DATEXEL

DAT 31xx
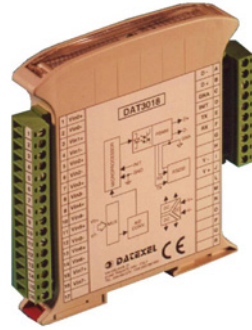
DATA ACQUISITION
MODULE
Digital I/O

DAT3130: 4 IN + 4 RELE'
DAT3140: 4 IN + 8 OUT
DAT3148: 8 IN

Characteristics
Digital I/O module for remote data acquisition
Digital Inputs
NPN Open-Collector Digital Outputs isolated
SPDT and SPST-N.A. type Relay Outputs
RS485 serial line communication
Isolated Galvanically at 2000Vac (3 ways)
EMC compatibility - CE Mark
Housing thickness of only 17,5 mm.
DIN rail mounting

APPLICATIONS
- Data Acquisition and Controls
- Monitoring of Industrial Process
- Factory and Building Automation
- Distributed Measure and Control

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3 - Operation Principles

Chapter 1

TECHNICAL SPECIFICATIONS

1.1 Introduction
1.2 Pin Assignment
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1.1 Introduction

The modules of the DAT 3000 series find, for their peculiar characteristics, wide application in the treatment of the signals in the systems for the Automation and the Control of the Industrial Processes. They allows the conditioning of a wide range of signals, both analogical and digital, with an effective protection from the noises.

Thanks to the systematic employment of the microprocessor the DAT3000 modules are able to assure the conditioning of the signal, the supervision of system, the alarm outputs and the reliable generation of the desired value.

The module has been studied for being able to be assembled on the DIN-rail in simple way and with the maximum use of the spaces. In fact, if the conditions of dissipation allow it, the modules can be assembled one beside the other allowing so a considerable reduction of the space occupied. Extractable type screw terminals are employed for the connection . Thanks to this, the user can directly remove the modules so simplifying their maintenance.

DAT31xx Characteristics

The DAT31xx devices allows to manage input and output signals of digital type. Ouput ports can be used as alarms. The Dat 31xx is composed by the following modules:

Device	Digital Inputs	Digital Outputs
DAT 3140	4	8 Open Collector
DAT 3148	8 / 12	-
DAT 3130	4	4 Relays

- Digital I/O

- Watchdog Alarm

- Asyncronous serial data transmission
- Speed up to 38,4 Kbps warranted
- Distance up to 1,2 Km

- DIN-rail mounting housing
- Complete isolation at 2000 Vac
 with optocouplers and DC/DC converter

1.2.1 DAT3140 Pin Assignments
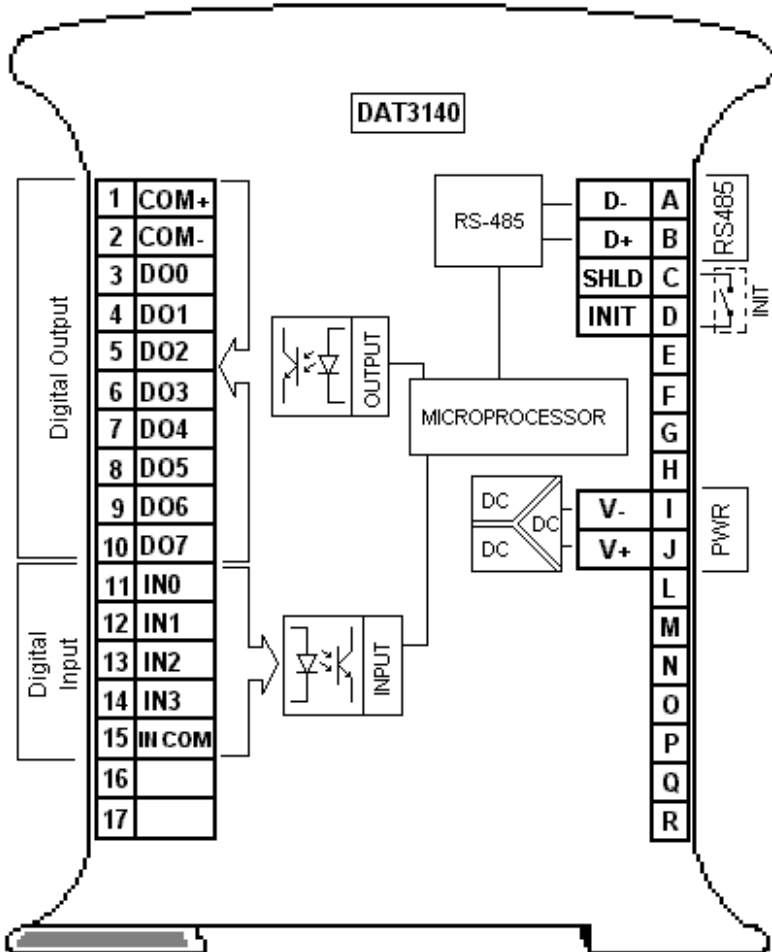
DAT3140 Pin Assignment Table

PIN	Name	Description
1	COM+	Output common +
2	COM-	Output common -
3	DO 0	Digital Output 0
4	DO 1	Digital Output 1
5	DO 2	Digital Output 2
6	DO 3	Digital Output 3
7	DO 4	Digital Output 4
8	DO 5	Digital Output 5
9	DO 6	Digital Output 6
10	DO 7	Digital Output 7
11	IN 0	Digital Input 0
12	IN 1	Digital Input1
13	IN 2	Digital Input2
14	IN 3	Digital Input3
15	IN COM	Input common
A	D-	D- RS485
B	D+	D+ RS485
C	GNA	RS485 Shield / INIT ground
D	INIT	INIT signal
I	V-	Supply ground
J	V+	Supply +24V

