ABB Drives

Installation and Start-up Guide

Pulse Encoder Interface Module
NTAC-0x

Digital I/O Extension Module
NDIO-0x

Analogue I/O Extension Module
NAIO-0x

Pulse Encoder Interface Module NTAC-0x Digital I/O Extension Module NDIO-0x Analogue I/O Extension Module NAIO-0x

Installation and Start-up Guide

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Safety Instructions

Overview

This chapter states the safety instructions that must be followed when installing and operating the NTAC-0x/NDIO-0x/NAIO-0x Module. The material in this chapter must be studied before attempting any work on, or with, the unit.

Warnings and Notes

This manual distinguishes two sorts of safety instructions. Warnings are used to inform of conditions which can, if proper steps are not taken, lead to a serious fault condition, physical injury and death. Notes are used when the reader is required to pay special attention or when there is additional information available on the subject. Notes are less crucial than Warnings, but should not be disregarded.

Warnings

Readers are informed of situations that can result in serious physical injury and/or serious damage to equipment with the following symbols:

Dangerous Voltage Warning: warns of situations in which a high voltage can cause physical injury and/or damage equipment. The text next to this symbol describes ways to avoid the danger.

General Warning: warns of situations which can cause physical injury and/or damage equipment by means other than electrical. The text next to this symbol describes ways to avoid the danger.

Electrostatic Discharge Warning: warns of situations in which an electrostatic discharge can damage equipment. The text next to this symbol describes ways to avoid the danger.

Notes

Readers are notified of the need for special attention or additional information available on the subject with the following symbols:

CAUTION! **Caution** aims to draw special attention to a particular issue.

Note: **Note** gives additional information or points out more information available on the subject.

General Safety Instructions

WARNING! All electrical installation and maintenance work on the drive should be carried out by qualified electricians.

The drive and adjoining equipment must be properly earthed.

Do not attempt any work on a powered drive. After switching off the mains, always allow the intermediate circuit capacitors 5 minutes to discharge before working on the frequency converter, the motor or the motor cable. It is good practice to check (with a voltage indicating instrument) that the drive is in fact discharged before beginning work.

The motor cable terminals of the drive are at a dangerously high voltage when mains power is applied, regardless of motor operation.

There can be dangerous voltages inside the drive from external control circuits even when the drive mains power is shut off. Exercise appropriate care when working with the unit. Neglecting these instructions can cause physical injury and death.

WARNING! There are several automatic reset functions in the drive. If selected, they reset the unit and resume operation after a fault. These functions should not be selected if other equipment is not compatible with this kind of operation, or dangerous situations can be caused by such action.

More Warnings and Notes are printed at appropriate instances along the text.

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Chapter 1 – Introduction to This Guide

Overview

This chapter contains a description of the *NTAC-0x/NDIO-0x/NAIO-0x Installation and Start-up Guide*.

Intended Audience

The Guide is intended for people who are responsible for installing, commissioning and servicing the pulse encoder interface (NTAC) or I/O extension modules (NDIO, NAIO) of ACS 600 frequency converters. The user is expected to have a basic knowledge of electrical fundamentals, electrical wiring practices and the ACS 600.

Applicability

This Guide is applicable to the following module revisions:

- NTAC-02 revision C or later
  (Refer to Appendix C for information on earlier revisions.)
- NDIO-02 revision A or later
  (Refer to Appendix D for information on earlier revisions.)
- NAIO-03 revision A or later
  (Refer to Appendix E for information on earlier revisions.)

What This Guide Contains

The installation and start-up of the Pulse Encoder Interface Module, the Digital I/O Extension Module and the Analogue I/O Extension Module are introduced in this Guide.

Safety Instructions are placed in the first few pages of this Guide. Safety Instructions describe the formats for various warnings and notations used within this Guide. This chapter also states the safety instructions which apply to the installation and operation of the option modules.

Chapter 1 – Introduction to This Guide contains a short description of the Guide and a list of related publications.

Chapter 2 – Overview contains a description of the Pulse Encoder Interface Module and the I/O Extension Modules, a delivery checklist and warranty information.

Chapter 3 – Installation contains instructions for module hardware settings, mounting, cabling and programming.

Appendix A contains Technical Data.

Appendix B – Ambient Conditions lists the requirements for ambient conditions during transportation, storage and use of the NTAC-0x/ NDIO-0x/NAIO-0x module.

Appendix C – NTAC-01 Information includes information on the earlier NTAC module type (NTAC-01) for reference.

Appendix D – NDIO-01 Information includes information on the earlier NDIO module type (NDIO-01) for reference.

Appendix E – NAIO-01/02 Information includes information on the earlier NAIO module types (NAIO-01 and NAIO-02) for reference.

Terms Used in This Guide

NAIO Module	The NAIO (Analogue I/O Extension Module) is an optional device for ACS 600 frequency converters. The module offers two current or voltage inputs and two current outputs.
NAMC Board	The NAMC is the Application and Motor Control Board of the ACS 600. There are different types of NAMC, e.g. NAMC-03 and NAMC-11.
NDCO Board	The NDCO (DDCS Communication Option) series includes optional communication boards for installation on top of the NAMC-11.
NDIO Module	The NDIO (Digital I/O Extension Module) is an optional device for ACS 600 frequency converters. The module offers two digital inputs and two relay outputs.
NIOC Board	The NIOC is the standard I/O interface of the ACS 600. It connects the drive to the external control circuits.
NTAC Module	The NTAC (Pulse Encoder Interface Module) is an optional device for ACS 600 frequency converters. The module offers an interface for a digital pulse encoder connection.

Chapter 2 – Overview

Overview

This chapter contains a description of the I/O Extension Link, the Pulse Encoder Interface Module, the I/O Extension Modules, and information on warranty.

The I/O Extension Link

All the Pulse Encoder Interface Module (NTAC) and I/O Extension Modules (NDIO and NAIO) are connected to the frequency converter via an optical DDCS-protocol communication link. The modules, together with the NIOC Standard I/O Board, are usually connected in a ring on Channel CH1 of the NAMC (Application and Motor Control Board). The NAMC board acts as the master, polling the other stations cyclically. The modules respond to the master's enquiries.

Each device on the DDCS link has an individual node number. The modules are numbered by setting the DIP switches located inside the module enclosure. (The address of the NIOC board is fixed to 1.)

NTAC-02 Pulse Encoder Interface Module

The Pulse Encoder Interface Module (NTAC) offers an interface for a digital pulse encoder connection. A pulse encoder should be used if accurate speed or position (angle) feedback from the motor shaft is required.

Delivery Check

The package contains:

- NTAC-02 module
- three pairs of fibre optic cables (120/370/2000 mm)
- two jumper bridges (for encoder voltage selection)
- mounting rail (DIN 50022, 35 × 7.5 mm, length 45 mm)
- This manual, the *NTAC-0x/NDIO-0x/NAIO-0x Installation and Start-up Guide*.

Compatibility

The NTAC-02 is compatible with the following application programs:

- ACS 600 Standard Application Program version 5.0 or later
- ACS 600 System Application Program version 4.2 or later
- ACS 600 Crane Drive Application Program version 5.0 or later
- ACS 600 Application Program Template (all versions).

Encoder Recommendation

Leine & Linde 18690010, Hübner POG 10 or equivalent:

- 90° (electrical) phase shift between channels 1 and 2
- Recommended output sinking/sourcing capability: 40 mA.

NDIO-02 Digital I/O Extension Module

The Digital I/O Extension Module (NDIO) offers two digital inputs (24 to 250 V d.c., or 110 to 230 V a.c.) and two relay outputs (2000 VA/250 V a.c. or 8 A/24 V d.c.).

Delivery Check

The option package contains:

- NDIO-02 module
- three pairs of fibre optic cables (120/370/2000 mm)
- mounting rail (DIN 50022, 35 × 7.5 mm, length 45 mm)
- This manual, the *NTAC-0x/NDIO-0x/NAIO-0x Installation and Start-up Guide*.

Compatibility

The NDIO-02 is compatible with the following application programs:

- ACS 600 Standard Application Program version 2.8 or later
- ACS 600 System Application Program version 4.2 or later
- ACS 600 Crane Drive Application Program version 5.0 or later
- ACS 600 Application Program Template (all versions).

NAIO-03 Analogue I/O Extension Module

The Analogue I/O Extension Module (NAIO) offers two bipolar current (±0(4) to 20 mA) or voltage (±0(2) to 10 V, or ±0 to 2 V) inputs and two unipolar current (0(4) to 20 mA) outputs. The signal resolution (12 bits) is better than that of the standard analogue I/O.

Delivery Check

The option package contains:

- NAIO-03 module
- three pairs of fibre optic cables (120/370/2000 mm)
- mounting rail (DIN 50022, 35 × 7.5 mm, length 45 mm)
- This manual, the *NTAC-0x/NDIO-0x/NAIO-0x Installation and Start-up Guide*.

Compatibility

The NAIO-03 is compatible with the following application programs:

- ACS 600 Standard Application Program version 2.8 or later
- ACS 600 System Application Program version 4.2 or later
- ACS 600 Crane Drive Application Program version 5.0 or later
- ACS 600 Application Program Template (all versions).

Warranty

See the *Hardware Manual* of the drive for information on warranty.

