ACS/ACH 400

Book 1 Course Documentation

Operation and Maintenance Customer

Student Training Binder

Course US 98

NB May/2001 DM

ABB

Contents

Course: US98

Customer ACS/ACH 400

Course Documentation

Release May 2001

Student Information

Drives Training Programs

Customer ACS / ACH 400 Operation & Maintenance School

General

The illustration, charts and examples given in this training session are intended solely to illustrate the theory and application of drive technology. Because of the many variables and requirements of applications, ABB cannot assume responsibility or liability for actual use based on the content of this training session

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Customer ACS/ACH 400 Operation and Maintenance Course Information

Section 1 Course Description

1.1 Duration

4 days including serial communications.

1.2 Description

The course covers the following subjects:

- Detailed information of the hardware and software
- Mechanical construction of the drive
- Installation and commisioning of the drive
- Operation of the drive
- Serial communication interfaces

1.3 Objectives

Upon completion of this course, the student will be able to:

- Commission, tune and operate the ACS/ACH 400
- Trace and correct faults
- Program the drive in detail
- Service,repair and troubleshoot the drive

1.4 Student Profile

Electricians, technicians and engineers who commission and service the ACS/ACH 400.

1.5 Prerequisites

Basic knowledge of (power) electronics and AC drives

Section 2 Course Calendar

DAY 1	DAY 2	DAY 3
08:00-17:00 08:00 Welcome & Introduction 08:15 PWM Basics 09:00 General overview of ACS & ACH 400 products DSS Policy and Procedure • 10:15 Break 10:30 Control Panel Functions and Operation 11:00 Operating Data Parameters Start-up Data Procedures and ID Run 12:oo Lunch 13:oo ACS Complete Programming Parameter Analysis ACS Macro Programming and Analysis 14:45 Break 15:oo ACS Complete Programming Parameter Analysis ACS Macro Programming and Analysis 17:00 Class dismissed	• 08:00-17:00 08:00 ACS Complete Programming Parameter Analysis ACS Macro Programming and Analysis (continued) • lo:oo . Break • 10:15 ACS Complete Programming Parameter Analysis ACS Macro Programming and Analysis (continued) • 12:00 Lunch • 13:oo ACH Complete Programming Parameter Analysis ACH Macro Programming and Analysis · 14:00 ACH 400 Lab Exercises, Analysis and Discussion (various Macros) • 14:45 Break • 15:00 ACS/ACH 400 Lab Exercises, Analysis and Discussion (various macros) • 17:00 Class Dismissed	• 08:00-17:00 • 08:00 Hardware Overview Schematic Block Diagram Analysis for ACS/ACH 401 Drives (RI. R2. R3. R4) • 9:45 Break • lo:oo Schematic Block Diagram Analysis for ACH 402 Drives (R5, R.5. R7, R8 and R9 Hybrid Drives) • 12:oo Lunch • 13:oo Plant Tour • 14:15 Break • 14:30 ACS & ACH 401 & 402 Hardware Lab Exercises Static Measurements Dynamic Measurements Registered Start-Up Procedure Warning and Fault Analysis Troubleshooting and Repair procedure • 17:00 Class Dismissed

DAY 4	
• 08:00-15:00 08:00 Serial Communication Overview • Quick Guide to Start-up • Installation and Start-up • 08:45 Drives Window LT Demonstration • 09:30 Drives Window Installation and Stat-Up Procedure RS 232/ 485 Connections & Interfacing Drives Window LT Lab Exercise • lo:oo • Break • 10:15 Drives Window LT Lab Exercise (continued) • II:oo NBAA-01 Fieldbus Module Interface Overview Drive and Module Programming and Set-up with DDCS Interface Module • 12:00 Lunch . 13:00 NBAA-01 Fieldbus Module Lab Demonstration of System Interface and Operation • 14:00 Johnson Controls N2 Bus Interface Overview Demonstration of System Interface and Operation • 15:00 End of Class!!!!!	

4.2 ABB Training Development Centers

Table 1-4. ABB Training Development Centers

AccuRay products	ABB MOD 300 products	ABB Master products	P4000 products
Columbus. Ohio USA ABB Industrial Systems Inc. 650 Ackerman Road MS 6330 Columbus, OH 43202 Phone: +1-614-261 2443 Fax: +1-614-261 2122	Rochester, New York USA ABB Industrial Systems Inc. 1175 John Street P.O. Box 22685 Rochester, NY 14692-2685 Phone: +1-716-273 7015 Fax: +1-716-273 7017	Västerås, Sweden ABB Industrial Systems AB Dept. LST S-72167 Västerås, Sweden Phone: +46-21-342 130 Fax: +46-21-137 124	Stevenage, United Kingdom ABB Industry Ltd. Phone: +44-438-742 366 Fax: +44-438-742 367
CDC. ACV. ACS, DCV, DCS	PPS 200 products		
Helsinki. Finland ABB Industry Oy Strömbergintie 1 P.O. Box 94 FIN-00381 HELSINKI Phone: +358-10-22 23727 Fax:+358-10-22 22453	Helsinki, Finland ABB Industry Oy Strömbergintie 1 P.O. Box 94 FIN.00381 HELSINKI Phone: +358-10-22 23727 Fax:+358-10-22 22453		

4.3 ABB Worldwide Companies

The table below lists the main headquarters (by country and company name) for each ABB firm.