DAT3140 Wiring
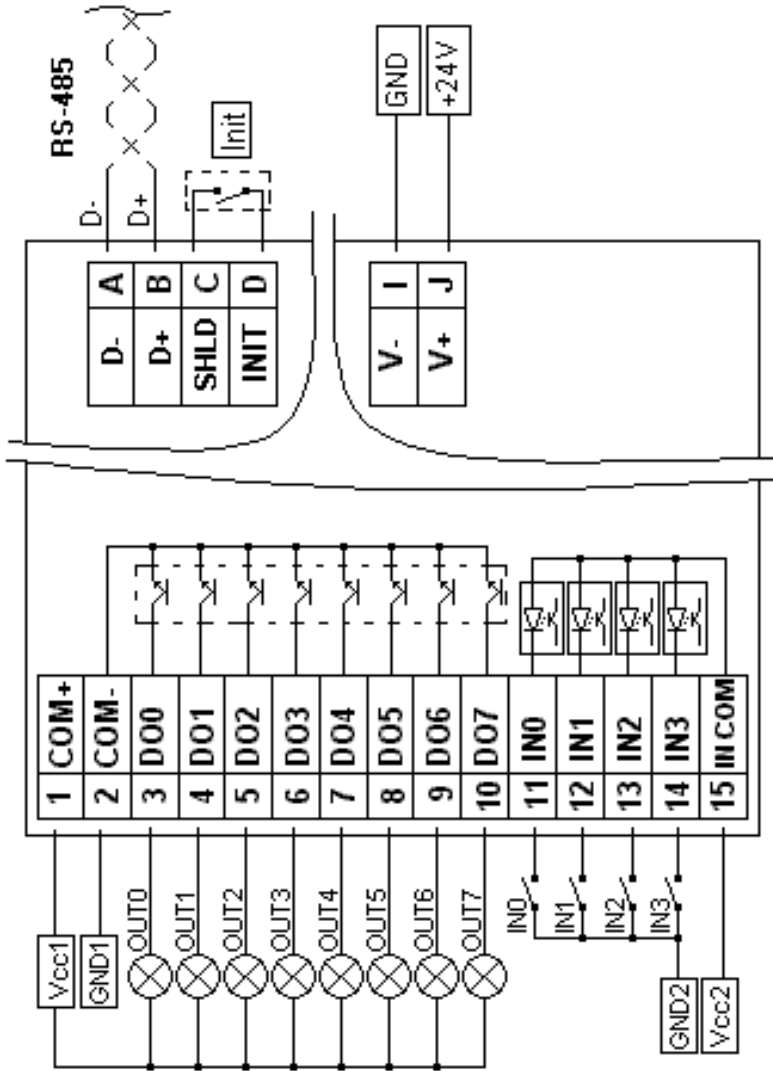
1.2.2   DAT3148 Pin Assignment
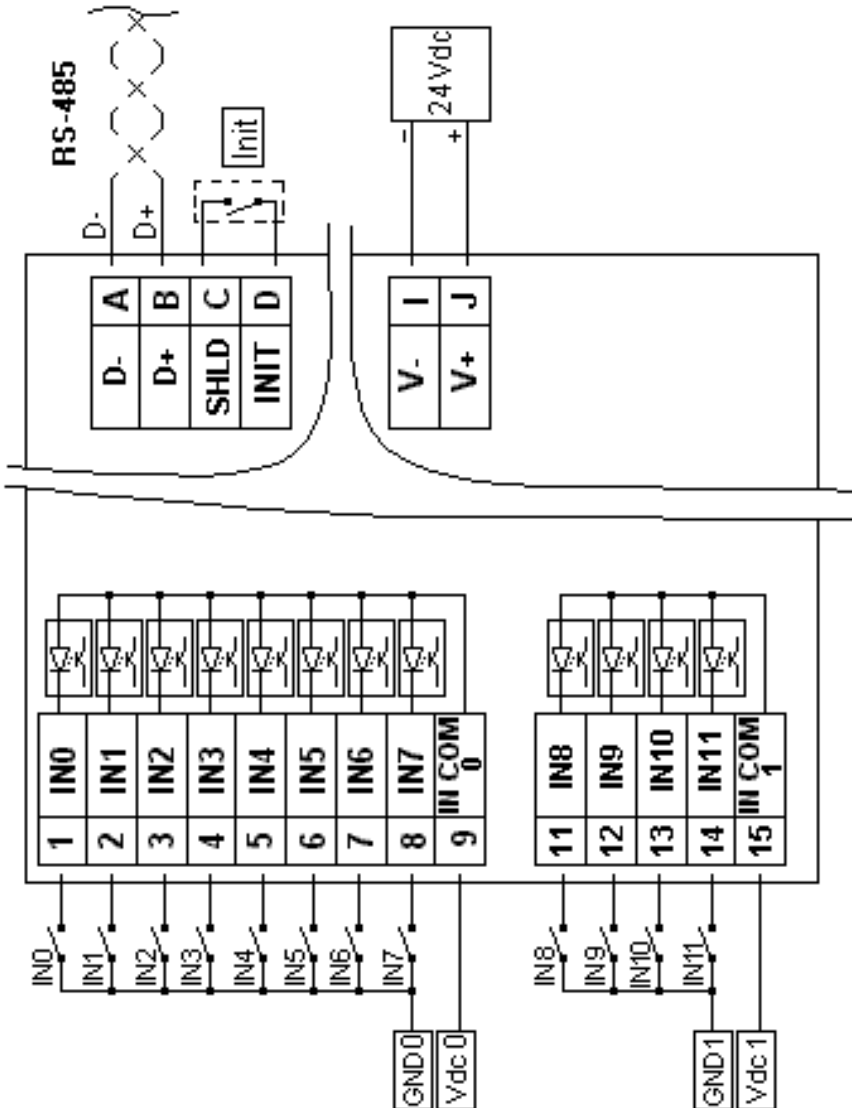
DAT3148 Pin Assignment Table