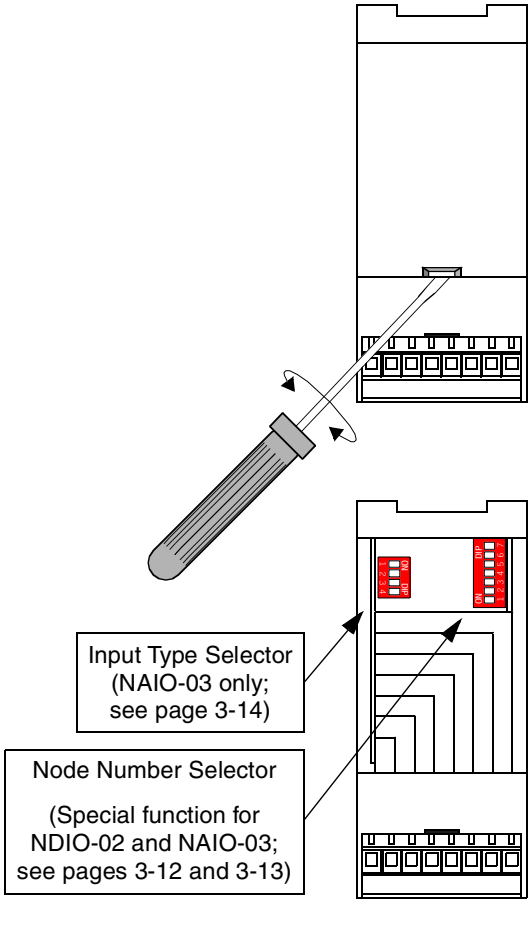
Chapter 3 – Installation

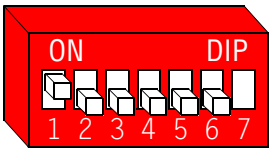
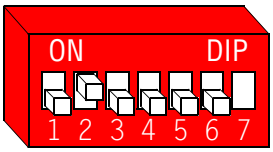
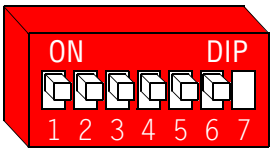
Overview

The first few pages of this chapter provide module-independent instructions on setting the node number, mechanical installation and ACS 600 connection. Module-specific instructions (e.g. on I/O and power connections) are given later in the chapter.

Setting the Module Node Number

Each module must be given an individual node number. The node number is set by adjusting the DIP switches located under the top lid of the module casing (see picture below left). The switch settings for each module are shown below. For allowable NDIO and NAIO node numbers, see the *Firmware Manual* of the drive.



NDIO or NAIO Node No.	Binary	DIP Switch Settings
1	000001	
2	000010	
• • •	• • •	• • •
63	111111	

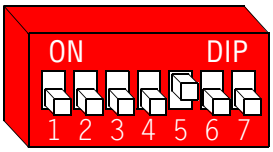
NTAC Node No.	Binary	DIP Switch Settings
16 (Fixed)	0010000	

Figure 3-1 Setting the module node numbers.

Note: The new settings take effect only the next time the module is powered up.

Mechanical Installation

Depending on the drive, the module(s) can be installed either inside or outside the drive housing or cabinet. See the *Hardware Manual* of the drive for module placement options.

Mounting Outside the Drive

Choose the location for the module. Note the following:

- The cabling instructions (given later in this chapter for each module type) must be followed. Also, the length of the fibre optic cables included in the option package may restrict the distance between the module and the drive.
- Observe the free space requirements for the module (min. 10 mm from adjoining equipment or wall) and the drive (see the drive documentation).
- The ambient conditions must be taken into account (see Appendix B). The degree of protection of the module is IP 20.
- Module earth is connected to the mounting rail by means of an earthing clip (see Figure 3-2 below). The mounting rail onto which the module is to be mounted must be earthed to a noiseless earth. If the rail is not mounted on a properly earthed base, a separate earthing conductor must be used. The conductor must be as short as possible and the cross-sectional area must be 6 mm^2 at least. ***Note:*** No solid copper conductor may be used (stranded wire allowed only).

Mounting instructions:

1. Switch off all dangerous voltages in the enclosure that the module is to be mounted in.
2. Fasten the rail and ensure proper earthing as described above.
3. Push the module onto the rail. The module can be released by pulling the locking spring with a screwdriver (see Figure 3-2).

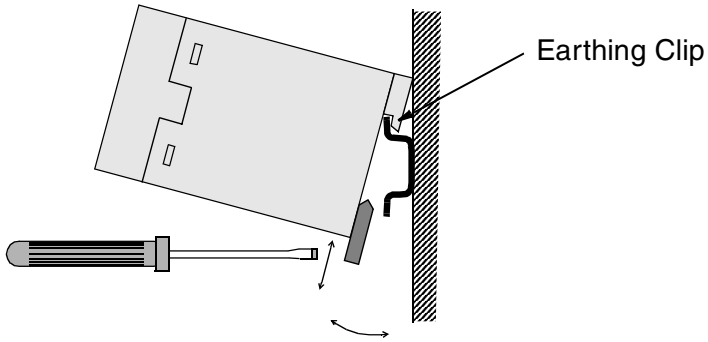


Figure 3-2 Mounting and removing the module.

Mounting Inside the Drive

The work inside the drive should be carried out by a qualified electrician only.

WARNING! Pay attention to the slowly discharging voltage of the capacitor bank and the voltages that are connected from external control circuits to the inputs and outputs of the drive.

WARNING! Do not touch the printed circuit boards. The integrated circuits are extremely sensitive to electrostatic discharge.

Mounting instructions:

1. Stop the drive.
2. Switch off the power supply of the drive and all dangerous voltages connected to the inputs and outputs.
3. Wait for five minutes to ensure that the capacitors in the intermediate circuit have discharged.
4. Remove the front cover of the drive.
5. Ensure that the mains cable, motor cable and capacitor bank (UDC+ and UDC–) are not powered.
6. Locate the position for the module (see the *ACS 600 Hardware Manual)*. Fasten the mounting rail to its place if not already installed. Observe the free space requirements for the module (min. 10 mm from adjoining equipment/wall).
7. Push the module onto the rail. The module can be released by pulling the locking spring with a screwdriver (see Figure 3-2).

ACS 600 Connection

General The modules are connected to the drive (NAMC/NDCO board) using the fibre optic cables included in the module package. Observe the connector colour coding: blue connectors should go to blue receivers (RXD), grey (or black) connectors to grey transmitters (TXD). Multiple modules on the same channel are connected in a ring.

The fibre optic cables must be handled with care. The maximum long-term tensile load is 1 N and the minimum short-term bend radius is 25 mm. The ends of the fibre must not be touched as optical fibres are sensitive to dirt. Grommets should be used at cable lead-throughs.

Terminals The terminals which the NTAC-02, NDIO-02 and NAIO-03 modules are connected to are given in the table below.

Module	Application Program	Board	Channel	Terminals
NTAC-02	Standard, V5.0 or later	NDCO (Optional)	CH2	V17, V18
	Standard, V5.0 or later with Master/Follower Macro	NAMC	CH1	V15, V16
	System	NAMC	CH1	V15, V16
	Crane, V5.0 or later	NAMC	CH1	V15, V16
NDIO-02 NAIO-03	(all)	NAMC	CH1	V15, V16

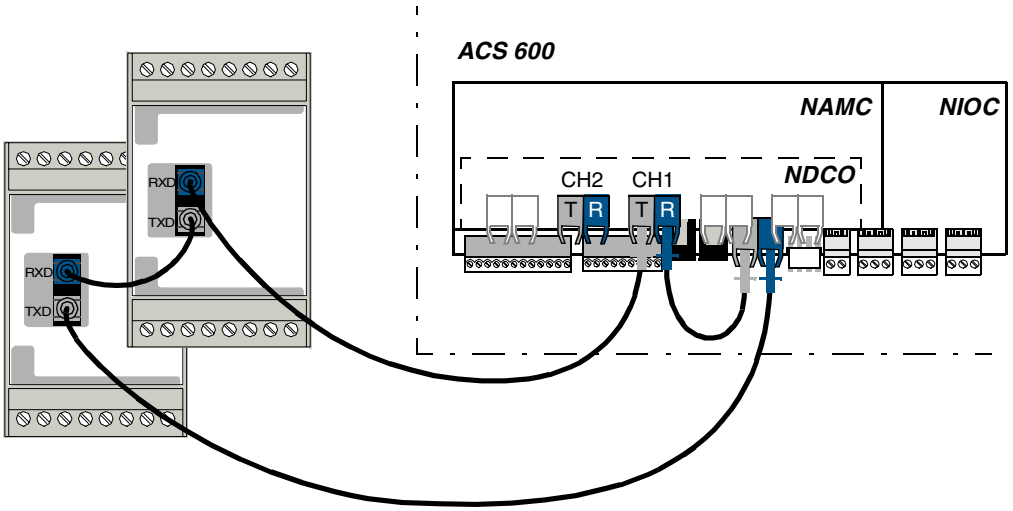
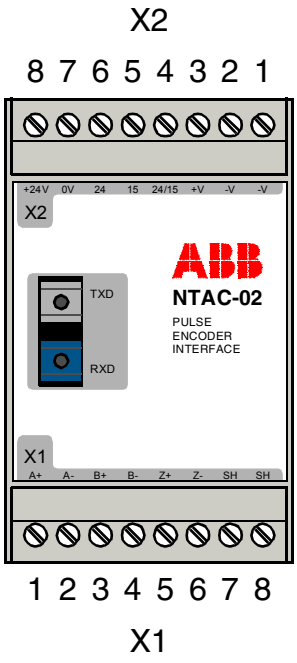
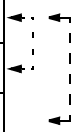


Figure 3-3 Connecting the modules to the ACS 600. The picture shows two modules on Channel CH1; the terminals may vary according to the application program used. Refer to the table above and the relevant Firmware Manual.

