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

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.

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.

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

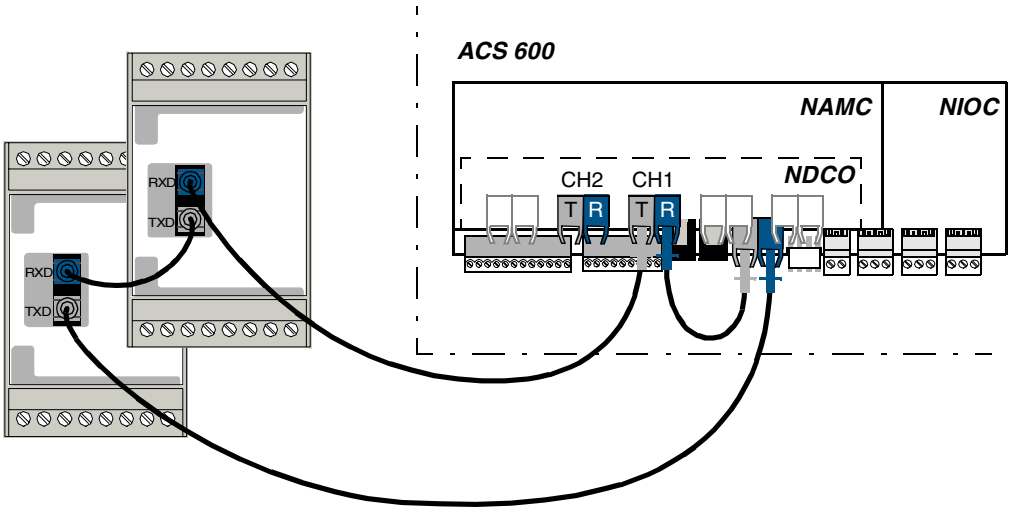
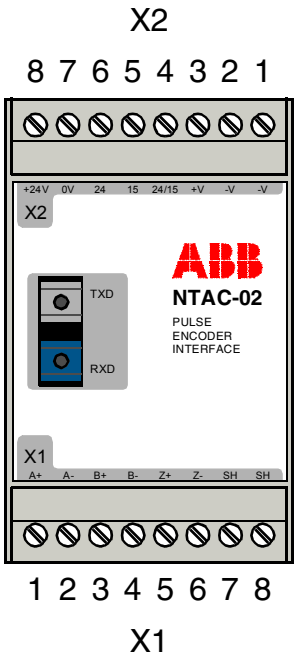
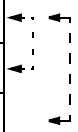


Figure 3-3 Connecting the modules to the ACS 600. The picture shows two modules on Channel CH1; the terminals may vary according to the application program used. Refer to the table above and the relevant Firmware Manual.

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.

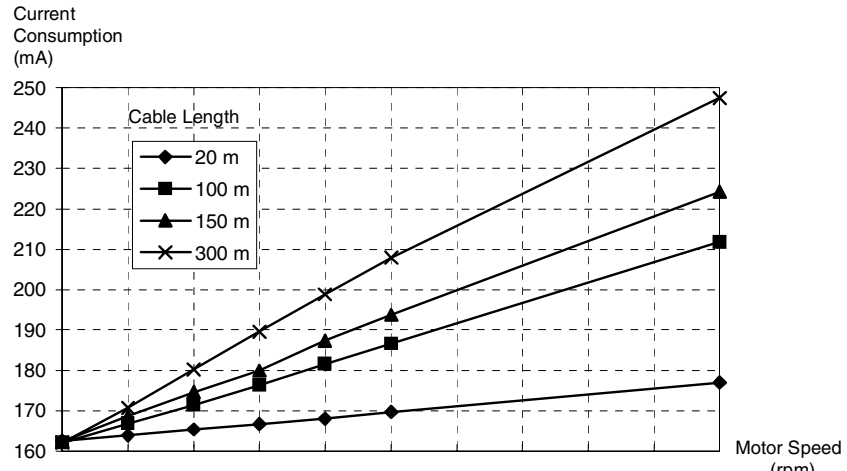
NTAC-02 Current Consumption (approx.):

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

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.

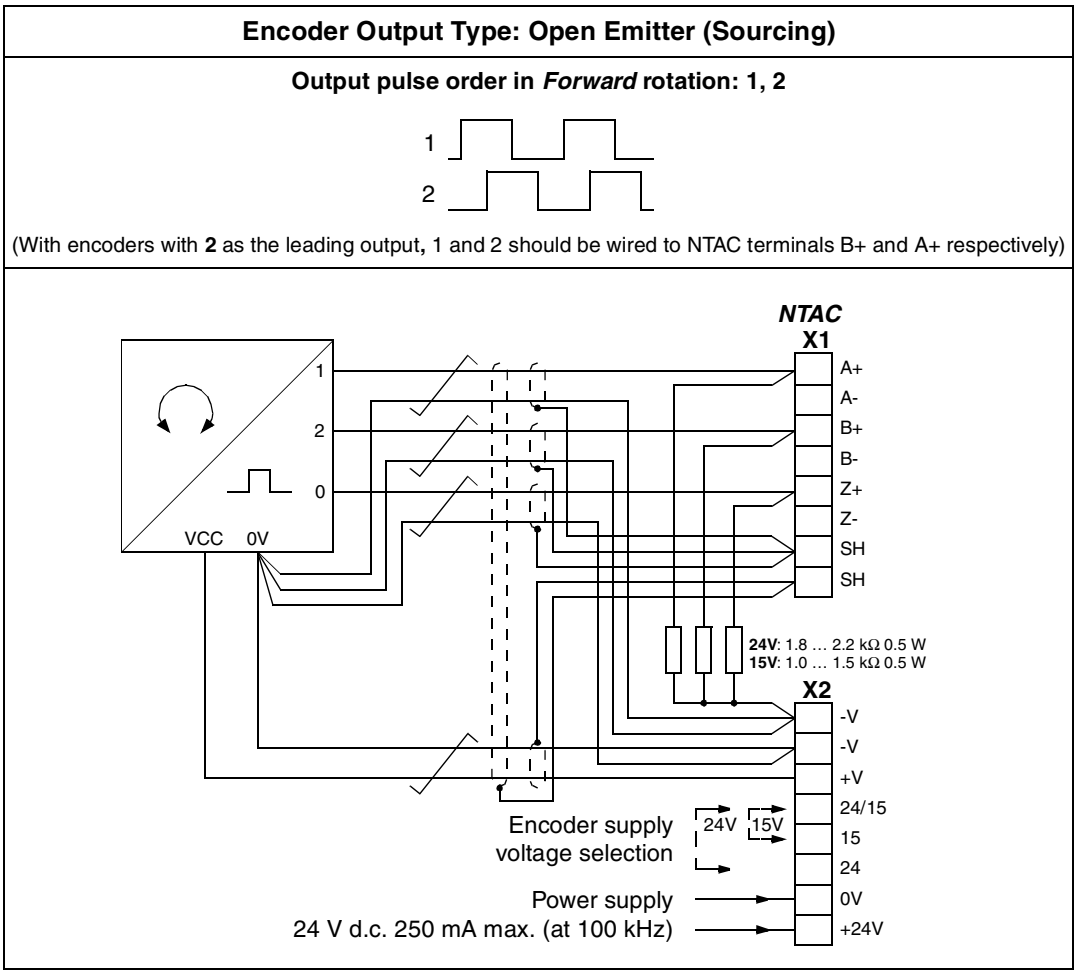


Figure 3-8 Connection diagram for pulse encoders with open emitter (sourcing) outputs.

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.

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

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.