PIN	Name	Description
1	IN 0	Digital Input 0
2	IN 1	Digital Input 1
3	IN 2	Digital Input 2
4	IN 3	Digital Input 3
5	IN 4	Digital Input 4
6	IN 5	Digital Input 5
7	IN 6	Digital Input 6
8	IN 7	Digital Input 7
9	IN COM	Input common
11	IN 8	Digital Input 8
12	IN 9	Digital Input 9
13	IN 10	Digital Input 10
14	IN 11	Digital Input 11
15	IN COM	Input common
A	D-	D- RS485
B	D+	D+ RS485
C	GNA	RS485 Shield / INIT ground
D	INIT	INIT signal
I	V-	Supply ground
J	V+	Supply +24V

DAT3148 Wiring
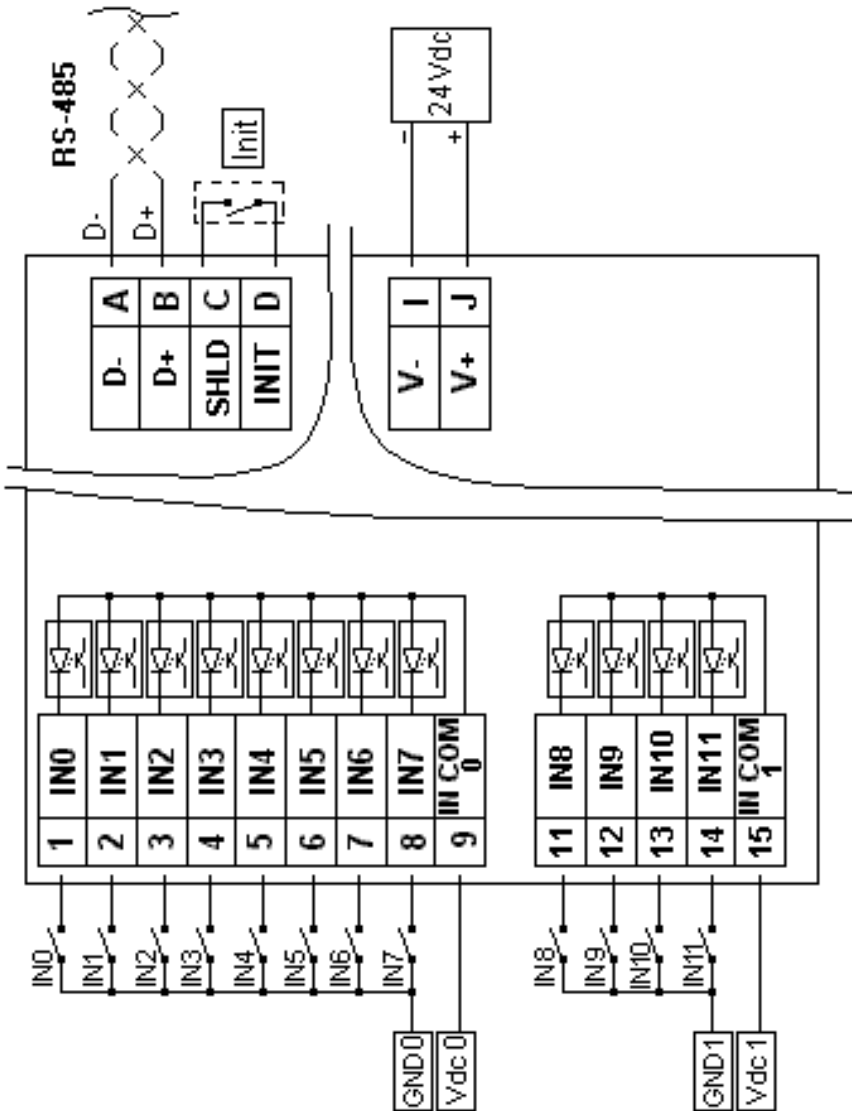
1.2.3   DAT3130 Pin Assignment
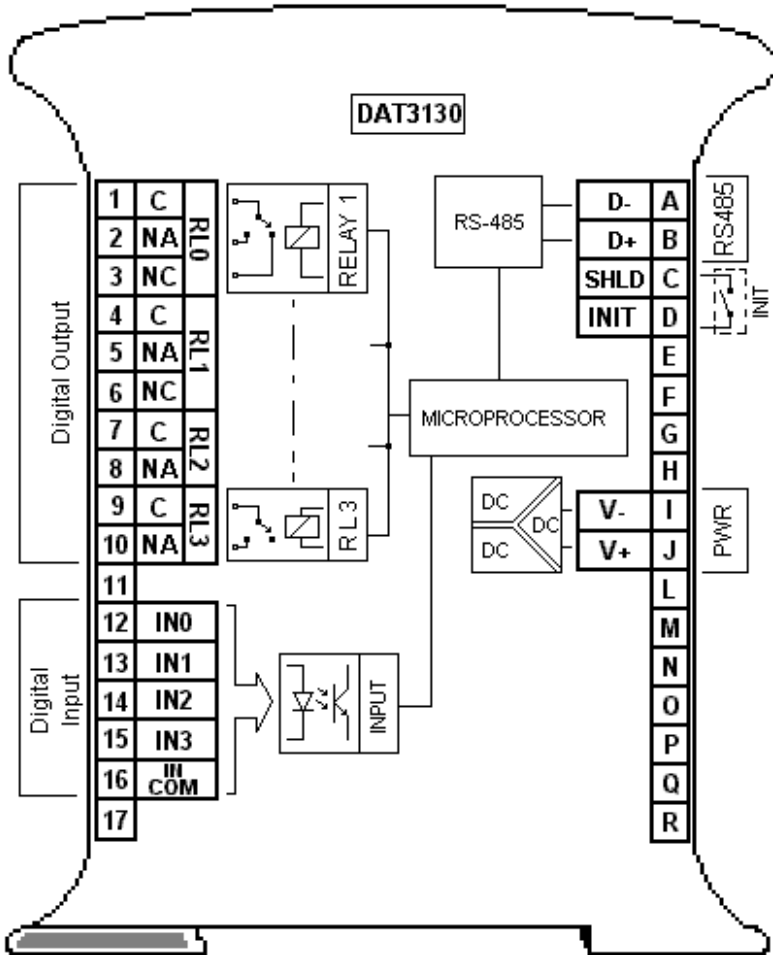
DAT3130 Pin Assignment Table