NTAC-02 Pulse Encoder Interface Module

Terminal Designations



X2	Marking	Description
1	-V	Encoder power supply, either 15 or 24 V d.c. (according to jumper selection on terminals 4, 5 and 6). Max. 5 W (-V is also used on single-ended encoder connection for balancing the A+, B+ and Z+ conductors. See Figures 3-6 to 3-8)
2	-V	
3	+V	
4	24/15	 Encoder supply voltage selection: Terminals 4 and 5 connected: 15 V Terminals 4 and 6 connected: 24 V (Two jumpers are supplied with the NTAC module)
5	15	
6	24	
7	0V	NTAC module power supply, 24 V d.c. ±10% (see *Current Consumption* below)
8	+24V	

X1	Marking	Description	
1	A+	A	• Max. signal frequency: 100 kHz • Signal levels: “1” > 7.6 V, “0” < 5 V (for 15 V supply) “1” > 12.2 V, “0” < 8 V (for 24 V supply) • Input channels isolated from power supply and earth • When the drive runs in the *Forward* direction, A should lead B by 90° (electrical) • Ch. Z: One pulse per revolution (used for positioning)
2	A-	$\overline{A}$	
3	B+	B	
4	B-	$\overline{B}$	
5	Z+	Z	
6	Z-	$\overline{Z}$	
7	SH	Shield	For earthing the encoder cable screens. Internally connected to NTAC module earth
8	SH		

Figure 3-4 The NTAC-02 Pulse Encoder Interface Module: terminal designations.

Current Consumption

The NTAC-02 has to be supplied with 24 V d.c. power, either from the NIOC board (max. 250 mA), or an external power supply. As the current consumption of the module depends on many factors (e.g. max. speed of the motor, encoder pulse number per revolution, encoder cable length and leakage capacitance), it should be checked on each occasion if an additional power supply is needed.

The approximate current consumption of the NTAC-02 can be read from the chart or calculated with the formula in Figure 3-5.

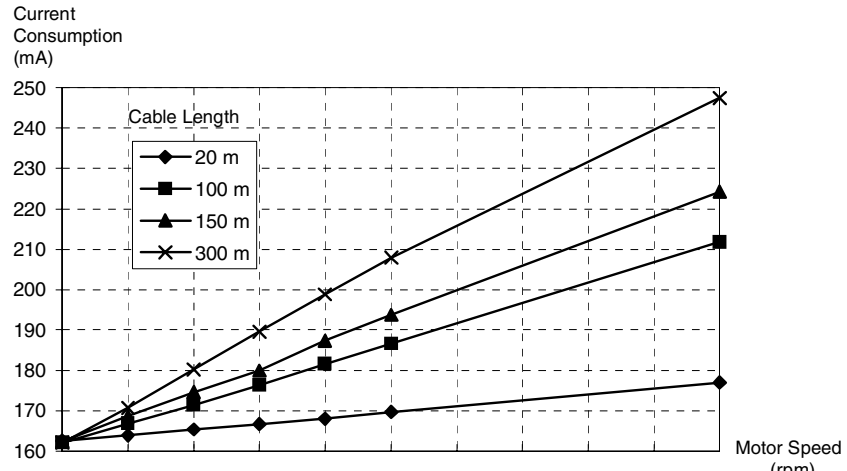
NTAC-02 Current Consumption (approx.):

$$162\ mA + k_c \cdot EPN \cdot \frac{n_{max}}{60 \cdot 10^3}$$

n_{max} = Motor Maximum Speed (rpm)
EPN = Encoder Pulse Number (ppr)
k_c = Coefficient (mA/kHz)
= 1.68 (300 m cable)
= 1.23 (150 m cable)
= 0.98 (100 m cable)
= 0.31 (20 m cable)

Note: The maximum allowed pulse frequency (f_{max}) is 100 kHz.

f_{max}= EPN · n_{max}/(60 · 10^3) kHz



Encoder Pulse Number: 1024 ppr	0	300	600	900	1200	1500	1800	2100	2400	2700	3000
Encoder Pulse Number: 2048 ppr	0	150	300	450	600	750	900	1050	1200	1350	1500
Encoder Pulse Number: 512 ppr	0	600	1200	1800	2400	3000	3600	4200	4800	5400	6000

Figure 3-5 The current consumption of the NTAC-02 for four different encoder cable lengths. The chart is based on a measurement with a 1024 ppr pulse encoder with differential outputs coupled to a motor shaft rotating at 1500 rpm.

Cabling The pulse encoder should be connected to the NTAC module with a cable specified below.

Cable construction	4 × (2+1) Twisted pair cable with individual and overall screens.
Conductor cross-sectional area	0.5 to 1.0 mm^2
Maximum length	Dependent on encoder output type as follows: 300 m (differential push-pull) 200 m (single-ended push-pull) 100 m (open collector or emitter)

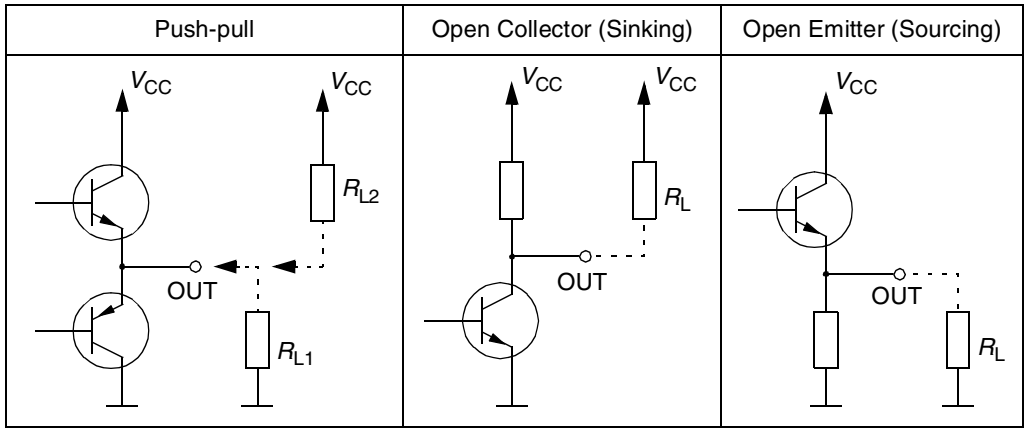
Either a *single-ended* or *differential* connection can be used, but the manufacturer's recommendations should be taken into account. On pages 3-8 to 3-10, there are wiring diagrams for different encoder output types. Compare encoder documentation and the following figure to determine the output type.

Note: The cable screens should be earthed at the NTAC module only.

Note: Do not route the encoder cables parallel to power cables.

Examples of Encoder Output Circuits

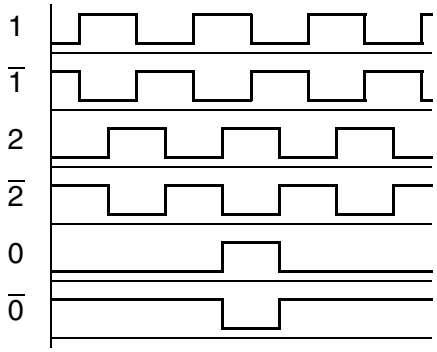
These diagrams present some typical encoder output circuits. The following pages include wiring diagrams for each output type.



Encoder Phasing

When the encoder is connected correctly, running the drive in the *Forward* (positive) direction should produce positive encoder feedback.

On incremental encoders, the two output channels, usually marked 1 and 2 or A and B, are 90° (electrical) apart from each other. When rotated clockwise, most encoders – but not all – have channel 1 leading channel 2 as illustrated below. Determine the leading channel by referring to the encoder documentation, or by measuring with an oscilloscope.



The encoder output channel that leads when the drive runs *Forward* should be connected to NTAC input A, the output channel that trails to NTAC input B.

The zero reference output channel (usually marked 0, N or Z) needs to be connected in positioning applications only.