Table 1-5. ABB Headquarters

Buenos Aires, Argentina Asea Brown Boveri S.A.	Ballerup, Denmark ABB Industri A/S	Kuala Lumpur, Malaysia ABB Industry	Västerås, Sweden ABB Industrial Systems AB
Melbourne. Australia ABB Process Automation Pty.	Helsinki, Finland ABB Industry OY	Estado de Mexico, Mexico ABB Equipos Y Sistemas	Baden Dättvill, Switzerland ABB Industrie Ltd.
Vienna. Austria ABB Industrie Gessellschaft	Décines Charpieu, France ABB Industry	Rotterdam. Netherlands ABB Industrie B.V.	Bangkok, Thailand Asea Brown Boveri Ltd.
Manama, Bahrain ABB Arescon E.C.	Mannheim. Germany ABB Industrie GmbH	Oslo, Norway ABB Industri AS	Istanbul. Turkey ABB Elektrik A.S.
Brussels, Belgium Asea Brown Boveri S.A.	Bangalore/Faridabad, India Asea Brown Boveri Ltd.	Lisbon, Portugal Asea Brown Boveri Lda.	Stevenage. United Kingdom ABB Industry Ltd.

Table I-5. ABB Headquarters

São Paulo, Brazil Asea Brown Boveri Ltda.	Milano, Italy ABB Industria S.p.A.	Singapore ABB Process Automation East Asia Pte. Ltd.	Columbus, Ohio U.S.A. ABB Industrial Systems Inc.
Toronto, Canada Asea Brown Boveri Inc.	Tokyo, Japan ABB Gadetius Industry K.K	Riyadh. Saudi Arabia ABB Saudi Arabia	Moscow. Russia Asea Brown Boveri Ltd.
Beijing. China Asea Brown Boveri China Ltd.	.Seoul, South Korea ABB Woojin Co. Ltd.	Madrid, Spain ABB Industria S.A.	Caracas, Venezuela Asea Brown Boveri S.A.

Section 5 Facility Information, New Berlin, Wisconsin Training Center

5.1 Building Access Hours

Normal building hours for this facility are from 7:30 to 17:00, Monday to Friday.

5.2 Parking

There is parking space available in the main general employee parking area outside the main door of the Training Center.

5.3 Emergency Evacuation

In the event of an emergency situation, a fire alarm will sound. Exit at the emergency exit signs

5.4 Class Hours

Normal class hours are:

Monday - Friday------ 8:00-17:00 hours

5.5 Mail

To receive mail while you are here, use our mailing address below.

Your Name ***(student)***

ABB Automation Inc.
Training Center
16250 W. Glendale Drive
New Berlin, WI 53151

5.6 Telephone Messages

Our Registrar will take phone messages and place them on the bulletin board in the student lounge. Please look for messages during coffee and lunch breaks.

Telephone no.: (262) 785-3357

5.7 Faxes

Our Fax number is: (262) 789-8608.

Fax messages to you will be delivered by our course registrar. If you need to send fax messages, please contact our course registrar or talk to your training instructor.

5.8 Student Telephones

We have 5 phones in the student lounge available for your convenience. They are credit card phones for long distance. Local calls are toll free. Long distance dialing instructions are posted at each phone.

5.9 Student Lounge

We serve a variety of beverages including coffee tea, cocoa and various soft drinks

5.10 Lunch

Lunch is available in our company cafeteria as an option for the student.

5.11 Smoking Regulations

Smoking is not allowed in any areas within the Training Center. You may only smoke in the designated smoking area on the patio or elseware outside.

5.12 Entertainment notices

Information about restaurants and other entertainment is available from the course registrar or the published entertainment guide.

5.13 Other

Feel free to ask your training instructor (or staff member) for help or information while you are here. We hope you enjoy your stay at ABB Automation University!

Section 6 Safety Regulations for Course Participants

6.1 Personal Safety

- All those who work in test laboratories and other places including class- and computer rooms must appreciate the risks involved in their work, and therefore perform with consideration and care for their own safety and that of others.
- Each person concerned is to familiarize theirself with the electrical installation at their work place and learn the location of emergency power cut-off switch in the event of an emergency.
- Learn how to contact the emergency services. Be prepared to answer the following questions:

Who are you? Where are you? What is the matter?

6.2 Product Security

- Handle circuit boards with care. Sensitive components might be damaged through static electricity. Use grounded wrist bands when working with unpowered equipment.
- Make sure that you and your tools are discharged before touching any circuit boards. Circuit boards are to be kept in antistatic bags when not installed in a rack.

Section 7 Course Evaluation

Course ______________________ Date ______________________

Instructor ______________________ Location ______________________

Your Job Title ______________________ Your Name ______________________
[optional]

We desire your honest opinion on our courses to help us improve the overall standard and attain a higher level of satisfaction. Please complete this form and add additional comments (particularly in areas where improvement is needed, or we performed especially well). Thank you.

Using scale from **5=best to 1=worst,** please circle your response to the following:

I. Quality of instructor's presentation	**5 4 3 2 1**
2. Adequacy of course content	5 4 3 2 1
3. Quality of training documentation	5 4 3 2 1
4. Quality of Instruction Books (Product Manuals).	5 4 3 2 1
5. Adequacy and quality of training equipment..	5 4 3 2 1
6. Instructor's readiness to teach this course	5 4 3 2 1
7. Instructor's communication and lesson objectives	5 4 3 2 1
8. Instructor's ability to resolve your questions or difficulties	5 4 3 2 1
9. Effectiveness of lab exercises to assist learning..	5 4 3 2 1
10. Training center environment and its effect on learning	5 4 3 2 1
11 . Staff's friendliness and support..	5 4 3 2 1
12. Extent that the course met your expectations?	5 4 3 2 1
13. OVERALL COURSE RATING..	5 4 3 2 1

14. What topic(s) would you like to see added to the course? Why?

15. What skill(s) or topic(s) would you see deleted from the course? Why?

Comments and Recommendations:

(use reverse side and/or additional paper if necessary)

ACS 600 Operation and Maintenance
Electronic Boards

Section 1 General Information

1.1 Description

This unit gives you some information about the electronic boards of the ACS 600 SingleDrive.

1.2 Objectives

Upon completion of this unit you will know the basic functions of the electronic boards included in the ACS 600.

- Identify and locate the electronic boards included in the ACS 600.
- Identify and locate terminals and cables between the boards.
- Understand the basic functions of the boards.

