog input module to accept several ranges of voltage input.

Remote configuration can be done by using the command set's configuration and calibration commands.
By storing configuration and calibration parameters in a nonvolatile EEPROM, modules are able to retain these parameters in case of power failure.

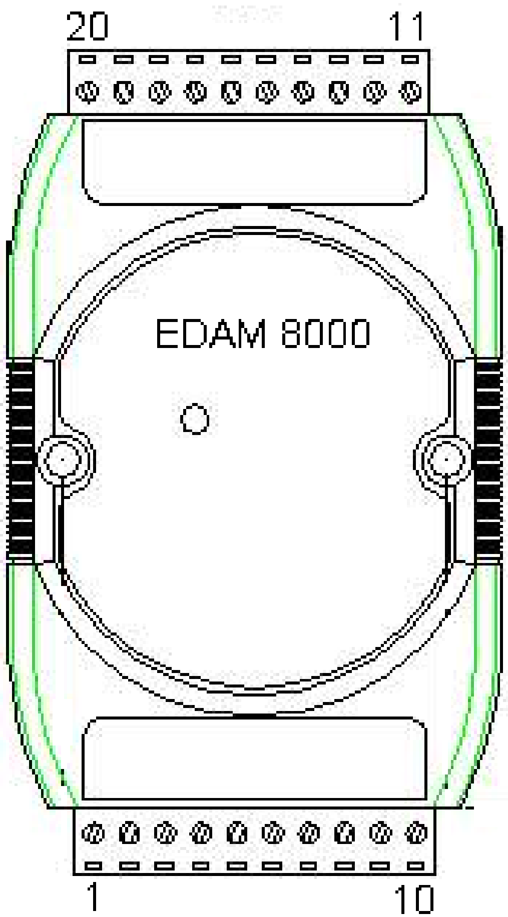
1.5 Watchdog Timer

A watchdog timer supervisory function will automatically reset the eDAM modules in the event of system failure. Maintenance is thus simplified.

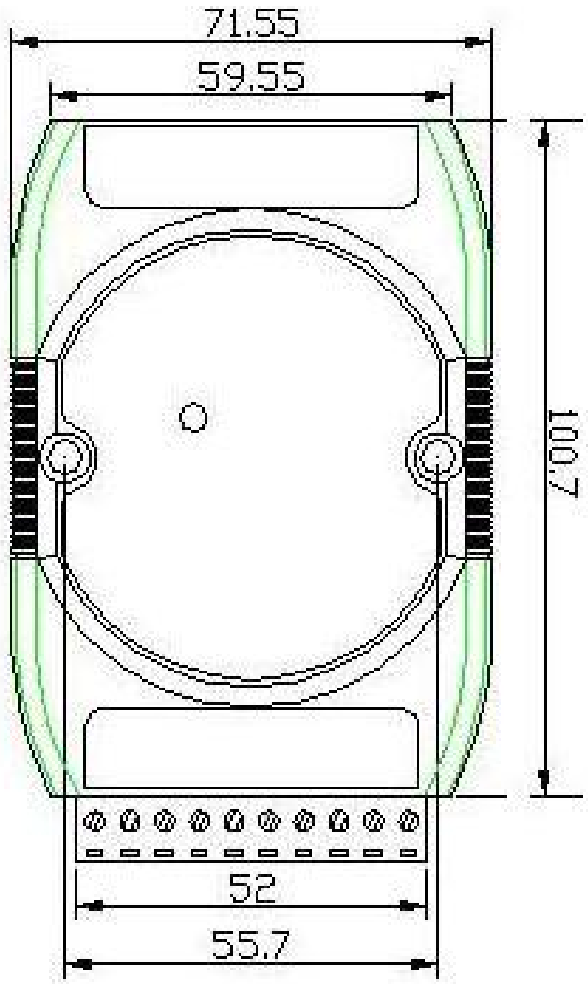
1.6 Power Requirements

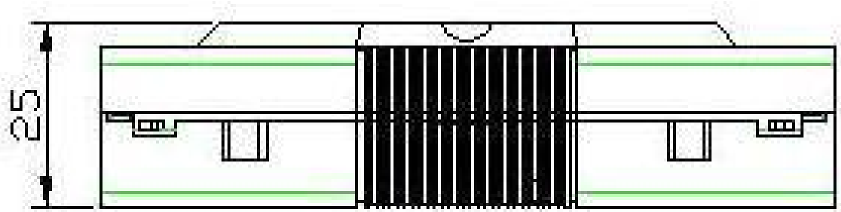
Although the modules are designed for standard industrial unregulated 24V DC power supply , they accept any power unit that supplies power within the range of +10 to +30 V DC . The power supply ripple must be limited to 5 V peak-to-peak, and the immediate ripple voltage should be maintained between +10 and +30 V DC .

2.1 Outline of eDAM Analog modules



2.2 Module Dimension

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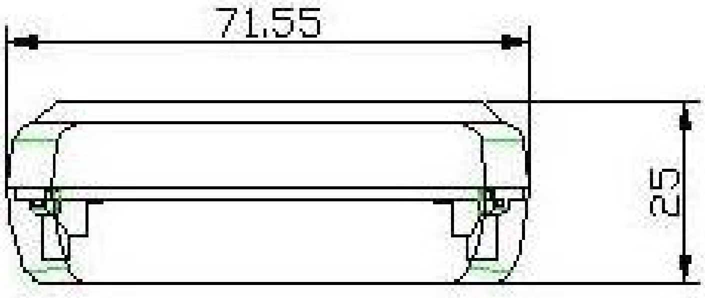
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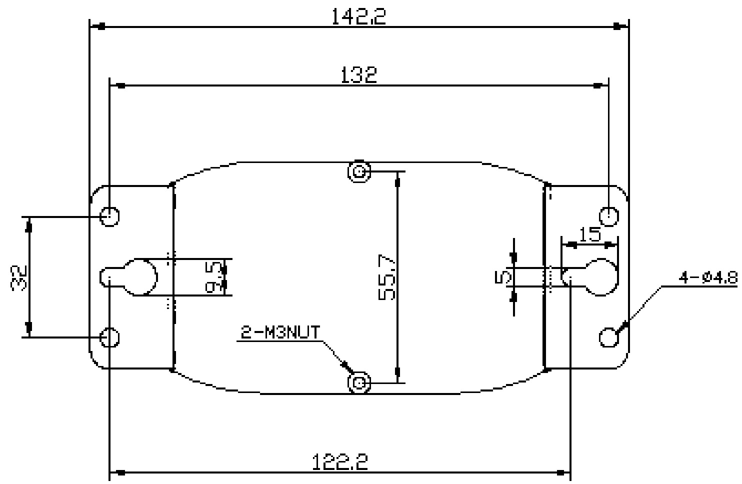
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2-M3NUT
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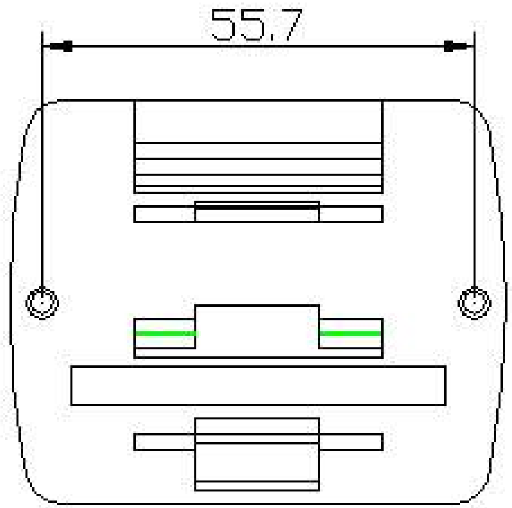
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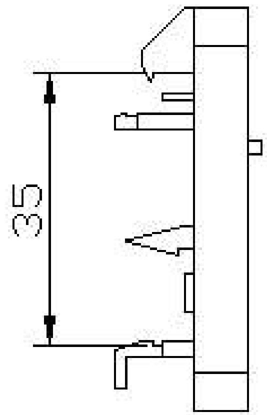
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2.3 eDAM Analog modules

The eDAM provides a series of analog input or digital in/output modules to sense the analog and digital signal or to control the remote devices.

- eDAM-8012 : Photo-isolated 1-channel analog input and 3 channel digital I/O module
- eDAM-8012D: Photo-isolated 1-channel analog input and 3 channel digital I/O module with seven segment display
- eDAM-8014: Photo-isolated 2-channel V/I input and 3 channel digital I/O module
- eDAM-8014D : Photo-isolated 2-channel V/I input and 3 channel digital I/O module with seven segment display
- eDAM-8017 : Photo-isolated 8-channel analog input module

2.4 Specifications

2.4.1 eDAM-8012/8012D module

eDAM-8012/D provides one isolated analog input channel with input type mV, V, mA, one digital input channel and two digital output channels with common ground.