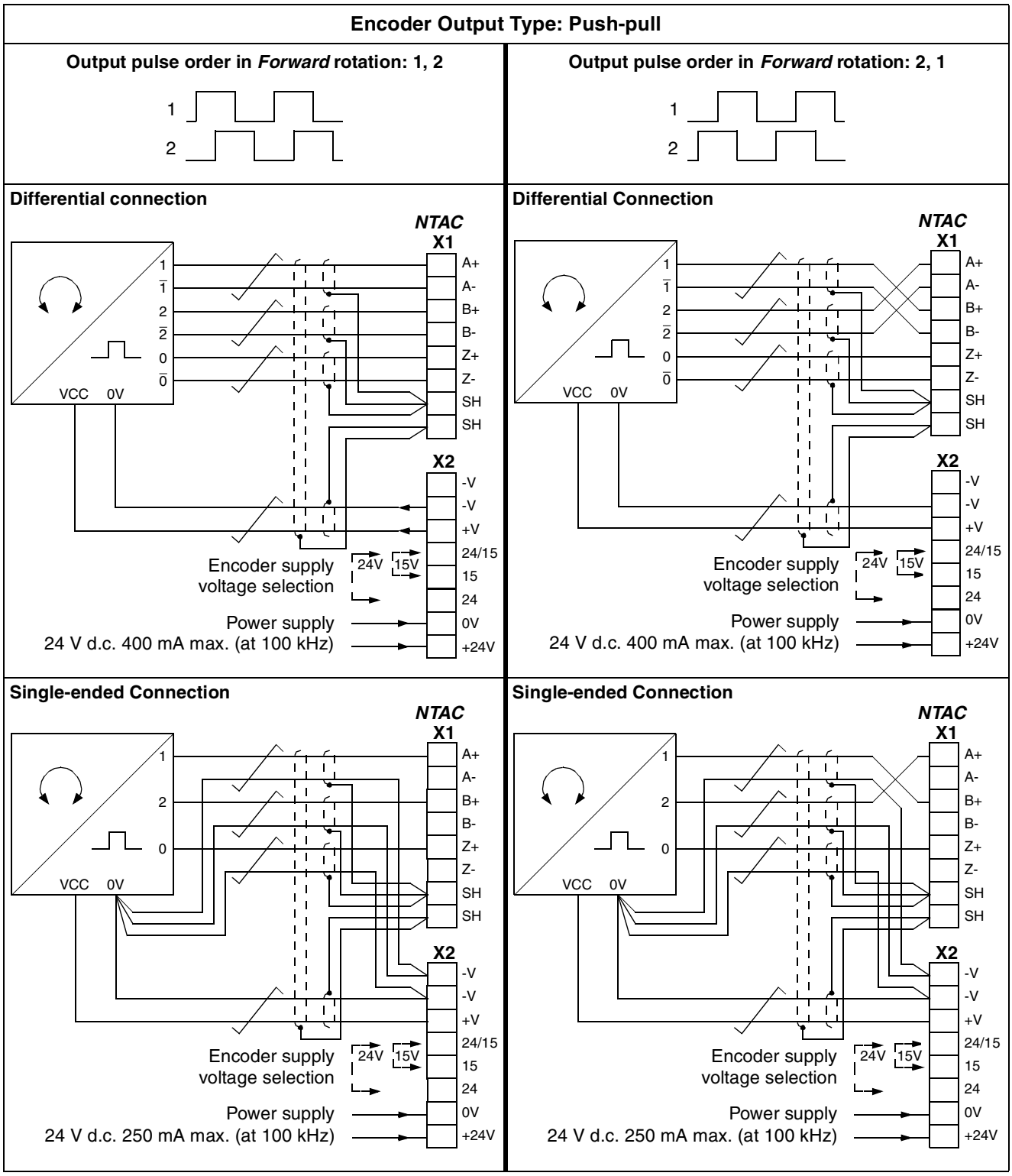


Figure 3-6 Connection diagrams for pulse encoders with push-pull outputs.

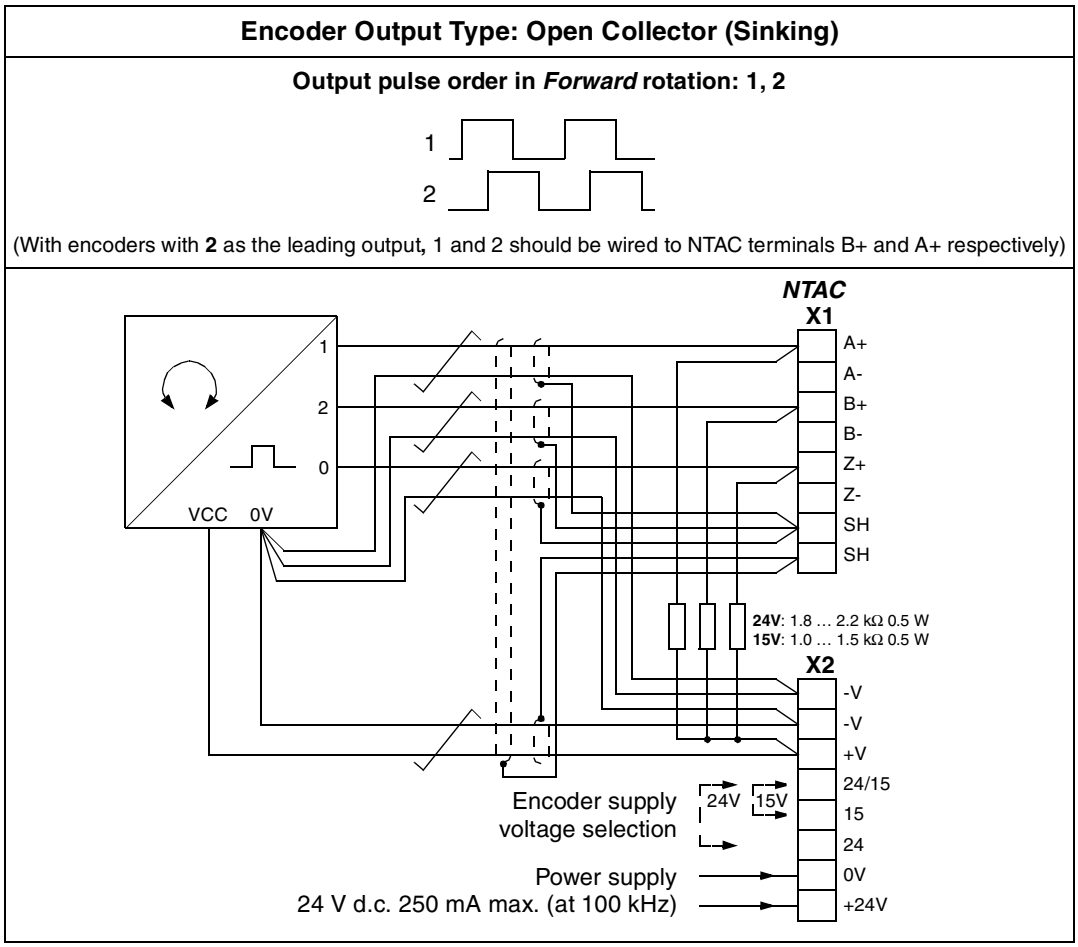


Figure 3-7 Connection diagram for pulse encoders with open collector (sinking) outputs.

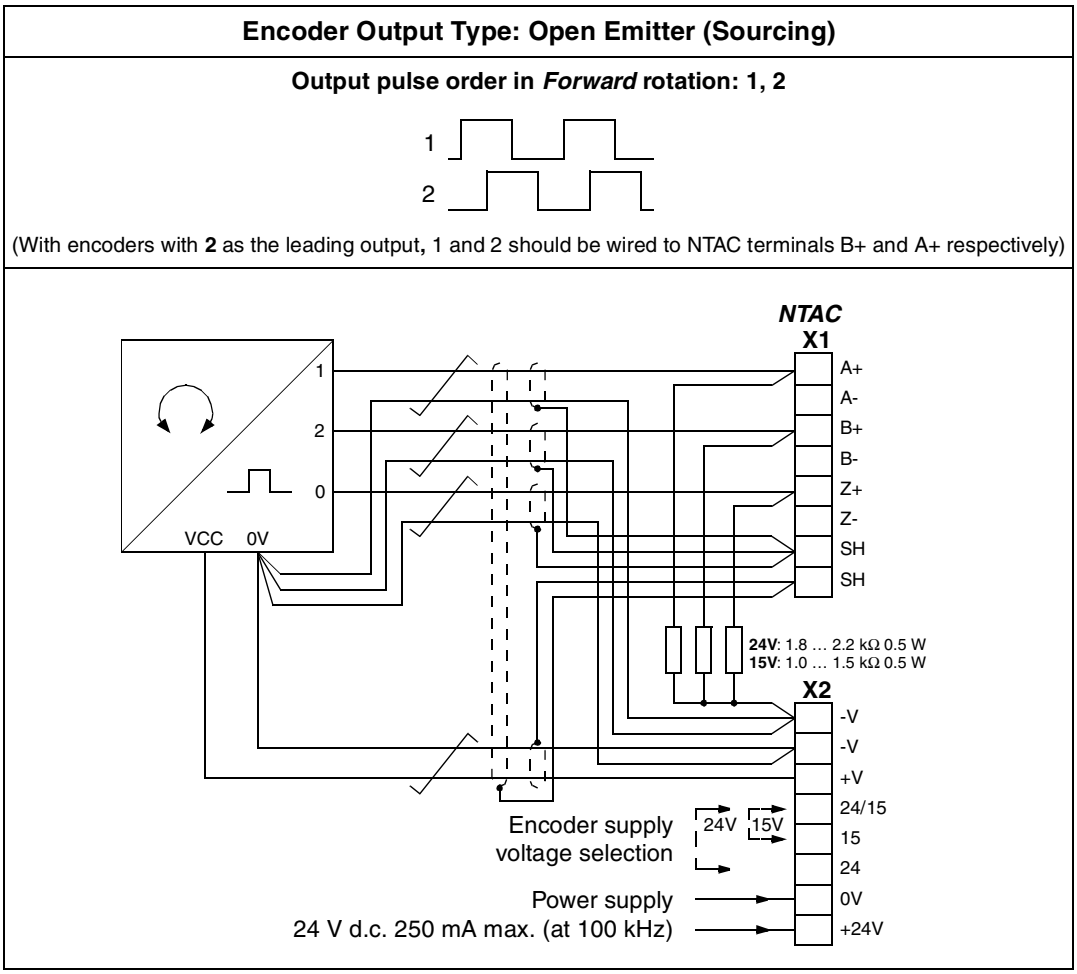


Figure 3-8 Connection diagram for pulse encoders with open emitter (sourcing) outputs.