1.3 Reference Documentation

ACS/ACC/ACP 601 Hardware Manual

ACS/ACC/ACP 604/607 Hardware Manual

ACS/ACC 607 Installation & Start-up Manual

Section 2 Electronic Boards

2-1 General

The control circuit is responsible for calculations, communication,. data collection and control. In frames R4 ... R12i this circuitry is grouped on to seven printed circuit boards on a functional basis:

- NAMC (Application and Motor Control) board contains the memory, digital signal processor and other circuits responsible for motor status calculation and communication inside the unit.
- NIOC (standard Input/Output Control) board contains the circuits responsible for communication with the Control Panel, the Panel Link and the standard I/O terminals.
- NINT (main circuit INTerface) board is responsible for power transistor control and protection, and for making the measurements for the motor status calculations.
- NGDR (Gate DRiver) board is a galvanically isolated link between the NINT board and the IGBT module. Two identical NGDR boards are required for each IGBT module.
- NPOW (POWer supply) board contains the' power supply which provides power to the control circuit.
- NINP (INPut bridge control) board is used in frames R5 . R12i for controlling the thyristor-diode rectifier bridge.

In frames R2 and R3 the functional arrangement is the same, but the number of control circuit boards has been optimized.

Figure 6-1 shows the connections of the boards with AMC Classic.

Figure 6-2 shows the block diagram of the control circuit with AMC-1

Figure 6-3 shows the block diagram of the boards with AMC-1.

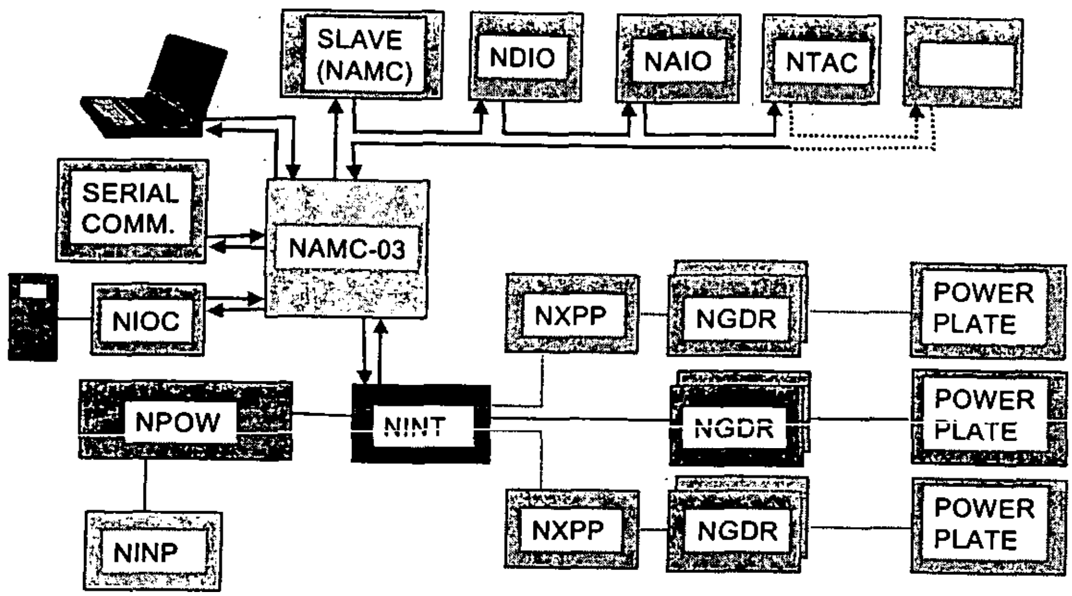

Figure 6-1. Connection *diagram of the boards with AMC* Classic.