Specifications

- Interface : RS-485, 2 wires
- Speed: 1200, 2400, 4800, 9600, 19.2K, 38.4K ,115.2K
- Analog input :
  Channel: 1
  Input type: mV, V, mA (with external 125 ohms shunt resistor)
  Sampling rate:
    Normal mode: 10 samples /sec (default)
    Fast mode: 100 samples/sec
  Resolution: 20-bit
  Bandwidth: 5.24Hz(normal mode)/52.4Hz(fast mode)
  Input Impedance: 20M ohms
  Isolation voltage: 3000VDC
  Overvoltage protection: ±40V
- LED display: 5 1/2 digits display (8012D only)
- Digital output
  Channel: 2
  Output type: Open collector (30VDC max.)
  Sink current: 300mA max.
  Power dissipation: 300mW

- Digital input
  Channel: 1
  Logical level 0: +1V max./Logical level 1: 3.5V to 30V
- Event counter:
  Maximum input frequency: 50Hz
  Minimum input width: 1ms
- Power input : +10V to +30VDC
- Consumption: eDAM-8012 :1.4W, eDAM-8012D: 2.0W

2.4.2 eDAM-8014/14D module

eDAM-8014/D provides one isolated voltage analog input channel and one current analog input channel with input type mV, V, mA, one digital input channel and two digital output channels with common ground

Specifications

- Interface: RS-485, 2 wires
- Speed: 1200, 2400, 4800, 9600, 19.2K, 38.4K ,115.2K
- Analog Input
  Channel: 1 voltage input and 1 current input
  Input type: single-ended input
  Unit conversion: mV, V, or mA
  Voltage Range: ±10V, ±5V, ±1V, ±500mV, ±150mV
  Current Measurement: ±20mA
  Input impedance:
    Voltage input: 20M ohms
    Current input: 125 ohms
  Accuracy: ±0.05%
  Isolation Voltage: 3000 Vrms.
  Over voltage protection: ±40V
- Digital Output
  Channel numbers: 2
  Output characteristic: open collector transistor
  Maximum current sink: 30mA
  Max. power dissipation: 300mW
- Digital Input
  Channel numbers: 1
  Logical level 0: +1V maximum
  Logical level 1: +2.0V~30V

Pull up resister: 10K ohms

- Event counter:
  Maximum input frequency: 50Hz
  Minimum input width: 1ms
- Excitation voltage output: +15VDC @30mA
- Power supply: +10V to +30V
- Power consumption: 8014: 1.4 W/ 8014D: 2W

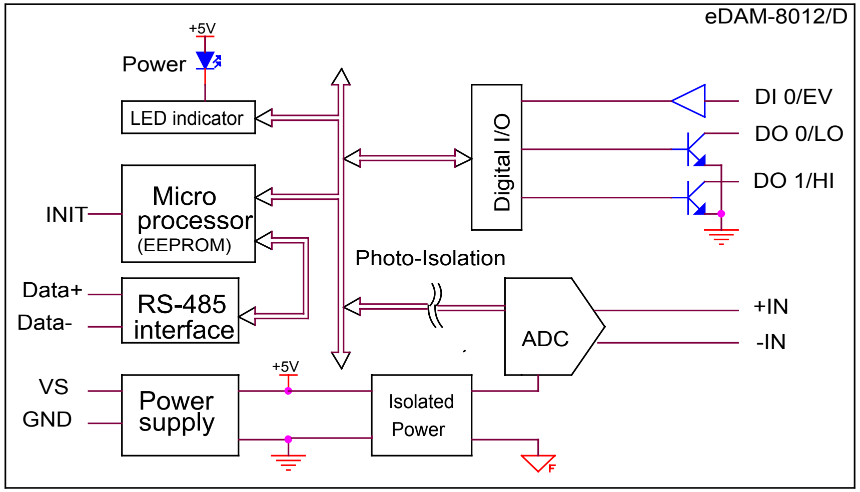
2.4.3 eDAM-8017 module

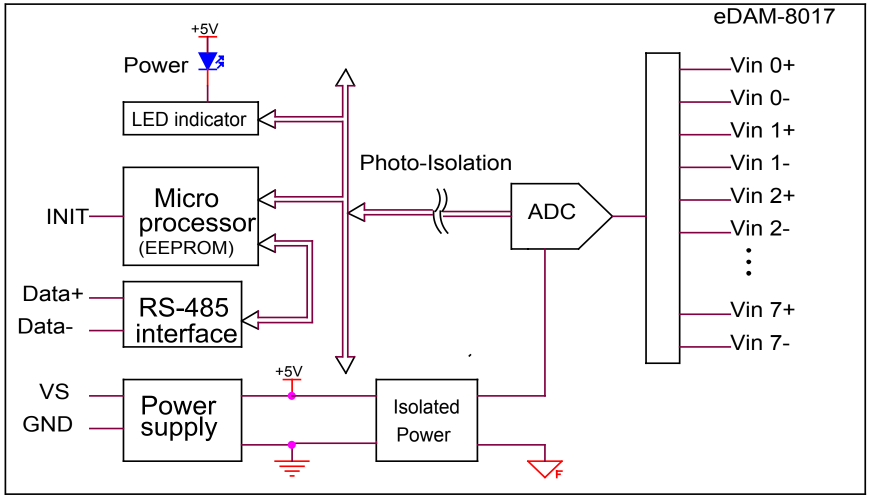
eDAM-8017 is an analog input module with 8 differential input channels or six differential inputs and two single-ended inputs

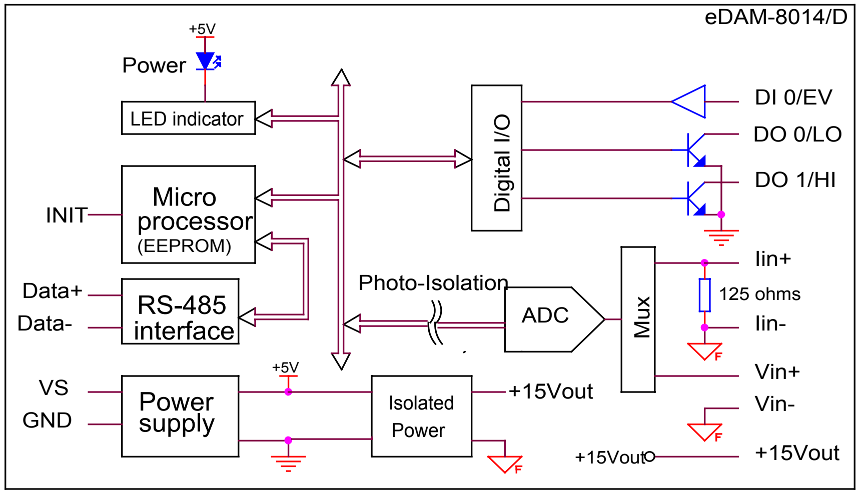
Specifications

- Interface : RS-485, 2 wires
- Speed: 1200, 2400, 4800, 9600, 19.2K, 38.4K ,115.2K
- Analog Input channels:
  6 differential and 2 single–ended or 8 differential
- Accuracy: ±0.1%(normal mode)/ ±0.5%(fast mode)
- Sampling rate:
  10 samples/sec (normal mode) (default)
  75 samples/sec (fast mode)
- Unit conversion: mV, V or mA
- Voltage range: programmable 5 levels:
  ±10V, ±5V,±1V,±500mV,±150mV
- Current measurement: 20mA (with 125 ohm shunt resistor)
- Isolation Voltage: 3000 Vrms
- Over voltage protection: ±40V
- Storage Temperature Range: -25 to 80 °C
- Operating Temperature Range: -10 to 70 °C
- Power Requirement: +10V to +30VDC Unregulated
- Power Consumption: 1.2W
- Case: ABS with captive mounting hardware