PIN	Name	Description
1	RL0-C	Relay 0 - Common
2	RL0-NO	Relay 0 - Normally Open
3	RL0-NC	Relay 0 - Normally Close
4	RL1-C	Relay 1 - Common
5	RL1-NO	Relay 1 - Normally Open
6	RL1-NC	Relay 1 - Normally Close
7	RL2-C	Relay 2 - Common
8	RL2-NO	Relay 2 - Normally Open
9	RL3-C	Relay 3 - Common
10	RL3-NC	Relay 3 - Normally Open
12	IN 0	Digital Input 0
13	IN 1	Digital Input 1
14	IN 2	Digital Input 2
15	IN 3	Digital Input 3
16	IN COM	Input Common
A	D-	D- RS485
B	D+	D+ RS485
C	GNA	RS485 Shield / INIT ground
D	INIT	INIT signal
I	V-	Supply ground
J	V+	Supply +24V

DAT3130 Wiring
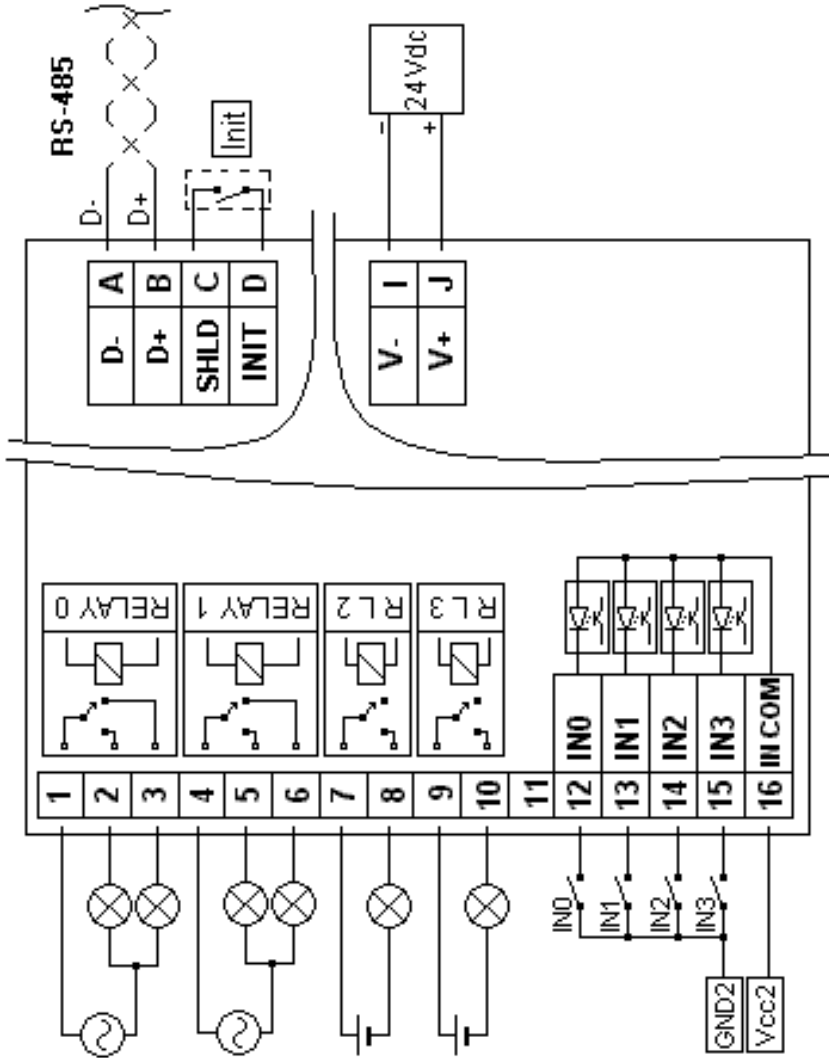
1.3 Technical Specifications
(typical @ 25°C and under nominal conditions)

Digital Input (DAT3140, DAT3148):

Channels:	DAT3140	4
	DAT3148	8 or 12
	DAT3130	4

Counters (optional):	DAT3148	4 (IN 0..3) of 16 bits
Frequency:	50 Hz max.	
Pulse Width:	10 ms. min.	

Logic Level:	ON state :	+10 to +30V
	OFF state :	0V to +5V
Input impedance :	4,7 Kohm	

Digital Output (DAT 3140, DAT3130):

Channels:	DAT3140	8 Open Collector
	DAT3130	4 Relays (2 SPDT + 2 SPST N.O.)