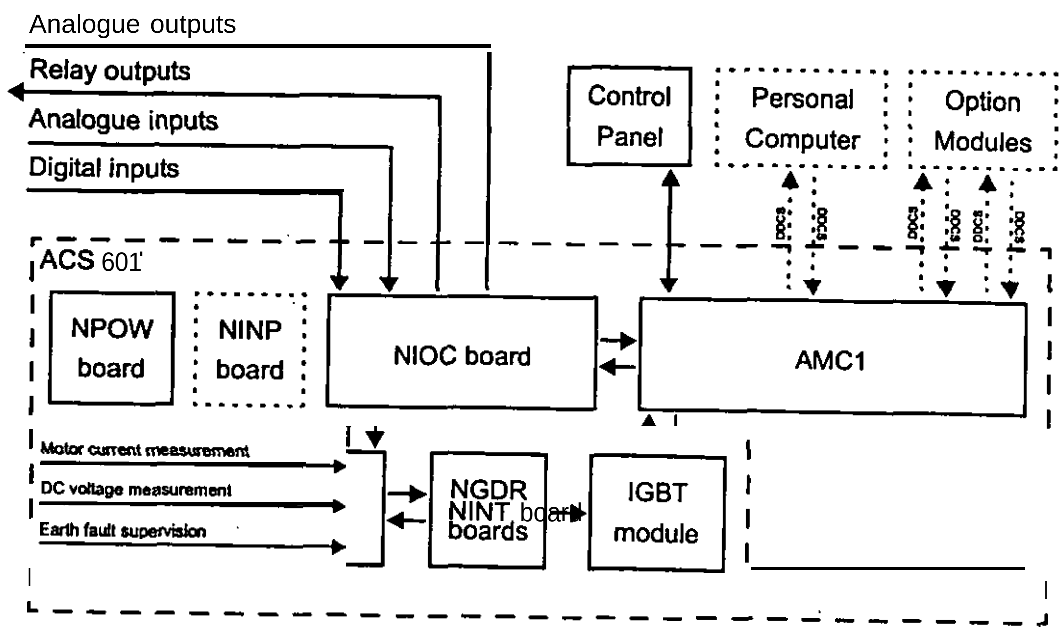

Figure 6-2. Control circuit block diagram with AMC1

2.2 Block diagram of the boards

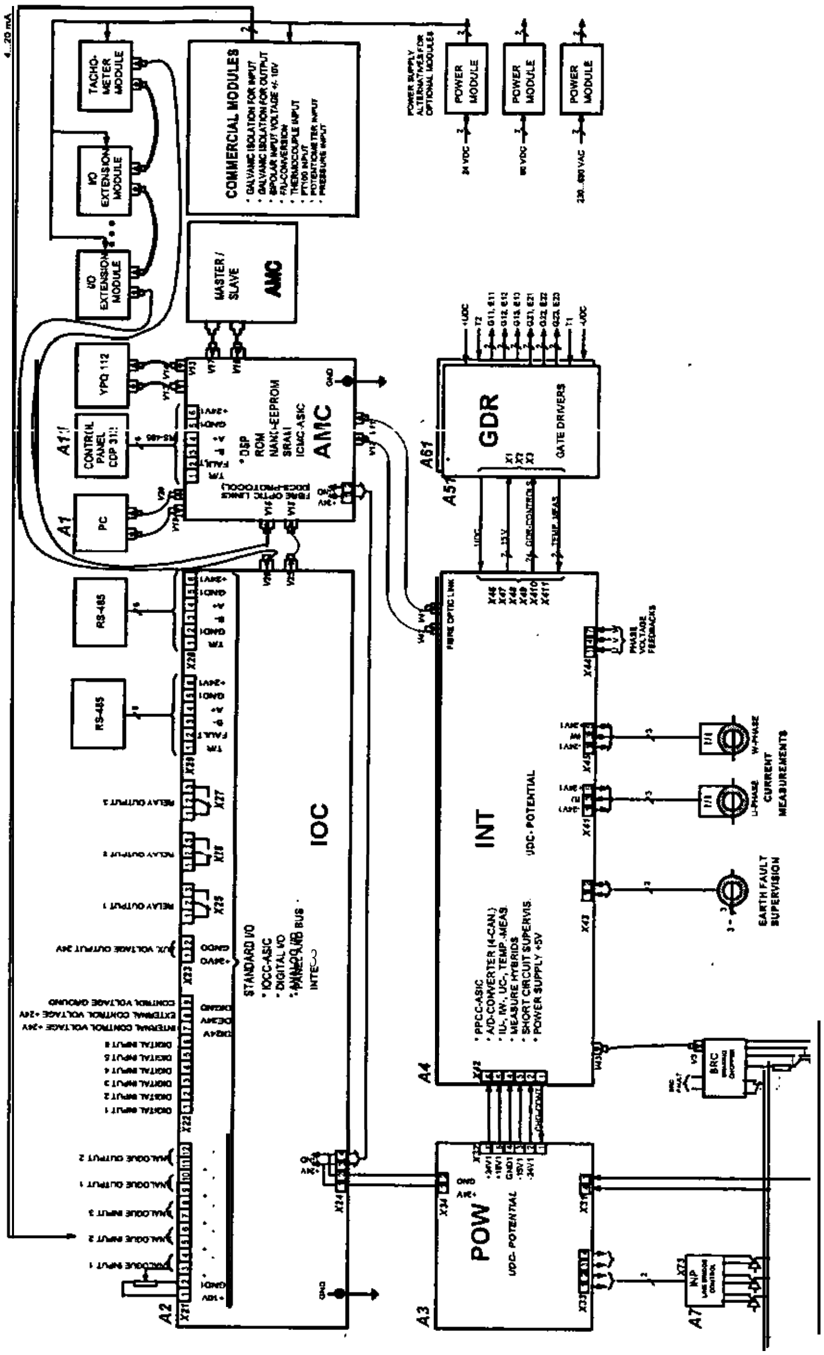

Figure 6-3. Block Diagram of the Boards.

2.3 Application and Motor Control Board

2.3.1 General

The whole ACS 600 series use the NAMC-boards which has a motor and application control functions. ACS 600 SingleDrive use AMC Classic (= NAMC-03) with Standard Application Program version 3.1 or earlier ones. AMC 1 (= NAMC-11 + NDCO) is a new application and motor controller used with Standard Application Program 5.0 which replase the present AMC Classic.

The boards are powered with a $+24V_{DC}$ from a frequency converter power supply (NPOW) and grounded directly to the converter frame.

2.3.2 AMC Classic board

AMC Classic -board has one duplex high speed (8 Mbit/s INT) and four 4 Mbit/s speed serial communication fibre optic links. The boards are implemented with DSP, ICMC-ASIC and some memory chips.

All serial links (except INT) utilize DDCS-protocol (Distributed Drive Communication System). Connection: Five pairs of fibre optic connectors (transmitter and receiver (V11 - V20).

Fibre optic cable is plastic core fiber optic, 1000um, max. length 10 m.

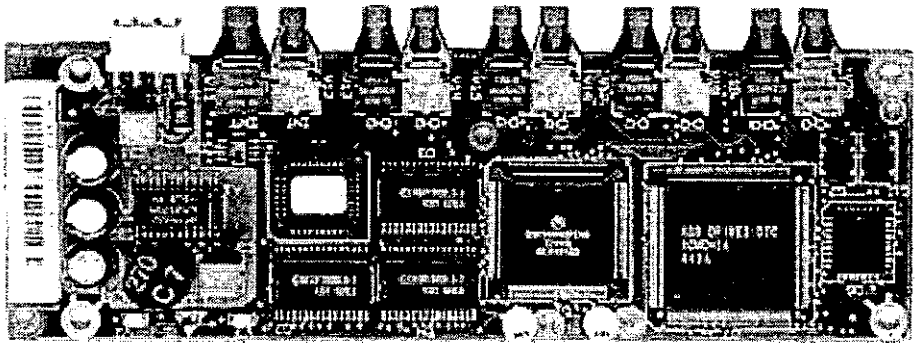

Figure 6-4. Application and Motor Control Board - Classic (NAMC-03)