Programming

The NTAC-02 is programmed through drive parameters. After the communication between the module and the drive is activated, several parameters are copied to the drive. These parameters must be checked and adjusted. For further information, see the *Firmware Manual*, Parameter Groups 98 and 50.

Note: The new settings take effect only the next time the module is powered up.

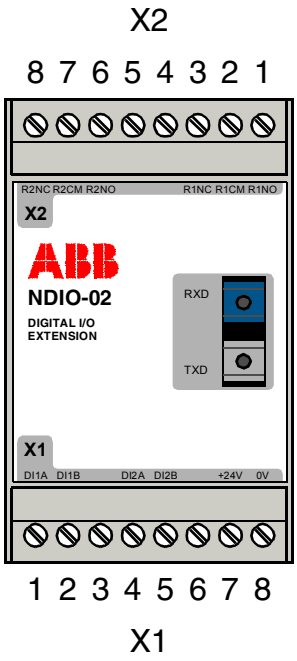
NTAC Module Replacement

The NTAC-01 and NTAC-02 are not interchangeable. A faulty NTAC module must be replaced with a spare part of the same type.

For reference, the differences between the NTAC-01 and NTAC-02 modules are detailed in Appendix C.

NDIO-02 Digital I/O Extension Module

Terminal Designations



X2	Marking	Description		
1	R1NO		Relay output 1	**Relay outputs 1 and 2:** Max. continuous current: 2 A rms Switching capability: 8 A (24 V d.c., resistive load) 0.4 A (120 V d.c., resistive load) 2000 VA (250 V a.c.) Isolated (4 kV for 1 min)
2	R1CM			
3	R1NC			
4	Unused			
5	Unused			
6	R2NO		Relay output 2	
7	R2CM			
8	R2NC			

Note: When used with inductive loads (relays, contactors, motors, etc.), the contacts of the relays must be protected with varistors or RC networks (AC) or diodes (DC) against voltage transients. Place these protective components at the load rather than at the NDIO terminals.

X1	Marking	Description	
1	DI1A	Digital input 1	**Digital inputs 1 and 2:** DC signal: 24 to 250 V, min. 4 mA, max. 10 mA. Signal levels: “1” > 12 V; “0” < 8 V AC signal: 110 to 230 V ±10%, max. 4 mA. Signal levels: “1” > 40 V; “0” < 20 V Isolated (4 kV for 1 min)
2	DI1B		
3	Unused		
4	DI2A	Digital input 2	
5	DI2B		
6	Unused		
7	+24V	Power supply for the module (24 V d.c. ±10%, 50 mA)	
8	0V		

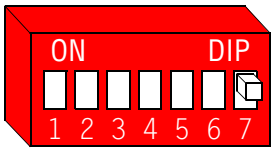
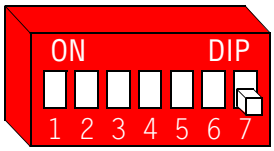
Figure 3-9 NDIO-02 terminal designations.

Cabling With 24 V d.c. signals, a twisted pair cable with an overall screen is recommended. The cable screens should be earthed to the rail onto which the module is mounted. The rail must be properly earthed. (See page 3-2.)

Note: Do not route the signal cables parallel to power cables.

DI1 Hardware Filter Suppression

For faster input with a DC signal, the hardware filter on digital input DI1 can be disabled using the node number selection DIP switch. This, however, reduces the noise immunity of the input.

	DIP Switch Setting
DI1 Hardware Filtering Enabled (Default)	
DI1 Hardware Filtering Disabled	

Note: Always have the hardware filtering enabled when using an AC input signal.

Programming

The communication between the module and the drive is activated by a drive parameter. After activation, the NDIO replaces certain standard inputs. See the *Firmware Manual*, Parameter Group 98.

Users of Standard Application Program versions up to 3.0 should refer to Appendix D for a listing of related drive parameters.

Note: The new settings take effect only the next time the module is powered up.

NDIO Module Replacement

An NDIO-02 can be used to replace a faulty NDIO-01. For reference, the differences between the two types are listed in Appendix D.

NAIO-03 Analogue I/O Extension Module

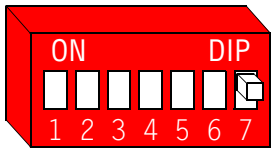
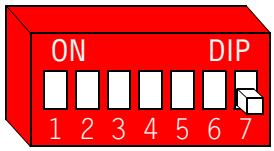
Mode Selection

The operating mode of the analogue inputs can be selected using the node number selection DIP switch (actuator 7). The drive parameters must be set accordingly.

In bipolar mode, the analogue inputs can handle positive and negative signals. The resolution of the A/D conversion is 11 data bits (+ 1 sign bit). The way the drive interprets the negative range of the inputs depends on the settings of the drive. See the *Firmware Manual.*

In unipolar mode, the analogue inputs can handle positive signals only. The resolution of the A/D conversion is 12 data bits.

The outputs of the NAIO-03 are always unipolar.

Mode	DIP Switch Setting	Input Signal Type
Bipolar (Default)		±0(4) … 20 mA ±0(2) … 10 V ±0 … 2 V
Unipolar		0(4) … 20 mA 0(2) … 10 V 0 … 2 V

The following table shows the settings for the NAIO-03 mode switch and the module activation parameter for the ACS 600 Standard Application Program. (Users of other application programs should refer to the drive manuals.)

	Standard Application Program Version	
DIP Switch Setting	**2.8 to 3.0b**	**3.0c or later**
Bipolar	Not applicable	OK (Par. 98.06 setting: NAIO-02 or BIPOLAR)
Unipolar	OK (Par. 98.6 setting: YES)	OK (Par. 98.06 setting: NAIO-01 or UNIPOLAR)

Input Signal Type Selection

Each input can be used with a current or voltage signal. The selection is made with a DIP switch located behind the top lid of the NAIO module casing (see Figure 3-1). The switch settings are shown below.

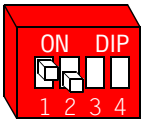
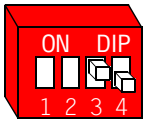
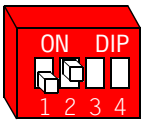
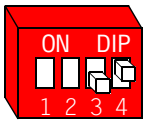
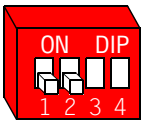
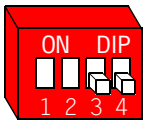
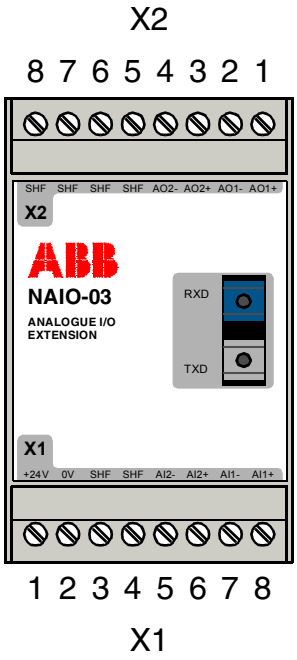
Input Signal Type	DIP Switch Settings AI1	DIP Switch Settings AI2
Current signal 0(4) … 20 mA		
Voltage signal 0(2) … 10 V		
Voltage signal 0 … 2 V		

Figure 3-10 Analogue input type selection.

Note: Independent of the selection of the signal type, the values of the analogue inputs are displayed in mA on the ACS 600 Control Panel; e.g. 10 V will be displayed as 20 mA. This must be taken into account when scaling the signals or reading the actual value of the analogue inputs AI2 and AI3. See the drive manuals for more information.