Open Collector NPN:

Max Voltage	30Vdc
Max Current	600mA per channel.
	3A max per module.
Polarity protected	60 Vdc

Relays:

    Contact Rating: 2 A @ 250 Vac (resistive load) per contact
                        2 A @ 24 Vdc (resistive load) per contact
    Minimum Load: 5Vdc , 10mA
    Max. Voltage: 250Vca (50/60 hHZ) , 30Vdc

    Dielectric Strength: 1000 Vac between contacts (60 sec.)
                           4000Vac between contact and coil (60sec.)
    Operation Rating: 100.000 operations

Power Supply
Supply Voltage: +10Vdc to +30 Vdc
Power Consumption: 1W @ 24Vtyp.
Isolating Voltage: 2000 Vac (60 sec).
Polatiry protected: 60 Vdc

Temperature and Humidity
Ambient Temperature :   -10 to +60 °C
Store Temperature :   -30 to +90 °C
Humidity (not condensing) :   0 ÷ 90 %

EMC
Emission :   EN50081-2
Immunity :   EN50082-2
RF Immunity :   tested @ 10 V/m up to 1000 Mhz

Housing
Material :   Selfestinguishing plastic
Mounting :   DIN rail
Weight :   Approx. 100 g.
Dimensions :   (W x H x T) in mm
                    100 X 120 X 17.5 (DAT3140 , DAT3148)
                    100 X 120 X 23.0 (DAT3130)

DAT 3140, DAT3148 Mechanical Dimensions
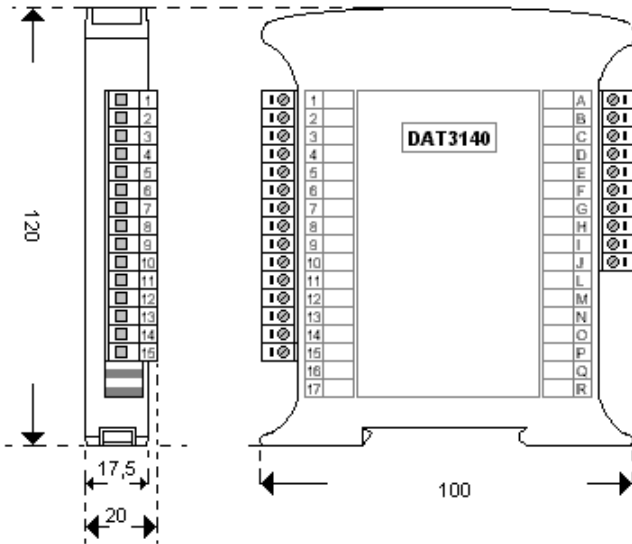
DAT3130 Mechanical Dimensions
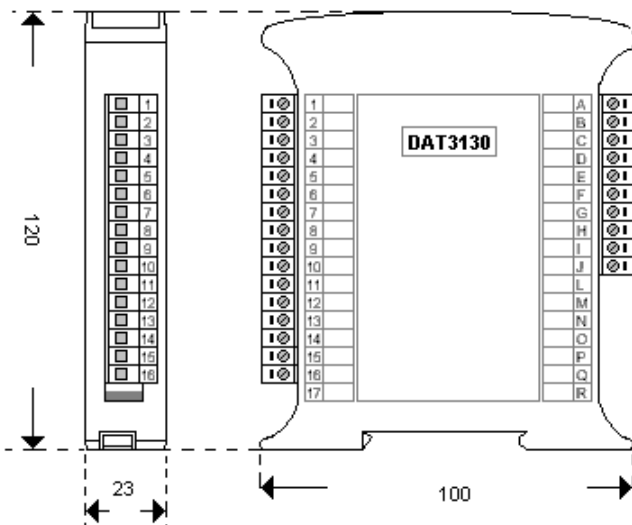
Chapter 2
PROTOCOL

2.1 Settings
2.2 Syntax
2.3 Tables
2.4 Commands

2.1 Settings

Default Settings :

Baud Rate	=	9600 bps
Address	=	00h
CheckSum	=	disabled

Character Format :

Parity	=	None
Bit Number	=	8
Stop Bit	=	1

2.2 Syntax

Command Syntax:

The DAT3010 modules have a set of 25 ASCII instructions for the input control, output, watchdog, calibration and device setting. Every command is foregone by a command character and by the address of the module to which it is destined.

For instance, the characters "%", "#", "$", "~", are command characters. They are positioned at the beginning of the commands and every symbol indicates a group of commands with different functions.

The address which has to follow these characters (except the commands addressed to all the devices of the net) is pointed out with 'AA ', and it is composed by two hexadecimal characters , from 00 to FF.
Consequently, the module n°0 will have address AA=00, the module n°255 will have address AA=FF. For instance, the command '$1F2 ' reads the setting of the module n°31.

Every module can have any address included between 0 and 255.
Two modules with the same address and the same baud-rate cannot exist.

The commands: "#* *" and "~ * *" don't have address because they are sent to all the modules of the net in the same moment, and they don't need an answer from the modules. The character '*' is a command character and it must not be modified.
Every command has to finish with the 13(cr) character.
If the communication foresees the Checksum, it must be positioned before the (cr) character.

Response Syntax:

When a module receives a string which it recognises as a command addressed to itself, it transmits its same address (AA) as answer. This message if foregone from "!" chracter if the command is valid or from "?" character if the command is invalid. If the command is valid, (AA) is eventually followed from the requested information (data).

If the module doesn't answer, this could be due to a communication error, a syntax error or a wrong address.

!AA   Received command is valid
!AA(data)   Sending data to the host
?AA   Received command is not valid

The modules answer to the reading commands regarding the digital output with the character '>' followed from the measureing value and without sending the address.

ATTENTION!
Writing the commands, like the configuration, the name setting etc, involves to write some data on EEPROM. As the component is guaranteed for a limited number of writing cycles (around 100.000) it is advisable to moderate the use of these commands, to avoid future malfunctions of the device. Moreover the writing on EEPROM involves to increase the response time of the module.

2.3 Tables

(data) : Data Format, 6 char. HEX.