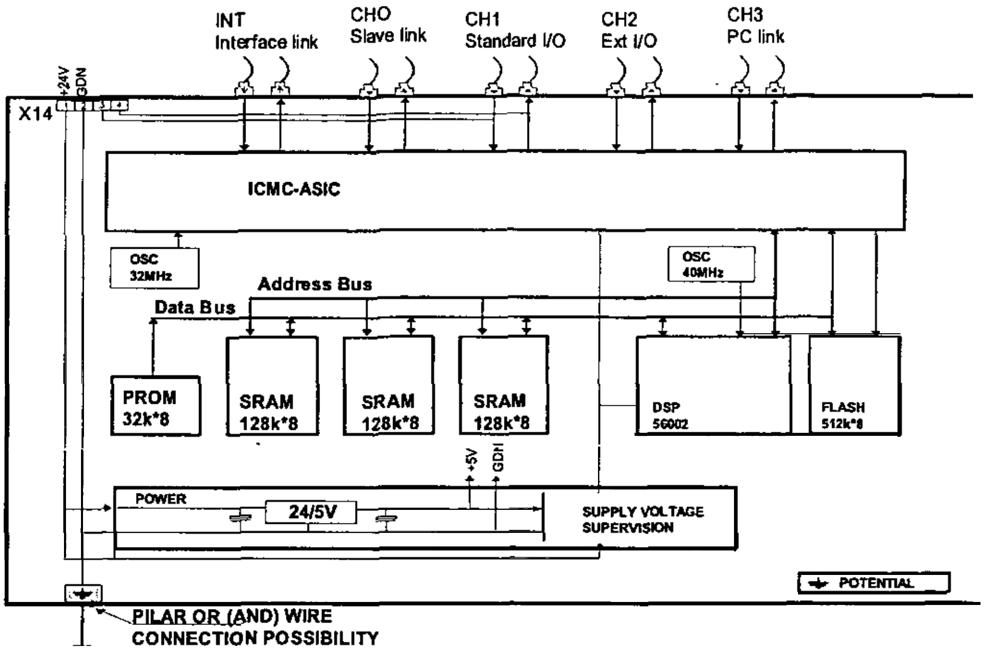

Figure 6-5. Block Diagram of the NAMC-03 Board

2.3.3 AMC 1 Controller Unit

As a standard the NAMC-11 board contains one optical PPCS link (8 Mbit/s) for communication with the inverter section (INT) and one standard opticat DDCS link (1...4 Mbit/s) for communication with I/O units (CH1). The board contains also one shielded RS-485 connector for Control Panel CDP 312 or another Modbus communication conection.

More communication channels are available as an option. The optional NDCO plug-in board contains three DDCS links, one for fieldbus interface (CHO), one for PC used for commissioning (CH3) and one for service operations (CH2). There is also one link for braking chopper (BRC).

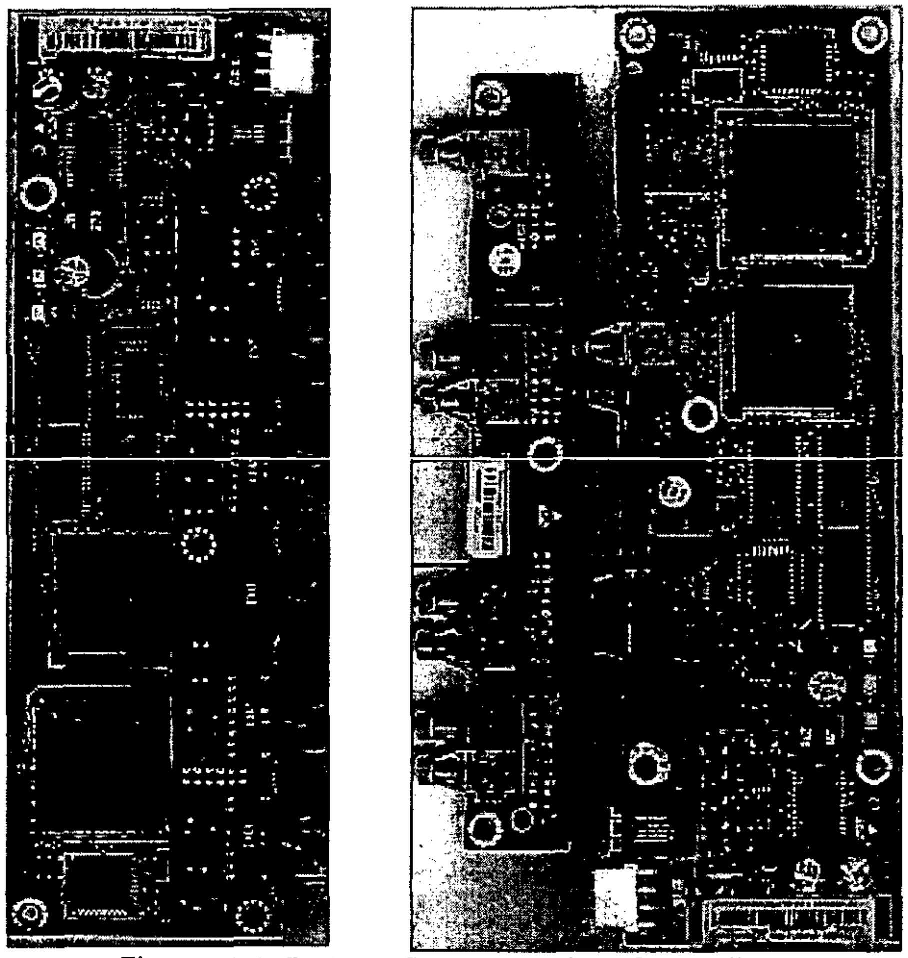

Figure 6-6. Application and Motor Control Board (AMC I).
NAMC-II and NDCO-02 separately in the right side picture.