2.5 Block diagram of modules

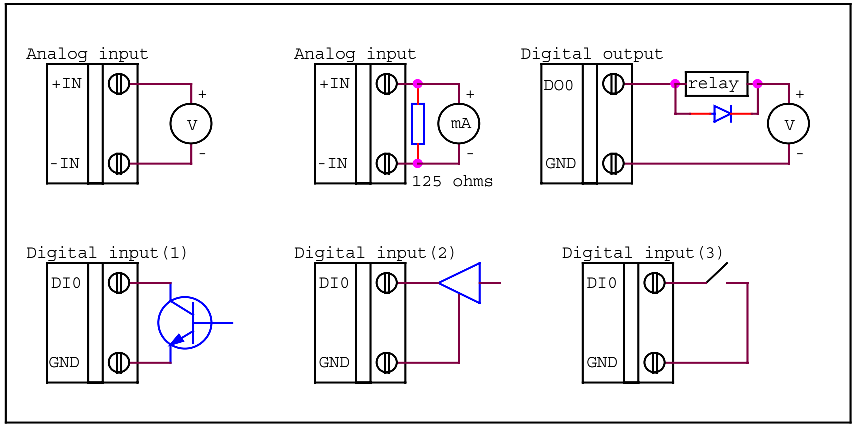




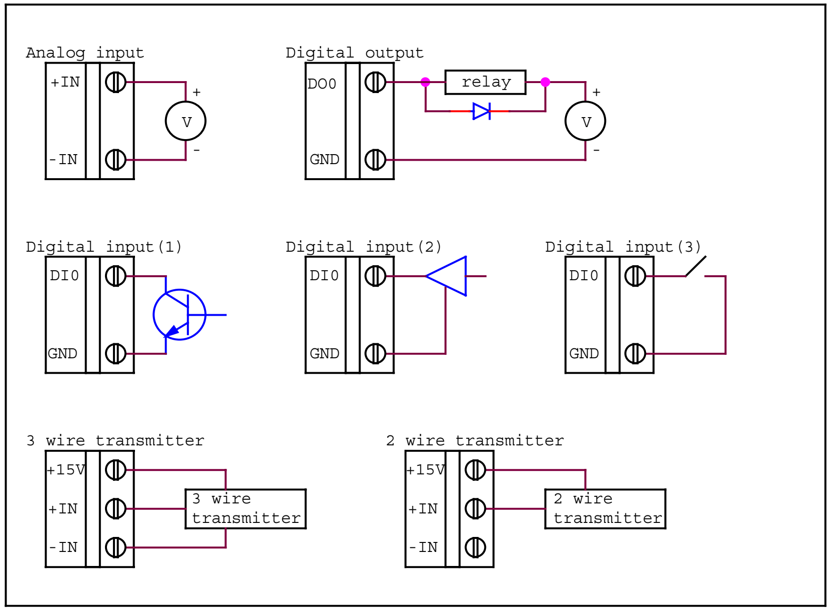


2.6 Wire connection

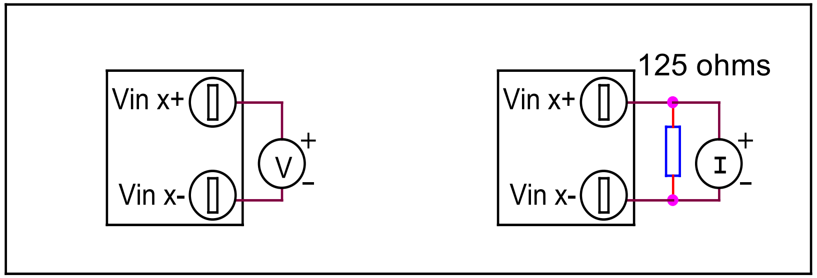
2.6.1 EDAM-8012/8012D wire connection



2.6.2 EDAM-8014/14D wire connection



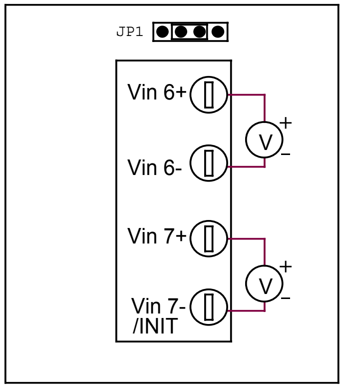
2.6.3 EDAM-8017 wire connection

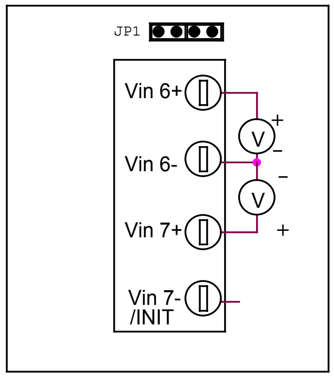


Differential analog input for channel 0 to channel 7

Analog input mode for channel 6 can channel 7 can be selected by setting JP1 on the board

Differential input channel 6 and 7 Single-ended input channel 6 and 7





Chapter 3 Pin definitions

3.1 EDAM8012/8012D

pin	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	INIT*	Initial state setting
7	DATA+	RS-485 series signal, positive
8	DATA-	RS-485 series signal, negative
9	+Vs	Power supply, +10V~+30V
10	GND	Ground

3.2 EDAM8014/8014D

pin	name	description
1	+15V out	External +15V output
2	Iin+	Current input positive terminal
3	Iin-	Current input negative terminal
6	INIT*	Initial state setting
7	DATA+	RS-485 series signal, positive
8	DATA-	RS-485 series signal, negative
9	+Vs	Power supply, +10V~+30V
10	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

3.3 EDAM8017

pin	name	description
1	Vin5+	Differential positive input channel 5
2	Vin5-	Differential negative input channel 5
3	Vin6+	Differential/single-ended input channel 6
4	Vin6-/AGND*	Differential negative ground of channel 6 or AGND for single-ended input channel 6 & 7
5	Vin7+	Differential/single-ended input channel 7
6	Vin7-/INIT**	Differential negative ground of channel 7 or Initial state setting
7	DATA+	signal, positive
8	DATA-	signal, negative
9	+VS	+10V ~ +30Vdc
10	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

* Negative input of channel 6 or common AGND of channel 6 and 7 depended on JP1 setting (see page 22)

** Negative input of channel 7 or INIT (Initial state setting) pin

Chapter 4 Installation

This chapter provides guidelines to what is needed to set up and install an eDAM network. A quick hookup scheme is provided that lets you configure modules before they are installed in a network. To help you to connect eDAM modules with sensor inputs, several wiring examples are provided. Finally, you will find at the end of this chapter a programming example using the eDAM command set.

Be sure to carefully plan the layout and configuration of your network before you start. Guidelines regarding layout are given in Appendix E: RS-485 Network.

NOTICE: Except for changing eDAM to other compatible modules, which have on-board switches for their baud rate setting, eDAM modules should not be opened. There is no need to open the eDAM modules: all configuration is done remotely and there are no user serviceable parts are inside. Opening the cover will therefore void the warranty.

4.1 Set up an eDAM network

The following list gives an overview of what is needed to setup, install and configure an eDAM environment.

- A host computer that can output ASCII characters with an RS-232C or RS-485 port.
- Power supply for the eDAM modules (+10 to +30 V_{DC})
- eDAM Series Utility software

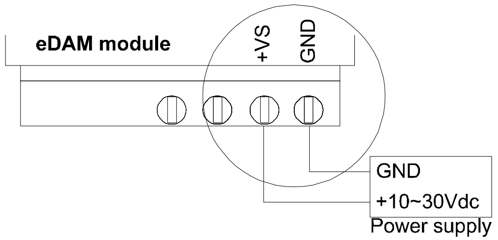
4.2 Host computer

Any computer or terminal that can output in ASCII format over either RS-232 or RS-485 can be connected as the host computer. When only RS-232 is available, an eDAM-8520 module (RS-232/RS-485 converter) is required to transform the host signals to the correct RS-485 protocol. The converter also provides opto-isolation and transformer-based isolation to protect your equipment.

For the ease of use in industrial environments the eDAM modules are designed to accept industry standard +24 V_{DC} unregulated power. Operation is guaranteed when using any power supply between +10 and +30 V_{DC}. Power ripples must be limited to 5 V peak to peak while the voltage in all cases must be maintained between +10 and +30 V_{DC} . All power supply specifications are referenced at module connector. When modules are powered remotely, the effects of line voltage drops must be considered.

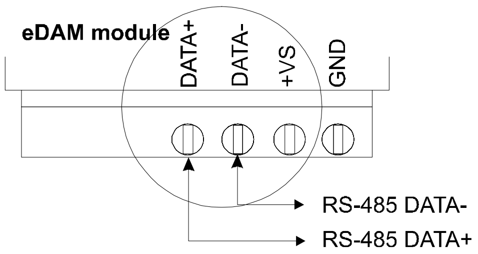
4.3 Power supply

All modules use on-board switching regulators to sustain good efficiency over the 10-30V input range, therefore we can assume that the actual current draw is inversely proportional to the line voltage. The following example shows how to calculate the required current that a power supply should be able to provide.



4.4 Communication Wiring

We recommend that shielded-twisted-pair cables that comply with the EIA RS-485 standard be used with the eDAM network to reduce interference.



4.5 eDAM Utility Software

A menu-driven utility program called "DOSEDAM.EXE" for DOS or "WINEDAM.EXE for Windows is provided for eDAM module configuration, monitoring and calibration. It also includes a terminal emulation program that lets you easily communicate through the eDAM command set

4.6 eDAM Isolated RS-232/RS485 Converter

When the host computer or terminal has only a RS-232 port, an eDAM-8520 Isolated RS-232/RS-485/422 converter connected to the host's RS-232 port is required.
This module equips a "Auto baud rate detector" inside, therefore it can detect the baud rate and data format automatically and control the direction of RS-485 precisely

4.7 Initializing a Brand-New Module

All eDAM modules in a RS-485 network must have an *unique* address ID. Therefore, to configure the brand-new 8012/D, 8014/D, 8017 before using is necessary

- Factory default settings:
  Address ID is 01
  Baud rate is 9600 bps, check-sum disable
  Analog input type: Type 08 (±10V)
  60Hz filter rejection mode
  Normal operation mode (for 8012/D, 8017)
  Six differential and 2 single-ended input mode (for 8017)
- INIT* State settings:
  The eDAM I/O modules must be set at *INIT* State* when you want to change the default settings, such as the *ID address, baud rate, check-sum status* etc. All eDAM I/O modules have an special pin labeled as **INIT***. The module will be in *Default State* if the **INIT*** 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.

4.8 Initialization Procedure

1. Power off the host computer and the installed eDAM-8520 to COM port of host computer.
2. Connect a brand new eDAM module with the RS-485. Set the module in *Default State* by shorting the **INIT*** pin to GND. Refer to Figure 4.1 for detailed wiring.
3. Power on the power supply for eDAM modules.
4. Use the eDAM utility to configure the address ID, baud rate, check-sum status and command sets of the module.

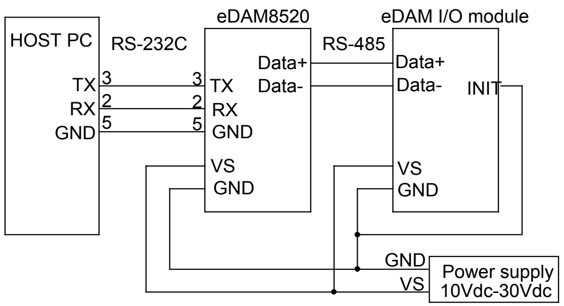


Figure 4.1

4.9 Install a New eDAM to a Existing Network

1. Equipments for Install a New Module
2. A existing eDAM network
3. New eDAM modules.
4. Power supply (+10 to +30 VDC)

Installing Procedures

1. Configure the new eDAM module according to the initialization procedure in section 4.7
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 eDAM modules on the network.
3. Power off the eDAM power supply of the existing RS-485 network.
4. Wire the power lines for the new eDAM with the existing network. Be careful about the signal polarity as wiring.
5. Wire the RS-485 data lines for the new eDAM with the existing network. Be careful about the signal polarity as wiring.
6. Wire to the input or output devices.
7. Power on the eDAM local power supply.
8. Use the eDAM utility to check entire network.