Device	5 4	3 2	10
DAT 3140	Output	Input	00
DAT 3148	Input H	Input L	00
DAT 3130	Output	Input	00

CC: Baud Rate   FF : CheckSum

CC	bps
03	1200
04	2400
05	4800
06	9600
07	19200
08	38400

7	6	5 4 3 2	1 0
0	0= no [chk] 1= [chk]	0	0

2.4 Command Description

Command	Response	Description
%AANN40CCFF	!AA	Set configuration
#**	Nessuna	Synchronized sampling
#AABBDD	>	Set digital outputs
$AA2	!AA40CCFF	Read configuration
$AA4	>S(data)	Read synchronized data
$AA5	!AAS	Read status readback
$AA6	!(data)	Read Digital I/O
$AAF	!AAFFFF	Read firmware version
$AAM	!AANNNN	Read module ID
$AALS	!(data)	Read Input Latch
$AAC	!AA	Reset Input Latch
~**	Nessuna	Host OK
~AA0	!AASS	Read module status
~AA1	!AA	Reset module status
~AA2	!AASTT	Read Host WDT
~AA3ETT	!AA	Enable Host WDT
~AA4P	!AAVV00	Read PowerOn value
~AA4S	!AAVV00	Read Safe value
~AA5P	!AA	Set PowerOn value
~AA5S	!AA	Set Safe value
~AAONNNN	!AA	Set module ID

%AANN40CCFF
Set Configuration

Description: Set the configuration of a module

Syntax: %AANN40CCFF[chk](cr)
            where:
            NN = New Address
            CC = Baud-Rate
            FF = CheckSum +Data Format

Response:

            !AA[chk](cr)   Valid Command
            ?AA[chk](cr)   Invalid Command
            no response   Communication Error or Address Error

Example:
Command   %0001400640

Response   !00

Description   The module 00 configuration becomes:
                Address= 01
                BaudRate=9600
                CheckSum=1

#**

Synchronized Sampling

Description: Order all input modules of the net, both analogical and digital, to sample immediately all their input data and to store the data in the internal register, waiting for the command $AA4 (Read Syncronized Data) coming from the host computer.

Syntax: #**[chk](cr)

Response:

        No response

Example:

Command	#**
Response	No response
Description	All the modules are sampling

Command	$004
Response	!1550000
Description	Sample Value of the module was:
	I = 00 h O = 55 h

#AABBDD
Set Digital Outputs

Description: Set the value (High or Low) of the digital outputs. It is possible, with the same command, to set all the ports to the desired value (DD) or only one port (BB) at time. This command is valid only for the DAT31xx series modules with digital outputs.

Syntax: #AABBDD[chk](cr)

BB	DD	Description
00	00..FF	Set all the outputs with the DD value
1x	00	Set only the "x" output Low
1x	01	Set only the "x" output High

Response:

>(data)[chk](cr)	Valid Command
?AA[chk](cr)	Invalid Command
No response	Comm. Error or Address Error

Example:
Command   #110055

Response   >

Description   The Output port become:
               55 = 01010101

⟨⟩ DATEXEL

$AA2
Read Configuration

Description: Read the module configuration. The response contains the address, the baud-rate and the CheckSum. This command is used for determining the module configuration when it is unknown.

Syntax: $AA2[chk](cr)

Response:

       !AA40CCFF[chk](cr)   Valid Command
       ?AA[chk](cr)   Invalid Command
       no response   Communication Error or Address Error

       where:
       CC = Baud-Rate
       FF = CheckSum + Data Format

Example:
Command $002

Response   !00400640

Description   The configuration of the module #00 is:
                BaudRate=9600
                CheckSum=1

$AA4
Read Synchronized Data

Description: Read the data sampled with the ' #** ' command (syncronized sampling). Read the sampled value come first by "1", by "0" the following ones.

Syntax: $AA4[chk](cr)

Response:

> >S(data)[chk](cr)   Valid Command
> ?AA[chk](cr)   Invalid Command
> no response   Communication Error or Address Error

> where:
> S = 1 (first reading)
> S = 0 (following readings)

Example:
Command $104

Response   >1550000

Description   Synchronized value is:
                 O=55   I=00   (first reading)

$AA5
Read Status Readback

(Hardware WatchDog)

Description: When the Hardware Watchdog circuit is activated, it will automatically reset the module. You can use this command to know if this fact has happened. At the power-on the state of the module will be always 1 (happened reset).

Syntax: $AA5[chk](cr)

Response:

    !AAS(data)[chk](cr)   Valid Command
    ?AA[chk](cr)   Invalid Command
    no response   Communication Error or Address Error

    where:
    S=0   The module has not been reset
    S=1   The module has been reset

Example:
Command $005

Response   !001

Descrizione   The module #00 has been resetted

$AA6
Leggi I/O Digitali

Descrizione: Read both the digital inputs and the digital outputs e with their values expressed in HEX.

Syntax: $AA6[chk](cr)

Response:

      !(data)[chk](cr)   Valid Command
      ?AA[chk](cr)   Invalid Command
      no response   Communication Error or Address Error

	5	4	3	2	1 0
DAT 3140		Output	Input		0 0
DAT 3148		Input H	Input L		0 0
DAT 3130		Output	Input		0 0

Example:
Command $006

Response   !FF0200

Description   O=FFh   I=02h

$AAF
Read Firmware Number

Description: Read the firmware number of the examined module. This number cannot be modified.

Syntax: $AAF[chk](cr)

Response:

    !AA(data)[chk](cr)   Valid Command
    ?AA[chk](cr)   Invalid Command
    no response   Communication Error or Address Error

Example:
Command $11F

Response   !11B001

Description   The module #11 has the B001 firmware number.

$AAM
Read Module Name

Description: Read the name of the examined module.
The module name can be modified with the ~AAO(name) command
(Set Module Name).