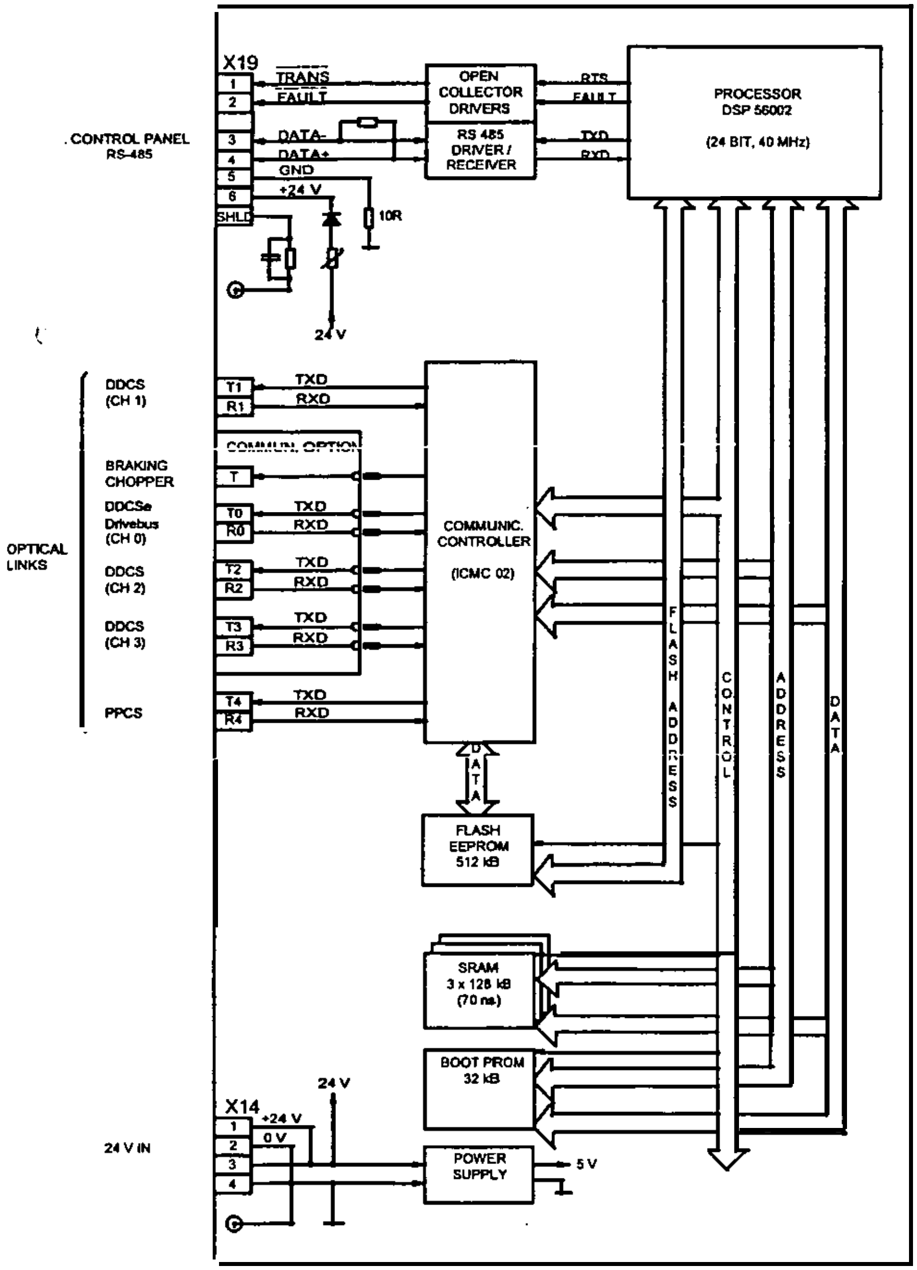

Figure 6-7. Block Diagram of the NAMC-11 Board

2.3.4 AMC Power Supply

The NAMC-board is powered by a $+24V_{DC}$. (X14: 1 $+24V_{DC}$, X14:2 GDN). The isolated $+24V_{DC}$ supply voltage comes from the NPOW-board. There is a possibility for external power supply. In this case the power is supplied to the same power connections as the internal supply. The voltages that the NAMC- board needs are regulated on the NAMC-board.

The board is grounded directly to the chassis via a metal pillar.

Input: $+24\ V_{DC}$, max. 200mA, from NPOW-board or customers power supply.

2.3.5 The Optical Transmitters and Receivers

In, the DDCS channels of the AMC board is two different types of the optical transmitters and receivers, 5MBd or 10 MBd. Only the plastic optical cable (POF) can be used with 5MBd optical components. With 10 MBd components either pastic or Hard Clad Silica (HCS) optical fibre can be used. Absorption of the HCS cable is much smaller than POF cable but the cross-section area of the HCS cable is four procent (1/25) of the POF cable, so HCS cable needs powerful transmitter power.

In the AMC connections the optical components at the both ends of the link should be the same type. Do not connect 5MBd and 10Mbd together

The maximum optical fibre cable length for the POF cable with 5MBd componenets is 10 m but operation at the lower speed than 1Mbit/s the cable length can be extended to 15 m.

For 10 MBd componenets the maximum cable legth:

CABLE	AMC 'CLASSIC'	AMC 1 & AMC 2
POF	20 m	30 m
HCS	50 m	200 m

Figure 6-8. The Optical Fibre Cable length with the 10 MBd componenet.

CHANNEL	STANDARD USAGE	AMC 'CLASSIC'		AMC 1			
					DDCS Communication Option		
DDCS	ACS 600 SD & MD	NAMC-03	NAMC-04	NAMC-11	NDCO-01	NDCO-02	NDCO-03
CHO	-Application Controller - Fieldbus Interface	5 MBd	10 MBd	-	10 MBd (DriveBus)	5 MBd	5 MBd
CH 1	-Standard I/O - Optional I/O (SW 5.X)	5 MBd	5 MBd	5 MBd	-		
CH 2	- Master, Follower	5 MBd	10 MBd	-	10 MBd	10 MBd	5 MBd
CH 3	- Drive*Window* (PC. 1 Mbit/s)	5 MBd	5 MBd	-	10 MBd	10 MBd	5 MBd
		ACS 600 SD & MD	ACS 600 MultiDrive	ACS 600 SingleDrive	ACS 600 SingleDrive	ACS 600 SingleDrive	ACS 600 SingleDrive

Figure 6-9. The DDCS Communication Links in AMC Controller.