Chapter 5 Command Set

5.1 Introduction

The eDAM 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 eDAM module except those synchronized commands with wildcard address command “#**”. The eDAM may or may not give response to the command. The host should check the response to handshake with the modules.

5.2 Format of eDAM Commands

Syntax: (Leading code)(Addr)(Command)[Data] <Cksum><CR>

Every command begins with a delimiter character. There are five valid characters: a dollar sign $, a pound sign #, a percentage ,a wave sign ’~’ ,sign % and an at sign @.
The delimiter character is followed by a two-character address (hexadecimal) that specifies the target module. The actual two character command follows the address. Depending on the command, an optional data segment follows the command string. An optional two character checksum may be appended to the total string. Every commands is terminated by a carriage return (cr).
Conventions

Leading Code	The first characteristic of the eDAM command, such as %,$,#,~, @, ...etc(1- character)
Addr	Module’s address ID, the value is in the range of 00 – FF (Hex) 2- character
Command	Command codes or value of variables
Data	Data needed by some output command
Checksum	Checksum in brackets indicate optional parameter, only checksum is enable then this field is required (2- character)
<CR>	carriage return(0x0D)

Note:

1. all commands should be issued in ASCII uppercase characters. There is no spacing between characters.

Calculate Checksum:

1. Calculate ASCII sum of all characters of command (or response) string except the character return(cr)
2. Mask the sum of string with 0ffh
3. [Checksum]={(Leading code)+(addr)+(command)+[data]} MOD 0x100

Example:
Command string : $012(cr)
Sum of string='$'+'0'+'1'+'2'=24h+30h+31h+32h=B7h
The checksum is B7h, and [CHK]="B7"
Command string with checksum=$012B7(cr)
Response string : !01400600(cr)
Sum of string='!'+'0'+'1'+'4'+'0'+'0'+'6'+'0'+'0'
=21h+30h+31h+34h+30h+30h+36h+30h+30h=1ACh
The checksum is ACh, and [CHK]="AC"
Response string with checksum=!01400600AC(cr)

5.3 Response of Commands

The response message depends on eDAM 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.
But under the following conditions, there will have no response message.

- The specified address ID is not exist.
- Syntax error.
- Communication error
- Some special commands does not have response.

5.4 Summary of Command Set

There are four categories of eDAM commands. The first is the ***eDAM special command***s. The second is the ***general commands***, The third is the ***analog commands***., the forth is the ***digital commands*** and the last is ***linear mapping commands***. All the commands used in the eDAM analog input module are list in the following table.

5.4.1 eDAM Special commands

Command	Syntax	Modules	page
Set brand compatible	~AA2X01V	All modules	42
Read current brand setting	~AA2X02	All modules	43

5.4.2 General Commands

Command	Syntax	Modules	page
Set configuration	%AANNTTCCFF	All modules	44
Read configuration	$AA2	All modules	49
Set module Name	~AAO	All modules	50
Reset module	$AARS	All modules	51
Read module Name	$AAM	All modules	52
Read firmware Version	$AAF	All modules	53
Host OK	~**	Al modules	54
Read module status	~AA0	All modules	55
Reset module status	!AA1	All modules	56
Read host watchdog timeout interval	~AA2	All modules	57
Set watchdog timeout interval	~AA3EVV	All modules	58
Read power on value/safe value	~AA4	All modules	61
Set power on value/safe value	~AA5PPSS	All modules	63

5.4.3 Analog functional commands

Command	Syntax	Modules	page
Synchronized Sampling	#**	8012/D,8014/D	64
Read Synchronized Analog Data	$AA4	8012/D,8014/D	65
Read Analog Data	#AA	8012/D,8014/D	66
Span Calibration	$AA0	8012/D,8014/D,8017	67
Offset Calibration	$AA1	8012/D,8014/D,8017	69
Read Data From Chan. N	# AAN	8017	70
Enable/disable calibration	~AAEV	8012/D,8014/D,8017	67
Read All Analog Data	$AAA	8017	71
Enable/Disable Channel for Multiplexing	$AA5VV	8017	72
Read Channel Status	$AA6	8017	73
Read LED configuration	$AA8	8012D,8014D	74
Set LED configuration	$AA8V	8012D,8014D	75
Set LED data	$AA9DD	8012D,8014D	76

5.4.4 Digital functional Commands

Command	Syntax	Modules	page
Read Digital I/O and Alarm Status	@AADI	8012/D,8014/D	77
Set Digital Output	@AADODD	8012/D,8014/D	79
Clear Latch Alarm	@AACA	8012/D,8014/D	80
Clear Event Counter	@AACE	8012/D,8014/D	81
Disable Alarm	@AADA	8012/D,8014/D	82
Enable Alarm	@AAEAM	8012/D,8014/D	83
Set High Alarm	@AAHIDD	8012/D,8014/D	84
Set Low Alarm	@AALODD	8012/D,8014/D	85
Read Event Counter	@AARE	8012/D,8014/D	86
Read High Alarm	@AARH	8012/D,8014/D	87
Read Low Alarm	@AARL	8012/D,8014/D	88

5.4.5 Linear mapping functional Commands

Command	Syntax	Modules	page
Read Source High/Low Values for Linear Mapping	$AA3	8014/D	89
Read Target High/Low Values for Linear Mapping	$AA5	8014/D	90
Write Source High/Low Values for Linear Mapping	$AA6(SL)(SH)	8014/D	91
Write Target High/Low Values for Linear Mapping	$AA7(TL)(TH)	8014/D	92
Enable/Disable Linear Mapping	$AAAV	8014/D	93
Read Linear Mapping Status	$AAA	8014/D	93

5.5 Set brand compatible

Modules:	All eDAM modules	
Description:	Set compatible to other brand	
Command:	~AA2X01V[CHK](cr)	
Syntax:	~	Command leading code
	AA	Module address ID (00 to FF)
	2X	eDAM exclusive code
	01	Set Compatible command.
	V	Brand ID 0= eDAM , 1=ADAM 2=NuDAM, 3=I-7000
	CHK	Check sum
	(cr)	Carriage return
Response:	!AA[CHK](cr)	Valid Command
	?AA[CHK](cr)	Invalid Command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	AA	Module address ID
	CHK	Check sum
	(cr)	Carriage return and then reboot module

Note: Module will be set to default states after this command issued

Example: Set eDAM-8017 module with ID=02 to command compatible to NuDAM-6017

Command: ~022X012(cr)

Response: !02((cr)

Example: Set eDAM-8012 module with ID=02 to command compatible to I-7012

Command: ~022X013(cr)

Response: !02(cr)

5.6 Read current brand setting

Modules:	All eDAM modules	
Description:	Read current brand ID setting	
Command:	~AA2X02[CHK](cr)	
Syntax:	~	Command leading code
	AA	Module address ID (00 to FF)
	2X	eDAM exclusive code
	02	Read Brand ID com..
	CHK	Check sum
	(cr)	Carriage return
Response:	!AAV[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	AA	Module address ID
	V	Brand ID
	CHK	Check sum
	(cr)	Carriage return

Example: Read current brand ID of eDAM-8017 module with ID=02
Command: ~022X02(cr)
Response: !022((cr)   // Compatible to uDAM-6017

5.7 Set Module configuration

Modules:	8012/D, 8014/D, 8017	
Description:	Set module configuration	
Command:	%AANNTTCCFF[CHK](cr)	
Syntax:	%	Command leading code
	AA	Module address ID (00 to FF)
	NN	New eDAM address ID (00 to FF)
	TT	Analog input range (See *)
	CC	Set new baud rate of module (See **)
	FF	Data format (See ***)
	CHK	Check sum
	(cr)	Carriage return
Response:	!AA[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	AA	New Module address ID
	CHK	Check sum
	(cr)	Carriage return

Note: The module will be reboot after sending this command

***Analog Input type and range (TT)**

Type code	range	Modules
08	±10 V	8012/D,8017,8014/D
09	±5 V	8012/D,8017,8014/D
0A	±1 V	8012/D,8017,8014/D
0B	±500 mV	8012/D,8017,8014/D
0C	±150 mV	8012/D,8017,8014/D
0D	±20 mA	8012/D,8017, 8014/D (Required 125Ω current conversion resistor.)

**** Baud Rate settings (CC)**

code	03	04	05	06	07	08	09	0A
baud rate	1200	2400	4800	9600	19200	38400	57600	115200

*** :Data format settings (FF)

Bit	7	6	5	4	3	2	1	0

Bit7: =0 for 60 Hz (default)
=1 for 50 Hz
Bit6: =1 Enable checksum
=0 Disable checksum (default setting)
Bit5: =0 for normal operation mode (Default setting)
=1 for fast operation mode (8012/D,8017)
Bit4~bit2: No used
Bit1~bit0:=00 Engineer unit format (default setting)
=01 Percent format
=11 2's complement Hex format

Input types and data format table

Code	Range	Format	+F.S.	zero	-F.S
08	-10~+10 V	Engineer unit	+10.000	+00.000	-10.000
		%of F.S.R	+100.00	+000.00	-100.00
		2's complement	7FFF	0000	8000
09	-5~+5 V	Engineer unit	+5.0000	+0.0000	-5.0000
		%of F.S.R	+100.00	+000.00	-100.00
		2's complement	7FFF	0000	8000
0A	-1~+1 V	Engineer unit	+1.0000	+0.0000	-1.0000
		%of F.S.R	+100.00	+000.00	-100.00
		2's complement	7FFF	0000	8000
0B	-500~+500 mV	Engineer unit	+500.00	+000.00	-500.00
		%of F.S.R	+100.00	+000.00	-100.00
		2's complement	7FFF	0000	8000
0C	-150~+150 mV	Engineer unit	+150.00	+000.00	-150.00
		%of F.S.R	+100.00	+000.00	-100.00
		2's complement	7FFF	0000	8000
0D	-20~+20 mA	Engineer unit	+20.000	+00.000	-20.000
		%of F.S.R	+100.00	+000.00	-100.00
		2's complement	7FFF	0000	8000

Note:
It's needed to short the INIT pin to ground while changing baud rate and/or enable/disable checksum (see following examples)*

Example 1: Change ID address from 01 to 03 (Assume current baud rate is 9600 and checksum disabled)

Command: %0103080600(cr)
Response: !03(cr)
response new module ID address 03 (change ID address only)

Example 2: Change baud rate from 9600 to 19200(Assume current ID is 03, baud rate is 9600, and checksum disabled).