Terminal Designations

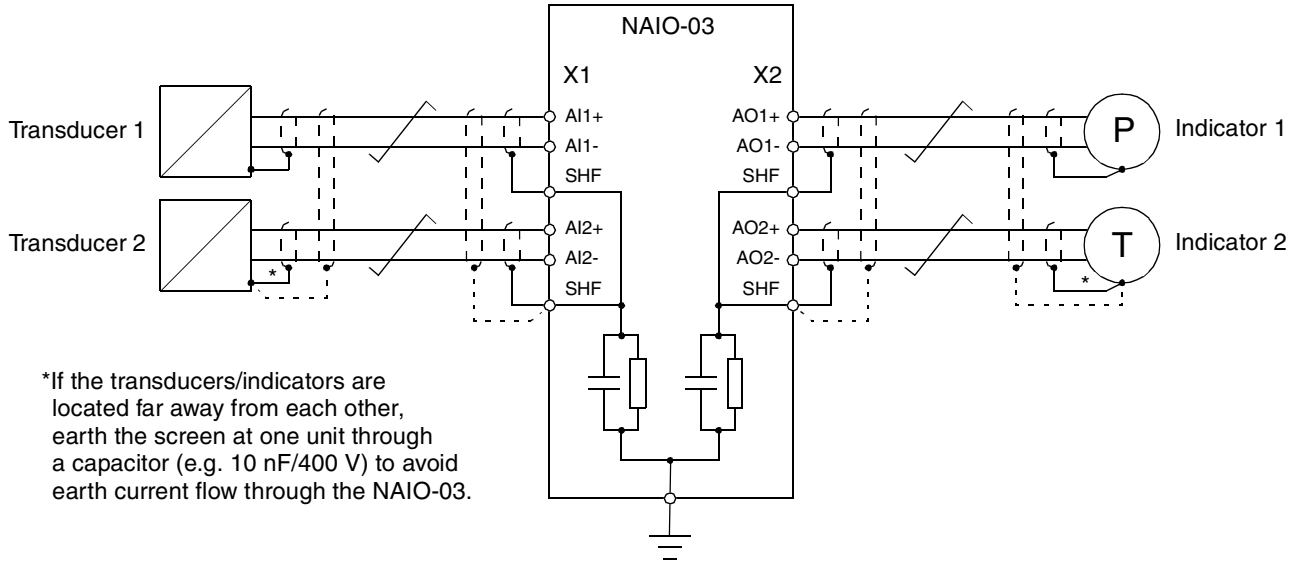


X2	Marking	Description	
1	AO1+	Current Output 1	Current signal 0(4) … 20 mA $R_{load} \leq 700\ \Omega$ Isolated from power supply and from earth
2	AO1-		
3	AO2+	Current Output 2	
4	AO2-		
5	SHF	Cable screen AC earthing (via an RC filter). For connection of the cable screens	
6	SHF		
7	SHF		
8	SHF		

X1	Marking	Description	
1	+24V	Power supply for the module (24 V d.c. ±10%, 160 mA)	
2	0V		
3	SHF	Cable screen AC earthing (via an RC filter). For connection of the cable screens	
4	SHF		
5	AI2-	Analogue Input 2	Current signal ±0(4) … 20 mA $R_{in} = 100\ \Omega$ Isolated from power supply and from earth Voltage signal ±0(2) … 10 V or ±0 … 2 V $R_{in} = 200\ k\Omega$ Isolated from power supply and from earth
6	AI2+		
7	AI1-	Analogue Input 1	
8	AI1+		

Figure 3-11 NAIO-03 terminal designations.

Cabling 0.5 to 1.5 mm^2 twisted pair cables with individual and/or overall screens should be used for analogue signals. The screens should be connected to the SHF terminals on the NAIO module. See the example below.



Note: X1 and X2 have separate RC filters as pictured above, i.e. the SHF terminals on one terminal block are connected together, then to earth through an RC filter.

Note: Do not route the signal cables parallel to power cables.

Programming The communication between the module and the drive is activated by a drive parameter. (Ensure that the parameter settings correspond to the mode switch setting of the module.) After activation, the NAIO replaces certain standard inputs and outputs. See the drive *Firmware Manual*, Parameter Group 98.

Users of Standard Application Program versions up to 3.0 should refer to Appendix E for a listing of related drive parameters.

Note: The new settings take effect only the next time the module is powered up.

NAIO Module Replacement An NAIO-03 can be used to replace a faulty NAIO-01/02. For reference, the differences of the NAIO types are detailed in Appendix E.

Appendix A – Technical Data

I/O Extension Link

Compatible Devices: NAIO module, NDIO module, NTAC module, ACS 600 frequency converter

Maximum size of the link: 128 stations

Topology: Ring

Serial communication type: Asynchronous

Transmission speed: 1 Mbit/s

Protocol: ABB Distributed Drives Communication System (DDCS)

Medium access control method:

- Application and Motor Control Board (NAMC) of the ACS 600 polls other stations cyclically

Cable: Fibre optic cable

- Construction: Plastic core, diameter 1 mm, sheathed with plastic jacket
- Cable attenuation: 0.23 dB/m
- Cable maximum length: 10 m between two stations
- Cable specifications:

Parameter	Minimum	Maximum	Unit
Storage Temperature	-55	+85	°C
Installation Temperature	-20	+70	°C
Operating Temperature	-40	+85	°C
Short Term Tensile Force		50	N
Short Term Bend Radius	25		mm
Long Term Bend Radius	35		mm
Long Term Tensile Load		1	N
Flexing		1000	Cycles

Connectors:

- Simplex connectors. Blue = receiver, Grey or Black = transmitter

NTAC-02

Enclosure: Plastic, dimensions: 45 mm x 75 mm x 105 mm. Degree of protection: IP 20

Mounting: Onto a standard mounting rail

Hardware settings: Seven DIP switches for setting the node number. Allocated node number: 16 (default).

Connectors:

- Light transmitter and receiver (Hewlett-Packard Versatile Link) for ACS 600 connection
- Two screw terminal blocks (Phoenix Contact MVBSTW 2,5/8-ST-5,08) for encoder and power supply connections. Conductor cross-sectional area: 0.5 to 2.5 mm^2

Encoder inputs:

- Max. signal frequency: 100 kHz
- Logical thresholds (15 V encoder supply): “1” > 7.6 V, “0” < 5 V
- Logical thresholds (24 V encoder supply): “1” > 12.2 V, “0” < 8 V
- Speed feedback resolution: 0.00305 % (15 bits)
- Isolated from the power supply and from earth
- Channel B 90° (electrical) apart from Channel A
- Channel Z: one pulse per revolution (used in positioning)

General:

- Current consumption: 250 mA max. at 24 V d.c. (typical). Refer to Figure 3-5
- All materials are UL/CSA approved
- Fast transient burst immunity (IEC 801-4): 4 kV 5/50 ns
- Electromagnetic emissions: In accordance to EN 55022 B

NDIO-02

Enclosure: Plastic, dimensions: 45 mm x 75 mm x 105 mm. Degree of protection: IP 20

Mounting: Onto a standard mounting rail

Hardware settings:

- Six DIP switches for setting the node number. Allocated node numbers: module 1 = 2 (default), module 2 = 3, module 3 = 4. Maximum: 63
- One DIP switch for enabling/disabling digital input DI1 hardware filtering. Default: filtering on

Connectors:

- Light transmitter and receiver (Hewlett-Packard Versatile Link) for ACS 600 connection
- Two screw terminal blocks (Phoenix Contact MVBSTW 2,5/8-ST-5,08) for digital I/O and power supply connections. Conductor cross-sectional area: 0.5 to 2.5 mm^2

Digital inputs 1 and 2:

- Voltage range: ±24 to 250 V d.c., 110 to 230 V a.c. ±10%
- Input current: 10 mA at 24 V d.c., 4 mA max. at 115/230 V a.c.
- Logical thresholds (d.c.): “1” > 12 V, “0” < 8 V
- Logical thresholds (a.c.): “1” > 40 V, “0” < 20 V
- Isolated from each other and the power supply.
  Test voltage: 4 kV a.c., 1 minute
- Hardware filtering time: max. 10 ms
  (Can be disabled for digital input 1)

Relay outputs 1 and 2:

- Max. voltage: 120 V d.c., 250 V a.c.
- Switching capacity: 8 A at 24 V d.c. (resistive load),
  0.4 A at 120 V d.c. (resistive load), 2000 VA at 250 V a.c.
- Max. continuous current: 2 A RMS
- Contact material: Silver cadmium oxide (AgCdO)
- Contact protection: Varistor (250 V). With an inductive load, an external protective component should be installed at the load end
- Isolated from each other and the power supply.
  Test voltage: 4 kV a.c., 1 minute

General:

- Current consumption: 50 mA at 24 V d.c
- All materials are UL/CSA approved
- Fast transient burst immunity (IEC 801-4): 4 kV 5/50 ns
- Electromagnetic emissions: In accordance to EN 55022 B

NAIO-03

Enclosure: Plastic, dimensions: 45 mm x 75 mm x 105 mm. Degree of protection: IP 20

Mounting: Onto a standard mounting rail

Hardware settings:

- Six DIP switches for setting the node number. Allocated node number: 5 (default). Maximum: 63
- One DIP switch for selection between bipolar mode (default) and unipolar mode
- Four DIP switches for input signal type selection

Connectors:

- Light transmitter and receiver (Hewlett-Packard Versatile Link) for ACS 600 connection
- Two screw terminal blocks (Phoenix Contact MVBSTW 2,5/8-ST-5,08) for analogue I/O and power supply connections. Conductor cross-sectional area: 0.5 to 2.5 mm^2

Analogue inputs 1 and 2:

- Input signal types: ±0(4) to 20 mA, ±0(2) to 10 V, ±0 to 2 V
- Input impedance: 100 Ω (current), 200 kΩ (voltage)
- Resolution in unipolar mode: 0.024% (12 data bits)
- Resolution in bipolar mode: 0.048% (11 data bits + sign bit)
- Inaccuracy: ±0.5% (Full Scale Range) at 25 °C.
  Temperature coefficient: ±100 ppm/°C max.
- Isolated from the power supply and from earth.
  Test voltage: 1.5 kV a.c., 1 minute
- Common mode voltage: ±15 V
- Hardware filtering time: 2 ms approx.