Syntax: $AAM[chk](cr)

Response:

!AA(name)[chk](cr)   Valid Command
?AA[chk](cr)   Invalid Command
no response   Communication Error or Address Error

where:
(name)= module name (4 characters max.)

Example:
Command $00M

Response   !003140

Description   Module name is: "3140".

$AALS
Read Latch Value of Digital Inputs

Description: Read the latch value of the digital inputs. The value are automatically sampled and is stored in the memory until the user don't send the " $AAC " command (clear latch).
The module store both the High Latch (on high rise front) and then Low Latch (on low rise front).
This command is valid only for the DAT31xx series modules with digital inputs.

Syntax: $AALS[chk](cr)
           where:
           S=0 read Low Latch ; S=1 read High Latch

Response:

           !AA(data)[chk](cr)   Valid Command
           ?AA[chk](cr)   Invalid Command
           no response   Communication Error or Address Error

Example:
Command $01L1

Response   !020000

Description   An High rise front is happened on the #02h digital
              input

$AAC
Clear Input Latch

Description: Force the input latch, both high and low, to logic level 0. This command is valid only for the DAT31xx series modules with digital inputs.

Syntax: $AAC[chk](cr)

Response:

!AA[chk](cr)	Valid Command
?AA[chk](cr)	Invalid Command
no response	Communication Error or Address Error

Example:
Command $21C

Response   !21

Description   Clear input latch

~**

Host OK

Description: This command is used to order to all the modules of the net to reset the watchdog timer.
By this command it is avoided that the modules, when the watchdog timer is active, goes in alarm condition.

Syntax: ~**[chk](cr)

Response: No response

Example
Command   ~**

Response   No response

Description   All the modules reset their watchdog timer.

~AA0
Read Module Status

Description: Read the module status.
If the status is 04 it means that the Host WatchDog is in alarm condition.
The status remains in this condition until the command ~ AA1 (reset) is not sent.

Syntax: ~AA0[chk](cr)

Response:

      !AASS[chk](cr)   Valid Command
      ?AA[chk](cr)   Invalid Command
      no response   Communication Error or Address Error

      where:
      SS=00 The module is in normal condition
      SS=04 The module is in alarm condition

Example:
Command   ~020

Response   !0204

Description   The module is in alarm condition.

~AA1
Reset Module Status

Description: Every time that the module is in WatchDog Host Alarm condition, its state assumes the value "04". By this way it is possible to know if the module is in alarm condition. The state remains in this condition until the command ~ AA1 (reset) is not sent.

Syntax: ~AA1[chk](cr)

Response:

!AA[chk](cr)	Valid Command
?AA[chk](cr)	Invalid Command
no response	Communication Error or Address Error

Example:

Command   ~021

Response   !02

Description   The module is not in alarm

~AA2
Read WatchDog Timer

Description: Read the Host Watchdog timer value, set by the ~AA3ETT (Enable WDT Timer) command.

Syntax: ~AA2[chk](cr)

Response:

      !AASTT[chk](cr)   Valid Command
      ?AA[chk](cr)   Invalid Command
      no response   Communication Error or Address Error

      where:
      S = 0 WDT disabled
      S = 1 WDT enabled
      TT = timer value in tenth of second in HEX
            (0001=0,1s)

Example:
Command   ~012

Response   !01130

Description   WDT enabled,
            Timer value: 30h —> 48d
                           48*0,1= 4,8s

~AA3ETT
Enable Watchdog Timer

Description: Enable/Disable the host WatchDog timer. When the host WDT is enabled, the host must to send the ~** command to all modules before the timer ends. When the ~** command is received, the timer of the host watchdog is reset and than it restarts. You can use ~AA2 command to read value and status of the host watchdog timer.

Syntax: ~AA3ETT[chk](cr)

            where:
            E = 0 Timer disabled
            E = 1 Timer enabled
            TT = timer value in tenth of second in HEX
                    (0001=0,1s)

Response:
            !AA[chk](cr)   Valid Command
            ?AA[chk](cr)   Invalid Command
            no response   Communication Error or Address Error

Example
Command   ~013130

Response   !01

Description WDT enabled.
             Timer: 30h —> 48d
                       48*0,1= 4,8s

~AA4P
Read PowerOn Value

Description: Read the value to which the outputs are forced at ever PowerOn event, set with the ~AA5P command (set PowerOn value). This command is valid only for the DAT31xx series modules with digital outputs.

Syntax: ~AA4P[chk](cr)

Response:

    !AAVV00[chk](cr)   Valid Command
    ?AA[chk](cr)   Invalid Command
    no response   Communication Error or Address Error

    VV= Output PowerOn Value (00..FF)

Example:
Command   ~024P

Response   !025500

Description   At the PowerOn, the outputs will be set to 55h value.

~AA4S
Read Safe Value

Description: Read the value to which the outputs are forced in case of WatchDog alarm, set with the ~AA5S command (set Safe value). This command is valid only for the DAT31xx series modules with digital outputs.

Syntax: ~AA4S[chk](cr)

Response:

    !AAVV00[chk](cr)   Valid Command
    ?AA[chk](cr)   Invalid Command
    no response   Communication Error or Address Error

    VV= Output Safe Value (00..FF)

Example:
Command   ~024P

Response   !025500

Description   At the WDT Alarm, the outputs will be set to 55h value.

~AA5P
Set PowerOn Value

Description: Set the current state of the outputs as PowerOn value. To set the outputs to the desired value, #AABBDD command is used. This command is valid only for the DAT31xx series modules with digital outputs.

Syntax: ~AA5P[chk](cr)

Response:

!AA[chk](cr)	Valid Command
?AA[chk](cr)	Invalid Command
no response	Communication Error or Address Error

Example:

Command	#0100FF
Response	!01
Description	Set the Outputs

Command	~015P
Response	!01
Description	The new PowerOn value is FF

~AA5P
Set PowerOn Value

Description: Set the current state of the outputs as Safe value.
To set the outputs to the desired value, #AABBDD command is used.
This command is valid only for the DAT31xx series modules with digital outputs.