Because that the baud rate is changed from 9600 to 19200, the following procedures should be done before sending this command

1. Power off the module
2. Short INIT* pin to GROUND (see Appendix A)
3. Power on the module
4. send command string

   Command: %0003080700(cr)
   Response: !03(cr)
   response module ID address 03
5. Power off module
6. Open INIT* pin
7. Power on module again (Baud rate changed to 19200)

Example 3: Enable checksum(Assume current ID is 03, baud rate is 9600 and checksum disabled).

Because that the checksum is changed from disable to enable, the following procedures should be done before sending this command

1. Power off the module
2. Short INIT* pin to GROUND (see Appendix A)
3. Power on the module
4. send command string

   Command: %0003080640(cr)
   Response: !03(cr)
   response module ID address 03
5. Power off module
6. Open INIT* pin
7. Power on module again (checksum enabled)

Example 4: Change baud rate from 9600 to 19200 and enable checksum (Assume current ID is 03, baud rate is 9600 and checksum disabled).

Because that both the baud rate and checksum is changed , the following procedures should be done before sending this command

1. Power off the module
2. Short INIT* pin to GROUND (see Appendix A)
3. Power on the module
4. send command string

   Command: %0003080740(cr)
   Response: !03(cr)
   response module ID address 03
5. Power off module
6. Open INIT* pin
7. Power on module again

   (Baud rate changed to 19200 and checksum enabled)

It is recommended to use the setup utility to configure the module (see section 4.7 and 4.8)

5.8 Read Configuration

Modules:	For eDAM modules		
Description:	Read module configuration		
Command:	$AA2[CHK](cr)		
Syntax:	$	Command leading code	
	AA	Module address ID (00 to FF)	
	2	Command for reading configuration	
	CHK	Check sum	
	(cr)	Carriage return	
Response:	!AATTCCFF[CHK](cr)		Valid command
	?AA[CHK](cr)		Invalid command
	!	Delimiter for valid command	
	?	Delimiter for invalid command	
	AA	Module address ID	
	TT	Analog input type and range (see sec.5.7)	
	CC	Baud rate (see sec.5.7)	
	FF	Data format of module (see sec.5.7)	
	CHK	Check sum	
	(cr)	Carriage return	

Example 5: Read configuration of module with ID address=05

Command: $052(cr)
Response: !05080600(cr)
Read address ID=05 module configuration
08=Analog input range ±10 V
06=9600 baud rate
00=no checksum,

5.9 Set module name

Modules:	For all eDAM modules		
Description:	Set new module name.		
Command:	~AAO(data)[CHK](cr)		
Syntax:	$	Command leading code	
	AA	Module address ID (00 to FF)	
	O	Command for setting new name	
	(data)	Module name, Max. 6 characters	
	CHK	Check sum	
	(cr)	Carriage return	
Response: (see Note)	!AA [CHK](cr)		Valid command
	?AA[CHK](cr)		Invalid command
	!	Delimiter for valid command	
	?	Delimiter for invalid command	
	AA	Module address ID	
	CHK	Check sum	
	(cr)	Carriage return	

Example 1: Set new module name at address ID=30

Command: ~30O4012<CR>
Set new name 4012 to the module at address ID=30
Response: !30<CR>
! Command is valid.,

5.10 Reset module

Modules:	All eDAM modules	
Description:	Reset all existing eDAM modules	
Command:	$AARS[CHK](cr)	
Syntax:	$	Command leading code
	AA	Module address ID (00 to FF)
	RS	Reset command
	CHK	Check sum
	(cr)	Carriage return
Response:	No response	

Note: Reset command will reset module to default settings.
This command has no response from module

Example 1: Example: Reset module with ID address is 02

Command: $02RS(cr)
Response: No response

5.11 Read module name

Modules:	For eDAM DIO modules	
Description:	Read module's name	
Command:	$AAM[CHK](cr)	
Syntax:	$	Command leading code
	AA	Module address ID (00 to FF)
	M	Command for reading module's name
	CHK	Check sum
	(cr)	Carriage return
Response: (see Note)	!AA(data)[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	AA	Module address ID
	data	Module's name
	CHK	Check sum
	(cr)	Carriage return

Example 1: Read module's name of address ID=30

Command: $30M<CR>
Response: !308014<CR>
! Command is valid., Address ID=30, module's name=8014

5.12 Read firmware version

Modules:	For eDAM DIO modules	
Description:	Read module's firmware version.	
Command:	$AAF[CHK](cr)	
Syntax:	$	Command leading code
	AA	Module address ID (00 to FF)
	F	Command for reading firmware version.
	CHK	Check sum
	(cr)	Carriage return
Response: (see Note)	!AA(data)[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	AA	Module address ID
	data	Module's firmware version.
	CHK	Check sum
	(cr)	Carriage return

Example 1: Read firmware version of module address ID=30

Command: $30F<CR>
Response: !30A1.04<CR>
! Command is valid., Address ID=30, Firmware Version=A1.04

5.13 Host OK

Modules:	For all eDAM modules	
Description:	Host send this command to all modules for send the information "Host OK"	
Command:	~**[CHK](cr)	
Syntax:	~	Command leading code
	**	For all modules
	CHK	Check sum
	(cr)	Carriage return
Response:	No response	

Note:
When host watchdog timer is enable, host computer must send this command to all module before timeout otherwise **"Host watchdog timer enabled"** module's output value will go to safety state output value.

5.14 Read module's status

Modules:	For all eDAM modules	
Description:	Read watchdog timeout status	
Command:	~AA0[CHK](cr)	
Syntax:	~	Command leading code
	AA	Module address ID (00 to FF)
	0	Command for reading timeout status
	CHK	Check sum
	(cr)	Carriage return
Response:	! AASS[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	AA	Module address ID
	SS	SS=00 - watchdog timeout is cleared SS=04 - watchdog timeout is set SS=80 - watchdog activated
	CHK	Check sum
	(cr)	Carriage return

Note:

1. the watchdog timeout status will be stored in EEPROM of the module and can only be cleared by issuing ~AA1 command (see ~AA1 and ~AA3EVV commands)
2. When the module's watchdog timeout value is reached, this command will be responded with SS=04 otherwise SS=00
3. When the module's watchdog timer is not timeout, this command will be responded with SS=80

5.15 Reset module status

Modules:	For all eDAM modules	
Description:	Reset watchdog timeout status	
Command:	~AA1[CHK](cr)	
Syntax:	~	Command leading code
	AA	Module address ID (00 to FF)
	1	Command for resetting watchdog timeout status
	CHK	Check sum
	(cr)	Carriage return
Response:	! AA [CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	AA	Module address ID
	CHK	Check sum
	(cr)	Carriage return

Note:

1. The module's watch dog status will be cleared after this command issued
2. (reference to ~AA3EVV command)

5.16 Read host watchdog timeout value

Modules:	For all eDAM modules	
Description:	Read host watchdog timeout value	
Command:	~AA2[CHK](cr)	
Syntax:	~	Command leading code
	AA	Module address ID (00 to FF)
	2	Command for reading watchdog timeout value
	CHK	Check sum
	(cr)	Carriage return
Response:	! AAEVV[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	AA	Module address ID
	E	Host watchdog enable/disable status E=1 – Enabled E=0 – Disabled
	VV	Timeout value in Hex format from 01 to FF=25.5 seconds (one unit is 0.1 sec)
	CHK	Check sum
	(cr)	Carriage return

(also see sec 5.17)

5.17 Set host watchdog timeout value

Modules:	For all eDAM modules	
Description:	Set host watchdog timeout value	
Command:	~AA3EVV[CHK](cr)	
Syntax:	~	Command leading code
	AA	Module address ID (00 to FF)
	3	Command for setting watchdog timeout value
	E	1= enable, 0= disable Host watchdog
	VV	Timeout value (01~FF, each for 0.1 second)
	CHK	Check sum
	(cr)	Carriage return
Response:	! AA [CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	AA	Module address ID
	CHK	Check sum
	(cr)	Carriage return

Note:

If host watchdog timer is enabled, the host should send *Host OK* (see section 5.13) command periodically within Timeout value to refresh the timer, otherwise the module will be forced to safety state (see section 5.19)

Example 1: Set module (ID=04) to have watchdog timeout value 10.0 seconds and enable host watchdog

Command: ~043164<cr>

Set watchdog timeout value 10.0 sec and enable host watchdog

Response: !04<cr> Valid command

Example 2: Read watchdog timeout value form module (ID=04)

Command: ~042<cr>
Read watchdog timeout value
Response: !04164
Watchdog timeout value=10.0 seconds, and host watchdog is enabled

Example 3: Reset watchdog timer

Command: ~**<cr>
Read host watchdog timer

Stop sending any command string to modules for at least 10.0 seconds. The LED on the module will go to flash. The flash LED indicates the host watchdog is timeout and timeout status is set

Example 4: Read watchdog timeout status

Command: ~040<cr>
Read module (ID=04) watchdog timeout status
Response: !0404<cr>
Timeout status is set