2.4 Standard I/O Board (NIOC-01)

The whole ACS 600 series uses the same NIOC-boards which have Standard Control connection circuits.

The Standard Control connection includes 6 digital inputs, 3 relay outputs, 3 analog inputs (two differential current inputs, one voltage input for reference potentiometer) and 2 analog outputs (current). One A/D-converter channel is for IOC-board temperature measurements. One digital input (number 6) can be used as a PTC-input for motor over temperature protection.

IOCC-ASIC also controls the panel bus interface. The panel connector has pins for FAULT-led lamp.

The board is powered from a +24 V_{DC} with on-board regulator. There is also a galvanic isolation between the digiiai inputs and other circuits. Digital inputs are optically isolated and the input-zone is allowed to float to some degree; grounding is done via a capacitor. The purpose of the isolation is to prevent any process signal noise from affecting the vital control circuits.

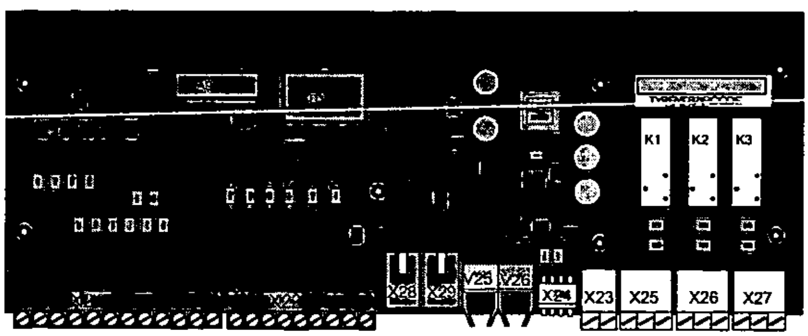

Figure 6-10. Standard I/O Board (NIOC)

No jumper switches (ex. analog inputs current / voltage sel).

2.4.1 Connections

X21:AI/AO

Constant voltage output, 10V, max. load 10mA.

Analogue Inputs, 3 channels, 0(2)...10V or 0(4)...20mA (1 voltage, 2 current), 10 bits.

Analogue Outputs, 2 channels 0(4)...20mA, 12 bits.

X22:DI

Digital inputs, 6 channels, 24 V_{DC} (-15% +20%, 10 mA DI1-DI5, D16 5 mA), channel 6 can be used for thermistor input.

Internal control voltage 24V_{DC} and ground.

X23:

Aux. voltage output, 24V_{DC} for 1 option module, max. current 200mA.

X24:

Power Supply from POW-board, 24V_{DC}

X25, X26, x27:

Relay outputs, 3 channels, changeover contact (8 A at 24 V_{DC} or 250 V_{AC}, 0.4 A at 120 V_{DC}, max. continuously current 2 Arms, isolation test voltage 4 kV_{AC} I minute))

X28:

Telephone jack for Panel link, RS-485

X29:

Telephone jack for (CDP311) Control Panel (X28/X29 connected directly together)

V25, V26:

Fibre optic transmitter/receiver to/from NAMC-board

2.4.2 NIOC Power Supply

NIOC-01, CDP3 11 and one option module are powered by +24V_{DC}.

The isolated +24V_{DC} supply voltage comes from the POW-board. There is the possibility for external power supply. In this case the power is supplied to the same power connection as the internal **supply.**

The voltages that the NIOC-board needs, are regulated by the NIOC-board.

Groundings:

Tbe Analog Output and the control circuits grounds are grounded directly to the chassis via a metal pillar.

The Digital Input - zone is floating with the possibility of grounding by wire.

Ratings:

Input:

Voitage: 24V_{DC} ±10%

Load: max load: 600mA,. min load: 300mA

Supply: From POW-board or customers power supply

Power: 15 w

Output:

+24V_{DC} max. load IOW, for panel, external I/O

+5V_{DC} max. load 4W, for logic of standard I/O

+15V_{DC} max. load 0.15W, for analogue circuits

-15V_{DC} max. load 0.1 OW, for analogue circuits

+24V_{DC} max. load 0.5W, digital inputs

2.4.3 Bus Interface

2.4.3.1 Bus Interface (X28 & X29)

Asynchronous, half-duplex, RS-485-level serial communication channel.

Connection: Plug-in type connector. (Telephone connector)

Terminator resistors and selection jumpers are not needed (see above).

2.4.4 Control Options (connection in NAMC board)

All control options can be connected to the NAMC - board with fibre optic links. I/O extension modules are using a DDSC-protocol. The NIOC -board can power one option module (200 mA max).

Connection: One pair of fibre optic connectors (transmitter and receiver).

Fibre optic cable: Plastic core fiber optic, 1000 um, max length 10 m.