Syntax: ~AA5P[chk](cr)

Response:

> !AA[chk](cr)   Valid Command
> ?AA[chk](cr)   Invalid Command
> no response   Communication Error or Address Error

Example:
Command   #0100FF
Response   !01
Description   Set the Outputs

Command   ~015P
Response   !01
Description   The new Safe value is FF

~AAO(name)
Set Module Name

Description: Set the module name.
The name must be composed by 4 ASCII characters.
You can use the $AAM command to read the module name.

Syntax: ~AAO(name)[chk](cr)

            where:
            (name)= module name (4 characters max.)

Response:
            !AA[chk](cr)   Valid Command
            ?AA[chk](cr)   Invalid Command
            no response   Communication Error or Address Error

Example:
Command   ~01O3140

Response   !01

Description   The new module name is: "3140"

Chapiter 3

OPERATION PRINCIPLES

3.1 INIT

If the exact configuration of a module is unknown, it can result impossible to establish a communication with it. The INIT pin resolves this problem.
Connecting the INIT pin to the GND pin (ground) and turning on the device, it will automatically goes in the default configuration:

address = 00
baud-rate = 9600
checksum = disabled

The user can send the "read configuration" command to the module and it will answer supplying the configuration into the memory; by this way the user knows the exact configuration of the module. If the INIT pin is disconnected from GND, at the next power-up the module automatically returns to the original configuration, and the connection can restart.

3.2 Digital I/O

INPUT

The digital input circuit of the DAT31xx series is galvanically isolated from the power supply of the module, for this reason it needs an external power supply. The positive reference of this voltage must be connected to the "IN COM" pin. The digital signal, connected to the "INx" pin must be referred to the negative reference of the same voltage, e.g. through a contact, as shown in the figure below.

When this contact is closed, the channel will assume logic level 1; when the contact is open, the channel will assume logic level 0.
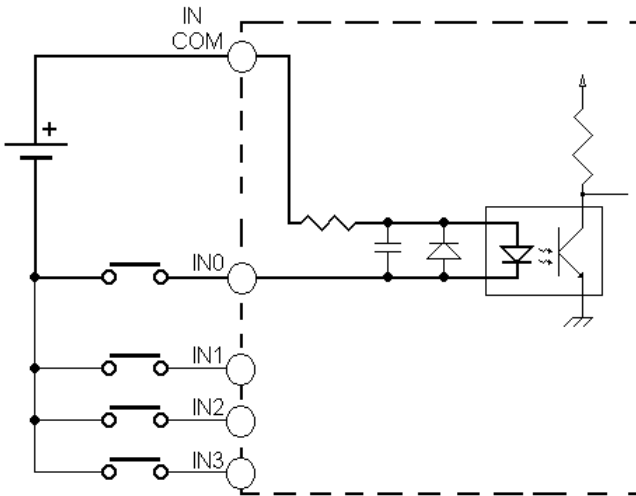
'OPEN COLLECTOR' OUTPUT

The digital output circuit of the DAT3140 module, is galvanically isolated from the other circuits, and is of NPN Open Collector type. The typical connection is shown in the figure below.

When the output is set to logic level 1, the power transistor go in saturation condition, closing the circuit between D0 and COM-, and allowing the current to flow in the load. When the output is set to logic level 0, the circuit is open, then the current in the load is zero.

The COM+ pin is needed to polarize the output circuit, and it consume low current.
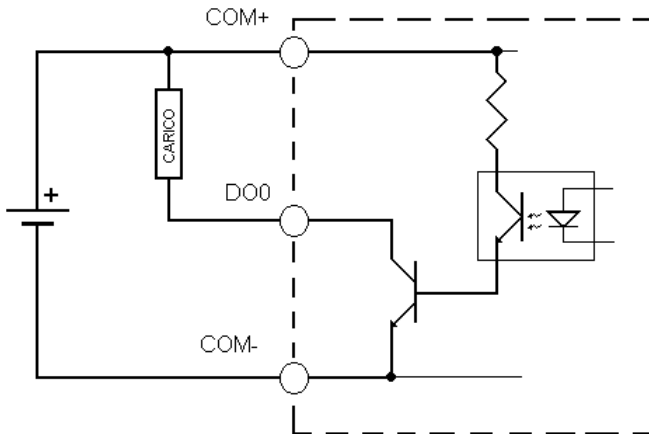
3.3 Dual WatchDog

The DAT3000 modules has been designed for working in industrial environments, where many noises or energy transient can be present.
If these noises are too much strong, the modules could suffer of them and working incorrectly, or being not able anymore to communicate with the host. This situation can be very dangerous in the case that the module commands some attuator in a not correctly way. For this reason the modules has provided of a Host Watchdog timer which, when it is enabled, makes to start the alarm every time that the communication between the module and the host is inactive for a time greater then the programmed one. When the alarm goes on, the values of the outputs automatically are converted in the values set as 'safety value', corresponding to the state in which must be putted the outputs, and therefore the attuators, to avoid damages to the system in case of failure.

There is also a Module Watchdog timer, a hardware circuit that watch the operation of the internal CPU and start when, expired the limit of time, reset doesn't come from the same CPU. If the CPU breaks for some reason and no reset of the Module Watchdog happens within the preset time, it start and resets the CPU, making to restart again its program. After the reset of the module, the digital outputs will assume their initial value (default), which may not to be identical to the value of the outputs before the reset. For this reason the user, after the reset of the module, has to resend the output setting command.
The user can know if the module is reset sending the $AA5 command, whose response contains the S value.
If S=1, this means that the module is reset.

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