Example 5: Read watchdog timeout value form module (ID=04)

Command: ~042<cr>
Read watchdog timeout value
Response: !04164
Watchdog timeout value=10.0 seconds, and host watchdog is **enabled**

Example 6: Reset watchdog timeout status

Command: ~041<cr>
Reset watchdog timeout status
Response: !04<cr>
Watchdog timeout is cleared and LED stop flashing, and host watchdog is disabled

Example 7: Read watchdog timeout status

Command: ~040<cr>
Read module (ID=04) watchdog timeout status
Response: !0400<cr>
Timeout status is cleared

5.18 Read power-on/safe value

Modules:	For all eDAM modules	
Description:	Read Power on and safe value	
Command:	~AA4[CHK](cr)	
Syntax:	~	Command leading code
	AA	Module address ID (00 to FF)
	4	Command for reading power on and safe value
	CHK	Check sum
	(cr)	Carriage return
Response: (see Note)	! AAPPSS[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	AA	Module address ID
	PP	Power on value (see *)
	SS	Safe value (see **)
	CHK	Check sum
	(cr)	Carriage return

*** Power on value:**

00=DO0 off and DO1 off
01=DO0 on and DO1 off
02=DO0 off and DO1 on
03=Do0 on and DO1 on

**** Safe value:**

00=DO0 off and DO1 off
01=DO0 on and DO1 off
02=DO0 off and DO1 on
03=Do0 on and DO1 on

Example 1: Read Power on /safe value

Command: ~0344<cr>
Read power on value
Response: !041100<cr>
11=power on value
00=safe value

5.19 Set power-on/safe value

Modules:	For all eDAM modules	
Description:	Set current output value as power on or safe value	
Command:	~AA5PPSS[CHK](cr)	
Syntax:	~	Command leading code
	AA	Module address ID (00 to FF)
	5	Command for setting power on or safe value
	PP	Power on value 00=DO0 off and DO1 off 01=DO0 on and DO1 off 02=DO0 off and DO1 on 03=DO0 on and DO1 on
	SS	Safe value 00=DO0 off and DO1 off 01=DO0 on and DO1 off 02=DO0 off and DO1 on 03=DO0 on and DO1 on
	CHK	Check sum
	(cr)	Carriage return
Response:	! AA [CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for valid command
	AA	Module address ID
	CHK	Check sum
	(cr)	Carriage return

Example 1: See sec.5.18

5.20 Synchronized Sampling

Modules:	For 8012,8012D,8014,8014D	
Description:	Synchronize all modules to sample analog input values and store 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.	
Command:	#**[CHK](cr)	
Syntax:	#	Command leading code
	**	Synchronized Sampling command
	CHK	Check sum
	(cr)	Carriage return
Response:	No response	

Example 1: Synchronized Sampling

command: #**<CR>
Synchronized sampling command has no response

5.21 Read Synchronized data

Modules:	For 8012,8012D,8014,8014D	
Description:	Read synchronized data	
Command:	$AA4CHK](cr)	
Syntax:	$	Command leading code
	AA	Module address ID (00 to FF)
	4	Command for reading synch. data
	CHK	Check sum
	(cr)	Carriage return
Response: (see Note)	!AAS(data)[CHK](cr)	Valid command
	? AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	AA	Module address ID
	S	Data status, S=1 first read, S=0 been read
	(data)	synchronized data
	CHK	Check sum
	(cr)	Carriage return

Example 1: Read Synchronized data from eDAM8012 (ID=05)

Command: $054(cr)
Response: !1097800(cr)
Read synchronized data from address ID=05 module
S=1 – first read
synchronized data=011+0.2556

5.22 Read analog data

Modules:	For 8012,8012D,8014,8014D,8017	
Description:	Read the ANALOG input value	
Command:	#AA[CHK](cr)	
Syntax:	#	Command leading code
	AA	Module address ID (00 to FF)
	CHK	Check sum
	(cr)	Carriage return
Response: (see Note)	>(data)[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	>	Delimiter for valid command
	?	Delimiter for invalid command
	(data)	Analog input data(see *)
	CHK	Check sum
	(cr)	Carriage return

*** "DD" Analog input data:**

If analog data of eDAM-8017 module be read by using this command, data of all channels are responded as follows:
>(chan.0 data) (chan.1 data) …… (chan.7 data) [CHK](cr)

Example 1: Read analog input data from eDAM8012 at address=05

Command: #05(cr)
Response: >+02.645(cr)
Read analog input data from address ID=05 module

Example 2: Read analog input data from eDAM8017 at address=05

Command: #05(cr)
Response:
+02.645-01.001+03.023+00.321+08.123-03.333+09.210-06.000(cr)

5.23 Enable/disable calibration

Modules:	For 8012,8012D,8014,8014D,8017	
Description:	Enable or disable Span calibration.	
Command:	~AAEV[CHK](cr)	
Syntax:	!	Command leading code
	AA	Module address ID (00 to FF)
	E	Enable/disable calibration command
	V	0=Disable span calibration 1=Enable span calibration
	CHK	Check sum
	(cr)	Carriage return
Response: (see Note)	!AA[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	AA	Module address ID (00 to FF)
	CHK	Check sum
	(cr)	Carriage return

Note: send enable calibration command before performing the calibration,

Example 1: Perform span calibration of module with address=06

Command: $06E1<CR> // Enable calibration
Response: !06<CR>
Command: $060<CR> // perform span calibration
Response: !06<CR>

5.24 Span calibration

Modules:	For 8012/D,8014/D,8017	
Description:	To correct the gain errors of AD converter by using the span calibration.	
Command:	$AA0[CHK](cr)	
Syntax:	$	Command leading code
	AA	Module address ID (00 to FF)
	0	Command for span calibration
	CHK	Check sum
	(cr)	Carriage return
Response: (see Note)	!AA[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	AA	Module address ID (00 to FF)
	CHK	Check sum
	(cr)	Carriage return

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 7 "**Calibratio**n".

Example 2: Perform span calibration of module with address=06

Command: $060<CR>
Response: !06<CR>

5.25 Offset calibration

Modules:	For 8012,8012D,8014,8014D,8017	
Description:	To correct the offset errors of AD converter by using the offset calibration	
Command:	$AA1[CHK](cr)	
Syntax:	$	Command leading code
	AA	Module address ID (00 to FF)
	1	Command for offset calibration
	CHK	Check sum
	(cr)	Carriage return
Response: (see Note)	!AA[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	AA	Module address ID (00 to FF)
	CHK	Check sum
	(cr)	Carriage return

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 7 **"Calibratio**n".

Example 1: Perform offset calibration of module with address=06

Command: $061<CR>
Response: !06<CR>

5.26 Read data from channel N

Modules:	For eDAM 8017 only	
Description:	Read the analog input value of a specified AD channel from an analog input module	
Command:	#AAN[CHK](cr)	
Syntax:	$	Command leading code
	AA	Module address ID (00 to FF)
	N	Command for reading analog input value
	CHK	Check sum
	(cr)	Carriage return
Response: (see Note)	>(data)[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	>	Delimiter for valid command
	?	Delimiter for invalid command
	(data)	Analog input data
	CHK	Check sum
	(cr)	Carriage return

Example 1: Read the analog input channel 1 of AD module at address 06 in the network. (Data format is engineering unit)

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

5.27 Read all analog data

Modules:	For eDAM 8017 only	
Description:	Read all the analog input channel value from 8017	
Command:	$AAA[CHK](cr)	
Syntax:	$	Command leading code
	AA	Module address ID (00 to FF)
	A	Command for reading all channels
	CHK	Check sum
	(cr)	Carriage return
Response: (see Note)	>(data0)..(data7)[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	>	Delimiter for valid command
	?	Delimiter for invalid command
	(data)	Data string of all channels in 2's complement Hex format (see *)
	CHK	Check sum
	(cr)	Carriage return

*** "data" Analog input data:**

data of all channels are responded as follows:

>(chan.0 data) (chan.1 data) …… (chan.7 data) [CHK](cr)

Example 1: Read all analog input data from eDAM8017 , assume address=03

Command: $03A(cr)

Response: 000132112321A221C001B12321103443(cr)

5.28 Enable/disable channel for multiplexing

Modules:	For eDAM 8017 only	
Description:	Enable/Disable multiplexing simultaneously for individual channel.	
Command:	$AA5VV[CHK](cr)	
Syntax:	$	Command leading code
	AA	Module address ID (00 to FF)
	5	Command for reading digital I/O status
	VV	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
	CHK	Check sum
	(cr)	Carriage return
Response: (see Note)	!AA[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	AA	Module address ID (00 to FF)
	CHK	Check sum
	(cr)	Carriage return

Example 1: Enable channel 3 and channel 6, the other channels are all disable of eDAM-8017.

Command: $06548<CR>

'48' is 01001000 that means enable channel 3 and channel 6, the other channels are all disable.

Response: !06<CR>

5.29 Read channel status

Modules:	For eDAM 8017 only	
Description:	Read the enable/disable status the channels of eDAM-8017	
Command:	$AA6[CHK](cr)	
Syntax:	$	Command leading code
	AA	Module address ID (00 to FF)
	6	Command for reading channel status
	CHK	Check sum
	(cr)	Carriage return
Response: (see Note)	!AAVV[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	AA	Module address ID (00 to FF)
	VV	Channel status (See sec 5.28)
	CHK	Check sum
	(cr)	Carriage return

Example 1: Read channel status of eDAM-8017 with address=06.

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.