Analogue outputs 1 and 2:

- Output signal type: 0(4) to 20 mA
- Maximum load resistance: 700 Ω
- Resolution: 0.024% (12 bits)
- Inaccuracy: ±0.5% (Full Scale Range) at 25 °C.
  Temperature coefficient: ±100 ppm/°C max.
- Isolated from the power supply and from earth.
  Test voltage: 1.5 kV a.c., 1 minute

General:

- Current consumption: 160 mA at 24 V d.c
- All materials are UL/CSA approved
- Fast transient burst immunity (IEC 801-4): 4 kV 5/50 ns
- Electromagnetic emissions: In accordance to EN 55022 B

Appendix B – Ambient Conditions

Ambient Conditions, Operation

Ambient operating conditions refer to the conditions the NTAC-02/ NDIO-02/NAIO-03 module is subjected to when installed for stationary use.

Air Temperature: 0 to +50°C.

Relative Humidity: 5 to 95%, no condensation allowed. Maximum allowed relative humidity is 60% in the presence of corrosive gases.

Contamination Levels:
Chemical gases: IEC 721-3-3, Class 3C2
Solid particles: IEC 721-3-3, Class 3S2

Installation Site Altitude: 0 to 2000 m above sea level. If the installation site is higher than 2000 m above sea level, please contact your local ABB distributor or office for further information.

Vibration: Max. 0.3 mm (2 to 9 Hz), max. 1 m/s^2 (9 to 200 Hz) sinusoidal (IEC 68-2-6)

Ambient Conditions, Storage

Ambient storage conditions refer to the conditions the option module is subjected to during storage in the protective package.

Temperature: -40 to +70°C.

Relative Humidity: Less than 95%, no condensation allowed.

Atmospheric Pressure: 70 to 106 kPa

Vibration: Max. 0.3 mm (2 to 9 Hz), max. 1 m/s^2 (9 to 200 Hz) sinusoidal (IEC 68-2-6)

Shock: Max. 100 m/s^2, 11 ms (IEC 68-2-29)

Ambient Conditions, Transportation

Ambient transportation conditions refer to the conditions the option module is subjected to during transportation in the protective package.

Temperature: -40 to +70°C

Relative Humidity: Max. 95%, no condensation allowed.

Atmospheric Pressure: 60 to 106 kPa

Vibration: Max. 3.5 mm (2 to 9 Hz), max. 15 m/s^2 (9 to 200 Hz) sinusoidal (IEC 68-2-6)

Shock: Max. 100 m/s^2, 11 ms (IEC 68-2-29)

Bump: Max. 300 m/s^2, 6 ms (IEC 68-2-29)

Fall: 250 mm

Appendix C – NTAC-01 Information

Overview

The NTAC-01 is compatible with ACS 600 drives with Standard Application Program versions from 2.8 to 3.0. Version 5.0 (and later) require the use of the NTAC-02. Thus, **NTAC-01 and NTAC-02 are not interchangeable**.

Differences between NTAC-01 and NTAC-02

All information about the NTAC-02 given elsewhere in this manual also applies to the NTAC-01, with the exception of what is listed in this section.

Terminal Designations

The terminals of the NTAC-01 can be connected as shown for the NTAC-02 in Chapter 3. Although unmarked on the label, NTAC-01 terminal X2:1 can actually be used as an additional -V terminal. Moreover, the SH and PE terminals are both connected to module earth.

Encoder Supply Voltage

The encoder supply voltages available from the NTAC-01 are 12 and 24 V (instead of 15 and 24 V available with the NTAC-02).

Cabling

The maximum encoder cable length for the NTAC-01 is 150 m.

Technical Data

Encoder inputs:

- Logical thresholds (12 V encoder supply): “1” > 8.3 V, “0” < 3.7 V

NTAC Setup in Std. Application Program V2.8 to 3.0

This section only applies when an NTAC-01 module is connected to an ACS 600 equipped with Standard Application Program version 2.8 to 3.0. Users of other application programs should refer to the drive manuals.

Before adjusting the parameters, ensure that the module node number is set to 16. Note that the setting takes effect only on the following module power-up.

98.1 ENCODER MODULE

This parameter activates the communication between the ACS 600 and the NTAC module.

YES
Communication is active.

NO
Communication is not active.

Parameter Group 50 The parameters in Group 50 define the encoder signal decoding and the operation of the ACS 600 in encoder or NTAC module fault conditions. These parameters are available only after the communication between the ACS 600 and the NTAC module is activated with Parameter 98.1.

50.1 PULSE NR This parameter sets the number of encoder pulses per one revolution.

128 … 4096

50.2 SPEED MEAS MODE This parameter defines how the encoder pulses are calculated.

A ‾ B DIR
Ch A: positive edges calculated for speed.
Ch B: direction.

A ‾ _
Ch A: positive and negative edges calculated for speed.
Ch B: not used.

A ‾ _ B DIR
Ch A: positive and negative edges are calculated for speed.
Ch B: direction.

A ‾ _ B ‾ _
All edges of the signals are calculated.

50.3 ENCODER FAULT This parameter defines the operation of the ACS 600 upon a communication loss between the pulse encoder and the NTAC module, or between the NTAC module and the ACS 600.

WARNING
A Warning indication is displayed on the control panel.

FAULT
A Fault indication is displayed on the control panel and the ACS 600 stops the motor.

50.4 ENCODER DELAY This parameter defines the time (in milliseconds) for which communication may be lost until the ACS 600 takes the action selected with Parameter 50.3.

0 … 50000

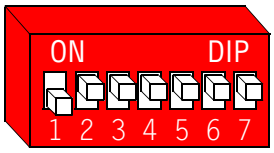
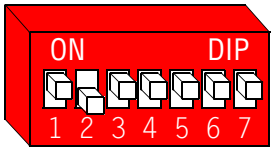
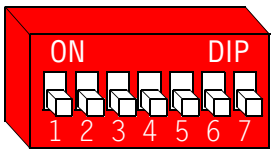
Appendix D – NDIO-01 Information

Differences between NDIO-01 and NDIO-02

All information about the NDIO-02 given elsewhere in this manual also applies to the NDIO-01, with the exception of what is listed in this section.

Setting the Module Node Number

On the NDIO-01, the 7-way DIP switch is used for address setting only (i.e., the NDIO-01 does not have the hardware filter suppression feature found in the NDIO-02). Moreover, switch actuator position “ON” corresponds to “0”. Here are the DIP switch settings for the NDIO-01:

NDIO-01 Node No.	Binary	DIP Switch Settings
1	0000001	
2	0000010	
• • •	• • •	• • •
127	1111111	

DI1 Hardware Filter Suppression

This feature is not supported by the NDIO-01.

Technical Data

Hardware settings: NDIO-01 has seven DIP switches for address number setting. See above.

Digital inputs 1 and 2: On the NDIO-01, the hardware filtering cannot be disabled.

NDIO Setup in Std. Application Program V2.8 to 3.0

This section only applies when an NDIO module is connected to an ACS 600 equipped with Standard Application Program version 2.8 to 3.0. Users of other application programs should refer to the drive manuals.

Up to three NDIO modules can be connected to the ACS 600. The modules should be numbered 1, 2 and 3 using the DIP switches.

Each NDIO module present replaces certain standard digital inputs of the ACS 600 Standard I/O Board (NIOC) depending upon the selected node number (1 to 3). The relay outputs of each NDIO module increase the total number of relay outputs available. The information which the module outputs indicate is preprogrammed and cannot be altered by the user.

The following parameters should be checked and adjusted to activate the NDIO module(s). Before adjustment, check that the node numbers are set correctly. Note that the setting takes effect only on the following module power-up.

98.3 DI/O EXT MODULE 1

This parameter activates the communication between the ACS 600 and the NDIO module with node number 1.

YES
Digital input 1 of the module replaces standard digital input DI1.
Digital input 2 of the module replaces standard digital input DI2.
Relay output 1 of the module indicates drive status READY.
Relay output 2 of the module indicates drive status RUNNING.

NO
Communication is not active or module not present.

98.4 DI/O EXT MODULE 2

This parameter activates the communication between the ACS 600 and the NDIO module with node number 2.

YES
Digital input 1 of the module replaces standard digital input DI3.
Digital input 2 of the module replaces standard digital input DI4.
Relay output 1 of the module indicates drive status FAULT.
Relay output 2 of the module indicates drive status WARNING.

NO
Communication is not active or module not present.

98.5 DI/O EXT MODULE 3

This parameter activates the communication between the ACS 600 and the NDIO module with node number 3.

YES
Digital input 1 of the module replaces standard digital input DI5.
Digital input 2 of the module replaces standard digital input DI6.
Relay output 1 of the module indicates drive status REF 2 SEL.
Relay output 2 of the module indicates drive status AT SPEED.

NO
The module is not active or module not present.

Appendix E – NAIO-01/02 Information

Overview

This Appendix contains information on the earlier versions of the NAIO module, i.e. NAIO-01 and NAIO-02.

Applicability

The table below shows the applicability of the NAIO-01/NAIO-02 modules and different versions of the ACS 600 Standard Application Program.