5.30 Read LED configuration

Modules:	For eDAM-8012D,8014D	
Description:	Read LED control status	
Command:	$AA8[CHK](cr)	
Syntax:	$	Command leading code
	AA	Module address ID (00 to FF)
	8	Command for reading LED status
	CHK	Check sum
	(cr)	Carriage return
Response: (see Note)	!AAV[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	AA	Module address ID (00 to FF)
	V	LED control status 1=LED controlled by module 2=LED controlled by host
	CHK	Check sum
	(cr)	Carriage return

Example 1: Read LED control status of eDAM-8012D at address=03

Command: $038(cr)
Response: !032(cr)
The module LED is controlled by host

5.31 Set LED configuration

Modules:	For eDAM-8012D,8014D	
Description:	Set module LED control mode	
Command:	$AA8V[CHK](cr)	
Syntax:	$	Command leading code
	AA	Module address ID (00 to FF)
	8	Command for setting LED control
	V	LED control status 1=LED controlled by module 2=LED controlled by host
	CHK	Check sum
	(cr)	Carriage return
Response: **(see Note)**	!AA[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	AA	Module address ID (00 to FF)
	CHK	Check sum
	(cr)	Carriage return

Example 1: Set LED control to host of eDAM-8012D at address=03

Command: $0382(cr)
Response: !03(cr)

5.32 Set LED data

Modules:	For eDAM-8012D,8014D	
Description:	Set LED display data when LED controlled by host	
Command:	$AA9(data)[CHK](cr)	
Syntax:	$	Command leading code
	AA	Module address ID (00 to FF)
	9	Command for setting LED data
	(data)	LED display data from –19999. to +19999.
	CHK	Check sum
	(cr)	Carriage return
Response:	!AA[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	AA	Module address ID (00 to FF)
	CHK	Check sum
	(cr)	Carriage return

Example 1: Set LED display data “+32.120” of eDAM-8012D at address=03

Command:$039+32.120(cr)
Repsonse:!03(cr)

5.33 Read Digital I/O and alarm status

Modules:	For eDAM-8012,8012D,8014,8014D	
Description:	Read the digital input channel value and readback the digital output channel value.	
Command:	@AADI[CHK](cr)	
Syntax:	@	Command leading code
	AA	Module address ID (00 to FF)
	DI	Command for reading DI/O & alarm status
	CHK	Check sum
	(cr)	Carriage return
Response: **(see Note)**	!AASDODI[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	AA	Module address ID (00 to FF)
	S	Alarm status(1-character) 0: alarm is disable 1: MOMENTARY mode enable. 2: LATCH mode enable.
	DO	Digital output status(2-character) 00=DO0 off,DO1 off 01=DO0 on,DO1 off 10=DO0 off,DO1 on 11=DO0 on,DO1 on
	DI	Digital input status(2-character) 00: channel is LOW. 01: channel is HIGH.
	CHK	Check sum
	(cr)	Carriage return

Example 1: Read digital I/O and alarm at address 06H.

Command: @06DI<CR>

Response: !0620301<CR>

alarm state is LATCH, digital output channel port 0 and 1 are ON and digital input channel is HIGH.

5.34 Set Digital output channel

Modules:	For eDAM-8012,8012D,8014,8014D	
Description:	Set digital output channels	
Command:	@AADODD[CHK](cr)	
Syntax:	@	Command leading code
	AA	Module address ID (00 to FF)
	DO	Output command type
	DD	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.
	CHK	Check sum
	(cr)	Carriage return
Response:	!AA[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	AA	Module address ID (00 to FF)
	CHK	Check sum
	(cr)	Carriage return

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

Command: @06DO02<CR>
Response: !06<CR>

5.35 Clear latch alarm

Modules:	For eDAM-8012,8012D,8014,8014D	
Description:	Clear latch alarm	
Command:	@AACA[CHK](cr)	
Syntax:	@	Command leading code
	AA	Module address ID (00 to FF)
	CA	Clear alarm command
	(cr)	Carriage return
Response:	!AA[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	AA	Module address ID (00 to FF)
	CHK	Check sum

Example 1: Clear the both High/Low latch alarm state at address 06H.

Command: @06CA<CR>
Response: !06<CR>

5.36 Clear event counter

Modules:	For eDAM-8012,8012D,8014,8014D	
Description:	Clear event counter	
Command:	@AACE[CHK](cr)	
Syntax:	@	Command leading code
	AA	Module address ID (00 to FF)
	CE	Clear event counter command
	CHK	Check sum
	(cr)	Carriage return
Response:	!AA[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	CHK	Check sum
	(cr)	Carriage return

Example 1: Clear event counter at address 06H.

Command: @06CE<CR>
Response: !06<CR>

5.37 Disable alarm

Modules:	For eDAM-8012,8012D,8014,8014D	
Description:	Disable alarm	
Command:	@AADA[CHK](cr)	
Syntax:	@	Command leading code
	AA	Module address ID (00 to FF)
	DA	Disable alarm command
	CHK	Check sum
	(cr)	Carriage return
Response:	!AA[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	CHK	Check sum
	(cr)	Carriage return

Example 1: Disable all alarm functions at address 06H.

Command: @06DA<CR>
Response: !06<CR>

5.38 Enable alarm

Modules:	For eDAM-8012,8012D,8014,8014D	
Description:	Enable alarm	
Command:	@AAEAM[CHK](cr)	
Syntax:	@	Command leading code
	AA	Module address ID (00 to FF)
	EA	Enable alarm command
	M	M= enable alarm to MOMENTARY mode. L=enable alarm to LATCH mode.
	CHK	Check sum
	(cr)	Carriage return
Response:	!AA[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	CHK	Check sum
	(cr)	Carriage return

Example 1: Enable alarm to MOMENTARY mode at address 06H.

Command: @06EAM<CR>
Response: !06<CR>

5.39 Set high alarm

Modules:	For eDAM-8012,8012D,8014,8014D	
Description:	Set high alarm value	
Command:	@AAH(data)[CHK](cr)	
Syntax:	@	Command leading code
	AA	Module address ID (00 to FF)
	HI	Set high alarm command
	(data)	High alarm value in engineer unit
	CHK	Check sum
	(cr)	Carriage return
Response:	!AA[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	CHK	Check sum
	(cr)	Carriage return

Example 1: Set high alarm limit value to +10.000 for analog input at address 03H.

Command: @03HI+10.000<CR>
Response: !03<CR>

(Refer to Appendix C)

5.40 Set low alarm

Modules:	For eDAM-8012,8012D,8014,8014D	
Description:	Set low alarm value	
Command:	@AALO(data)[CHK](cr)	
Syntax:	@	Command leading code
	AA	Module address ID (00 to FF)
	HI	Set low alarm command
	(data)	low alarm value in engineer unit
	CHK	Check sum
	(cr)	Carriage return
Response:	!AA[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	CHK	Check sum
	(cr)	Carriage return

Example 1: Set low alarm limit value to +00.400 for analog input at address 03H.

Command: @03LO+00.400<CR>
Response: !03<CR>

(Refer to Appendix C)

5.41 Read event counter

Modules:	For eDAM-8012,8012D,8014,8014D	
Description:	Read the event counter value	
Command:	@AARE[CHK](cr)	
Syntax:	@	Command leading code
	AA	Module address ID (00 to FF)
	RE	Read event counter command
	CHK	Check sum
	(cr)	Carriage return
Response:	!AA(data)[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	AA	Module address ID (00 to FF)
	(data)	Event counter value(from 00000 to 65535)
	CHK	Check sum
	(cr)	Carriage return

Example 1: Read event counter at address 03H

Command: @03RE<CR>
Response: !0312340<CR>
its value is 12340 (Decimal) at address 03H.

5.42 Read high alarm

Modules:	For eDAM-8012,8012D,8014,8014D	
Description:	Read the high alarm limit at specified analog input module.	
Command:	@AARH[CHK](cr)	
Syntax:	@	Command leading code
	AA	Module address ID (00 to FF)
	RH	Read high alarm value command
	CHK	Check sum
	(cr)	Carriage return
Response:	!AA(data) [CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	(data)	High alarm limit value in engineering units.
	CHK	Check sum

Example 1: Read the high alarm limit value at address 03H,

Command: @03RH<CR>
Response: !03+01.420<CR>
High alarm value is 1.420 Volts,

(Refer to Appendix C)

5.43 Read low alarm

Modules:	For eDAM-8012,8012D,8014,8014D	
Description:	Read the low alarm limit at specified analog input module.	
Command:	@AARL[CHK](cr)	
Syntax:	@	Command leading code
	AA	Module address ID (00 to FF)
	RL	Read low alarm value command
	CHK	Check sum
	(cr)	Carriage return
Response:	!AA(data)[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	(data)	low alarm limit value in engineering units.
	CHK	Check sum

Example 1: Read the low alarm limit value at address 03H,

Command: @03RH<CR>
Response: !03+0.3420<CR>
Low alarm value is +0.3420 Volts,

(Refer to Appendix C)

5.44 Read source HI/LO values for linear mapping

Modules:	For eDAM-8014,8014D	
Description:	Read source high/low limit values from input for linear mapping.	
Command:	$AA3[CHK](cr)	
Syntax:	$	Command leading code
	AA	Module address ID (00 to FF)
	3	Read source HI/LO values command
	CHK	Check sum
	(cr)	Carriage return
Response:	!AA(SL)(SH)[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	>	Delimiter for valid command
	?	Delimiter for invalid command
	(SL)	Low limit value in engineering unit for linear mapping.
	(SH)	High limit value in engineering unit for linear mapping.
	CHK	Check sum

Example 1: Read the high/low values for linear mapping. The address of this module is 02H.

Command: $023<CR>
Response: !02+04.000+20.000<CR>
The high limit value is +20mA and low limit value is +4mA
The linear mapping function should already have been executed.

(refer to Appendix B)

5.45 Read target HI/LO values for linear mapping

Modules:	For eDAM-8014,8014D	
Description:	Read target high/low limit values from input for linear mapping.	
Command:	$AA5[CHK](cr)	
Syntax:	$	Command leading code
	AA	Module address ID (00 to FF)
	5	Read target HI/LO values command
	CHK	Check sum
	(cr)	Carriage return
Response:	!AA(TL)(TH)[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	>	Delimiter for valid command
	?	Delimiter for invalid command
	(TL)	Low limit value in engineering unit for linear mapping.
	(TH)	High limit value in engineering unit for linear mapping.
	CHK	Check sum

Example 1: Read the target high/low values for linear mapping. The address of this module is 02H.

Command: $025<CR>
Response: !02+04.000+20.000<CR>
The high limit value is +20mA and low limit value is +4mA
The linear mapping function should already have been executed.

(refer to Appendix B)

5.46 Write source HI/LO values for linear mapping

Modules:	For eDAM-8014,8014D	
Description:	Write source HI/LO values for linear mapping. HI/LO values will be permanently stored into EEPROM on the module after #AA7(TL)(TH)(cr) command applied (see sec 5.47)	
Command:	$AA6(SL)(SH)[CHK](cr)	
Syntax:	$	Command leading code
	AA	Module address ID (00 to FF)
	6	Write source HI/LO values command
	(SL)	Low limit input value in engineering unit for linear mapping. It must be lower than the high limit input value.
	(SH)	High limit input value in engineering unit for linear mapping. It must be higher than the low limit input value.
	CHK	Check sum
	(cr)	Carriage return
Response:	!AA[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	AA	Module address ID (00 to FF)
	CHK	Check sum
	(cr)	Carriage return

Example: (see sec 5.47)

5.47 Write target HI/LO values for linear mapping

Modules:	For eDAM-8014,8014D	
Description:	Write target HI/LO values for linear mapping. This command need be followed with $AA6(SL)(SH)	
Command:	$AA7(TL)(TH)[CHK](cr)	
Syntax:	$	Command leading code
	AA	Module address ID (00 to FF)
	7	Write target HI/LO values command
	(TL)	Low limit input value in engineering unit for linear mapping. It must be lower than the high limit input value.
	(TH)	High limit input value in engineering unit for linear mapping. It must be higher than the low limit input value.
	CHK	Check sum
	(cr)	Carriage return
Response:	!AA[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	AA	Module address ID (00 to FF)
	CHK	Check sum
	(cr)	Carriage return

Example 1: set the source input high/low values from +120.00 to –160.00mV for linear mapping. The address of this module is 03H.

Command: $036-160.00+120.00<CR>
Response: !03<CR>

Example 2: set the target input high/low values from +120.00 to –160.00 for linear mapping. The address of this module is 03H.

Command: $037-160.00+120.00<CR>
Response: !03<CR>

Note:
The source HI/LO values and target HI/LO values will be stored into EEPROM on the module after "*Write target HI/LO values for linear mapping*" command applied

5.48 Enable/disable linear mapping

Modules:	For eDAM-8014,8014D	
Description:	Enable or disable the linear mapping function for the module.	
Command:	$AAAS[CHK](cr)	
Syntax:	$	Command leading code
	AA	Module address ID (00 to FF)
	A	Enable/disable the linear mapping command
	S	1: means enable. 0: means disable.
	CHK	Check sum
	(cr)	Carriage return
Response:	!AA[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	AA	Module address ID (00 to FF)
	CHK	Check sum
	(cr)	Carriage return

Example 1: set the linear mapping function enable, the address of this module is 03H.

Command: $03A1<CR>
Response: !03<CR>

(refer to Appendix B)

5.49 Read linear mapping status

Modules:	For eDAM-8014,8014D	
Description:	Read enable or disable the linear mapping status for the module.	
Command:	$AAA[CHK](cr)	
Syntax:	$	Command leading code
	AA	Module address ID (00 to FF)
	A	Read linear mapping status
	CHK	Check sum
	(cr)	Carriage return
Response:	!AAS[CHK](cr)	Valid command
	?AA[CHK](cr)	Invalid command
	!	Delimiter for valid command
	?	Delimiter for invalid command
	AA	Module address ID (00 to FF)
	S	1: means enable. 0: means disable.
	CHK	Check sum
	(cr)	Carriage return

Example 1: Read linear mapping function enable, the address of this module is 03H.

Command: $03A<CR>
Response: !030<CR>
the linear mapping function is disable,

(refer to Appendix B)

Chapter 6 Data Format and Input range

6.1 Data Format of Analog Input Modules

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

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

6.1.1 Engineering Units

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>

6.1.2 Percent of FSR (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

6.1.3 Two's Complement Hexadecimal

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

Chapter 7 Calibration

7.1 Calibration for 8012/D,8014/D,8017

The offset calibration is used to calibrate output offset when the input voltage is 0V
The span calibration is used to calibrate the full scale output when the input is full scale voltage

- Calibration procedures
  1. Apply zero voltage to channel 0 of analog module (refer to sec 2.6)
  2. Issues configuration command with type=08 (refer to sec 5.7)
  3. Issues enable calibration command
  4. Issues zero offset calibration command five times
  5. Apply span voltage to channel 0 of analog module
  6. Issues span calibration command five times
  7. Repeat procedure 1 to procedure 6 two times

Type code	08	09	0A	0B	0C	0D
Zero input	0V	0V	0V	0mV	0mV	0mA
Span input	+10V	+5V	+1V	+500mV	+150mV	+20mA

Table 7-1: 8012/D,8014/D,8017 Calibration voltages

Note:
While using calibration type 0D to calibrate 8012/D, 8017 module, an external shunt resistor 125 ohms should be connected to channel 0 of module

Appendix A INIT*pin operation

The “INIT*mode” has two purposes, one for reading module current configuration, and another for configuring the module baud rate and checksum

■ Reading module current configuration

Each eDAM module has a built-in EEPROM which is used to store the configuration information such as address ID, type, baud rate etc..
If the user unfortunately forget the configuration of the module. User may use a special mode called “INIT* mode” to resolve the problem
When the module is set to “INIT*” mode”, the default settings are ID=00, baud rate=9600, and checksum=disable

The following steps show you how to enable INIT* mode and read the current configuration
,

1. Power off the module
2. Connect the “INIT*” pin to GND pin
3. Power on the module
4. Send command $002<cr> in 9600 baud rate to read the current configuration stored in the EEPROM
5. Power off the module again
6. Open “INIT*” pin to force the module to normal mode

■

Configuring the module baud rate and checksum

The module should be set to “INIT* mode”, While changing baud rate and/or checksum state by sending “Set module configuration” command (see section 5.7)
The following steps show you how to enable INIT* mode and change baud rate and/or checksum state

1. Power off the module
2. Connect the “INIT*” pin to GND pin
3. Power on the module
4. Send command %AANNTTCCFF in 9600 baud rate to set baud rate and/or checksum state (*ID should be set to 00 in “INIT* mode”*)
5. Power off the module again
6. Open “INIT*” pin to force the module to normal mode

Appendix B Linear mapping

The linear mapping function is a mechanism that convert the analog input value into the physical quantity, such as load cell, pressure, water level etc.
The formula of linear mapping is

$$\text{Output value} = \frac{(V_{in} - V_{SL})}{(V_{SH} - V_{SL})} \times (V_{TH} - V_{TL}) + V_{TL}$$

Where
Vin =analog input value
V_{SL} =Source low value for linear mapping
V_{SH} =Source high value for linear mapping
V_{TL} =Target low value for linear mapping
V_{TH} =Target high value for linear mapping

Assume a load cell has voltage output range from 5mV to 80mV which relates to 0Kg to 50Kg in physical quantity

1. Set 8014D to have ±150 mV range by using command %AANNTTCCFF(cr) (see sec 5.7)
2. Set source low value(V_{SL}=+005.00) and source high value(V_{SH}=+080.00) by using command $AA6(SL)(SH)(cr) (see sec 5.46) ($AA6+005.00+080.00(cr))
3. Set target low value(V_{TL}=+000.00) and target high value(V_{TH}=+050.00) by using command $AA7(TL)(TH)(cr) see sec 5.47) ($AA7+000.00+050.00(cr))
4. Enable linear mapping function by using $AAA1(cr) (see sec 5.48)
5. The output data to host will be ranged from 00Kg to 50Kg

Appendix C About high/low alarm

The modules equipped with high/low alarm function will output a signal to outside world to indicate the input data has been over or under the alarm margin
The DO0 and DO1 are both used to output alarm signal when alarm function is enabled. The DO0 is low alarm indicator, and the DO1 is high alarm indicator (DO0 and DO1 can't be controlled by digital output commands when alarm function enabled)
When analog input value over high alarm value, the DO1 is ON else is OFF
When analog input value under low alarm value, the DO0 is ON else is OFF
The analog input value is compared to high alarm value and low alarm value. There are two types:

1. **Momentary alarm:** Alarm signal automatically cleared while the analog input data is not over/under the alarm values
2. **Latch alarm:** Alarm signal is always activated until the user send alarm clear command

Appendix D Power on/Safe value

Power on value:

Power on value are used to set the module default output value when the module is turned-on or watch dog timeout reset. This function is especially importance in some application where the specified initial output states are required

User can set power on value by sending *Set power-on/safe value* command *(*see section 5.19*)*

Safe value:

Safe value are used to set the module outputs into the specified values when Host watchdog timeout

If The host watchdog timer is enabled by sending *Set host watchdog timeout value*(see section 5.17), the host should send *Host OK* (see section 5.13) command periodically within Timeout value to refresh the timer, otherwise the module will be forced to safety state (see section 5.19)