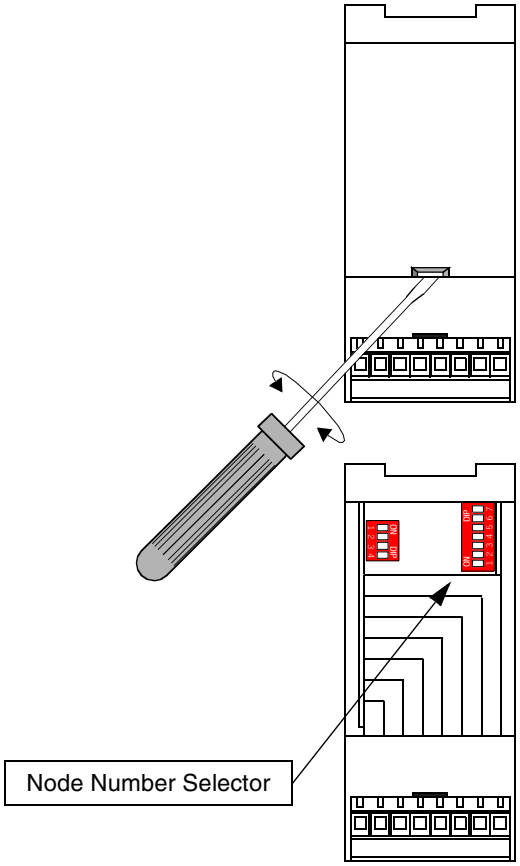
	Standard Application Program Version	
Module Type	**2.8 to 3.0b**	**3.0c or later**
NAIO-01 (Unipolar inputs only)	OK (Par. 98.6 setting: YES)	OK (Par. 98.06 setting: NAIO-01 or UNIPOLAR)
NAIO-02 (Bipolar inputs only)	Not applicable	OK (Par. 98.06 setting: NAIO-02 or BIPOLAR)

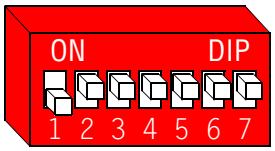
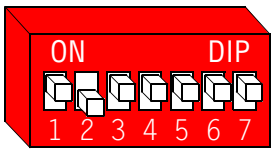
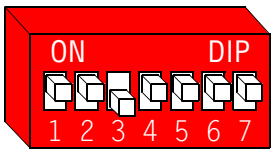
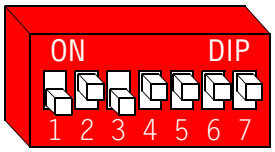
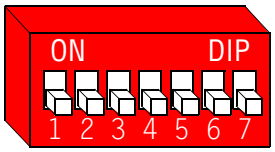
Differences between NAIO-03 and Earlier NAIO Types

All information about the NAIO-03 given in the previous chapters of this manual also applies to the NAIO-01 and NAIO-02, with the exception of what is listed below.

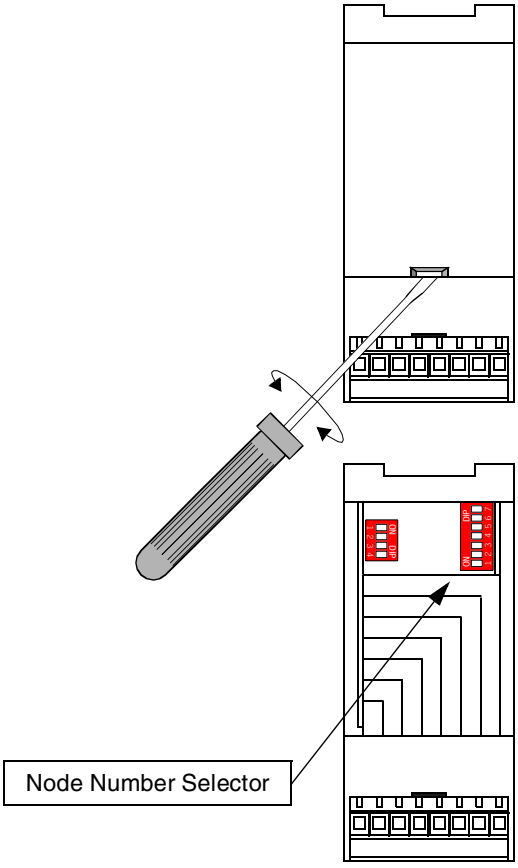
This Appendix also presents the related ACS 600 Standard Application Program Version 3.0 parameters that are not described in the *Programming Manual.*

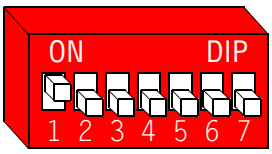
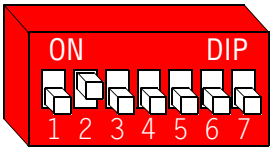
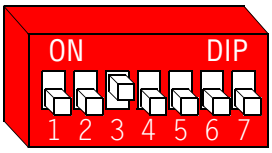
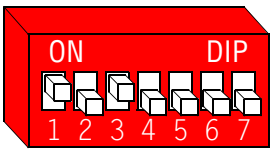
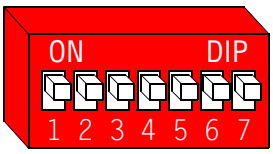
Setting the Module Node Number (NAIO-01)



Node No.	Binary	DIP Switch Settings
1	0000001	
2	0000010	
• • •	• • •	• • •
4 (Std. Application Program up to V3.0)	0000100	
5 (Std. Application Program V5.0 or later)	0000101	
• • •	• • •	• • •
127	1111111	

Setting the Module Node Number (NAIO-02)

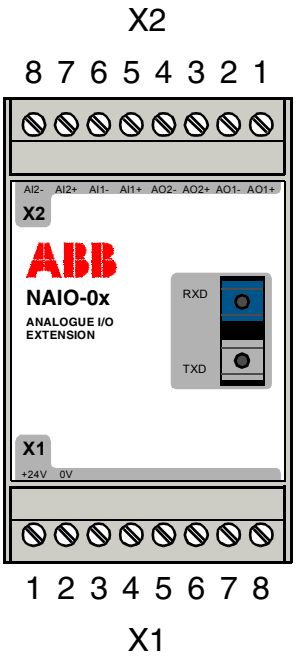


Node No.	Binary	DIP Switch Settings
1	0000001	
2	0000010	
• • •	• • •	• • •
4 (Std. Application Program V3.0c to 3.0f)	0000100	
5 (Std. Application Program V5.0 or later)	0000101	
• • •	• • •	• • •
127	1111111	

Mode Selection (NAIO-01, NAIO-02)

The inputs of the NAIO-01 are always unipolar, while the inputs of the NAIO-02 are always bipolar, i.e. neither module has any means of mode selection.

Terminal Designations (NAIO-01, NAIO-02)



X2	Marking	Description		
1	AO1+	Current Output 1	Current signal 0(4) … 20 mA $R_{load} \leq 700\ \Omega$ Isolated from power supply and from earth	
2	AO1-			
3	AO2+	Current Output 2		
4	AO2-			
5	AI1+	Analogue Input 1	Current signal ±0(4) … 20 mA $R_{in} = 100\ \Omega$ Isolated from power supply and from earth	Voltage signal ±0(2) … 10 V or ±0 … 2 V $R_{in} = 200\ k\Omega$ Isolated from power supply and from earth
6	AI1-			
7	AI2+	Analogue Input 2		
8	AI2-			

X1	Marking	Description
1	+24V	Power supply for the module (24 V d.c. ±10%, 160 mA)
2	0V	

Technical Data (NAIO-01, NAIO-02)

Hardware settings:

- Seven DIP switches for setting the node number. Range: 0 to 127

Analogue inputs 1 and 2:

- Hardware filtering time: 20 ms approx.

NAIO Setup in Std. Application Program V2.8 to 3.0

This section only applies when an NAIO module is connected to an ACS 600 equipped with Standard Application Program version 2.8 to 3.0. Users of other application programs should refer to the drive manuals.

Before adjusting the parameters, ensure that the module node number is set to 4. Note that the setting takes effect only on the following module power-up.

98.6 AI/O EXT MODULE 1

This parameter activates the communication between the ACS 600 and the NAIO module.

YES (Std. Application Program versions up to 3.0b)
NAIO-01; NAIO-02 (Std. Application Program versions 3.0c to 3.0f)
Analogue input 1 of the module replaces standard analogue input AI3.
Analogue input 2 of the module replaces standard analogue input AI2.
Analogue output 1 of the module replaces standard analogue output AO1.
Analogue output 1 of the module replaces standard analogue output AO2.

NO
Communication is not active or module not present.

Note: The ACS 600 assumes that the signals connected to the analogue inputs 2 and 3 are always current signals because the standard inputs are fixed that way. It is possible, however, to connect a voltage signal to the module input. In case the real input is a voltage signal, the panel will display the input signal incorrectly. A real value 10 V will be displayed as 20 mA. This must be considered when scaling the signals or reading the actual value of the AI2 and AI3.

Example: The input signal is scaled by setting the signal minimum and maximum values with the parameters in Group 13 ANALOGUE INPUTS. If the actual signal on AI2 of the module is a voltage signal, the setting of Parameter 13.11 MINIMUM AI2 to 0 mA corresponds to actual minimum 0 V and the setting 4 mA corresponds to actual minimum 2 V. The maximum setting 20 mA corresponds to actual maximum 10 V.

Parameter Group 13 Analogue Inputs

The parameters in Group 13 define the minimum and maximum values of the input signals, the signal scaling factors, the signal filtering time constants and the signal inversion. For more information see the *ACS 600 Programming Manual.*

Parameter Group 15 Analogue Outputs

The parameters in Group 15 define the actual analogue output signals, the signal minimum values, the signal scaling factors and the signal filtering time constants. For more information see the *ACS 600 Programming Manual.*

NTAC-0x/NDIO-0x/NAIO-0x/EN
3AFY 58919730 R0425 REV A
EFFECTIVE: 1.1.2000
SUPERSEDES: 1.7.1999

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