2.4.5 Block Diagram

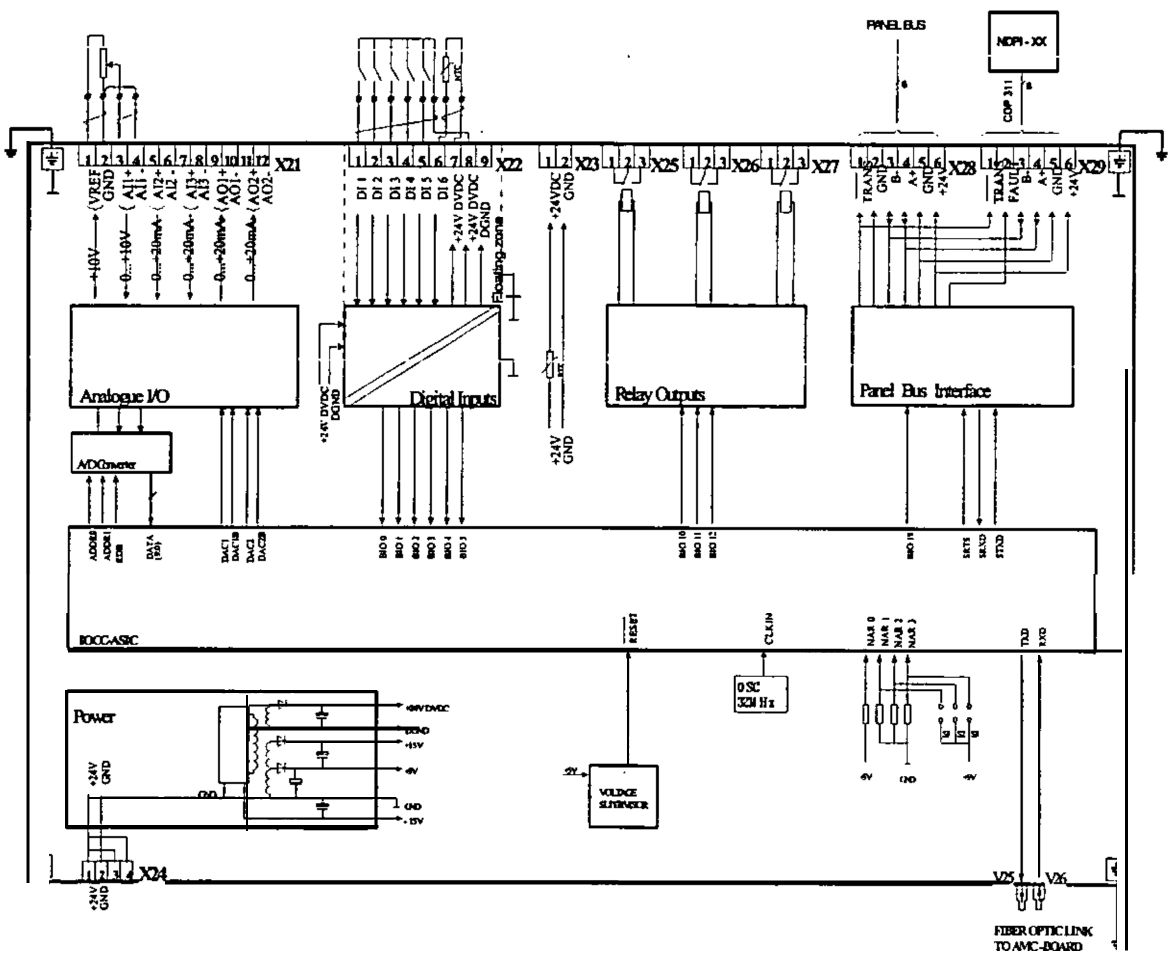

Figure 6-11. Block Diagram of the NIOC-01

2.5 Power Supply Board (NPOW-4x)

2.5.1 General

The power supply boards NPOW-41 and NPOW-42 are used in the 400/500V ACS 600 frequency converter series for supplying the converter control electronics. In addition to this, one option module can be powered. Board identity is A3.

Power supply board NPOW-43 is used in the 400/500V ACS 600 frequency converter series for supplying the R7 DC-fans. Board identity is AS.

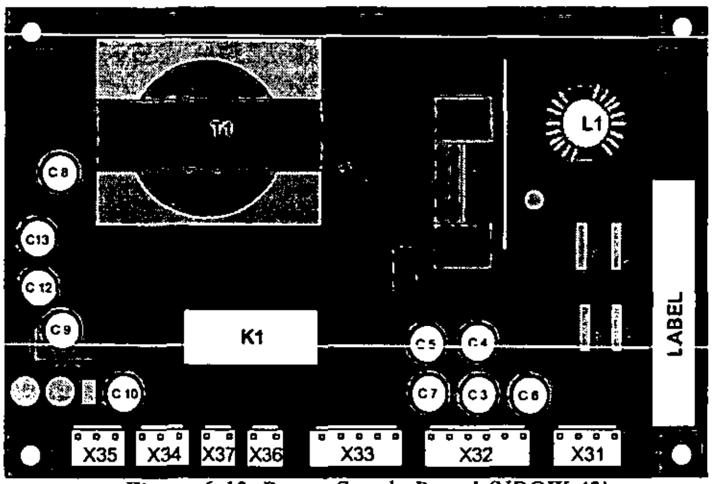

Figure 6-12. Power Supply Board (NPOW-42)

Dimensions:

NPOW-41 100*140mm

NPOW-42 100*152mm

NPOW-43 100*300mm

No jumper switches.

2.5.2 Functions and block diagrams, NPOW-41 and -42

NPOW-41 and NPOW-42 are flyback-type switched mode power supplies whose inputs are connected to a converter DC-link voltage. NPOW-41 is used in construction R4, where no half-controlled line bridge is utilized. In bigger types the NPOW-42 is used. The main difference between the two types is the number of output voltages. The maximum output power is about 70W in both types.

There **are two output voltage groups in** NPOW-41:

Group 0: +/-24V1, +/-15V1, on the input potential (GND1)

Group 1: +24V, galvanic&isolated from Group 0 (GND)

Output voltage groups in NPOW-42:

Group 0: +/-24V1, +/-15V1, on the input potential (GND1)

Group 1: +24V, galvanically isolated from Groups 0 and 2 (GND)

Gmup 2: +12V, galvanically isolated from Groups 0 and 1 (GND2)

Electrical Ratings:

Nominal input voltage (U_{in})	250-900 V_{DC}, **max** load
Maximum input voltage (U_{max})	1000 V_{DC}, Is
Start up time (t_{start})	< 500 ms, U_{in} > 300 V

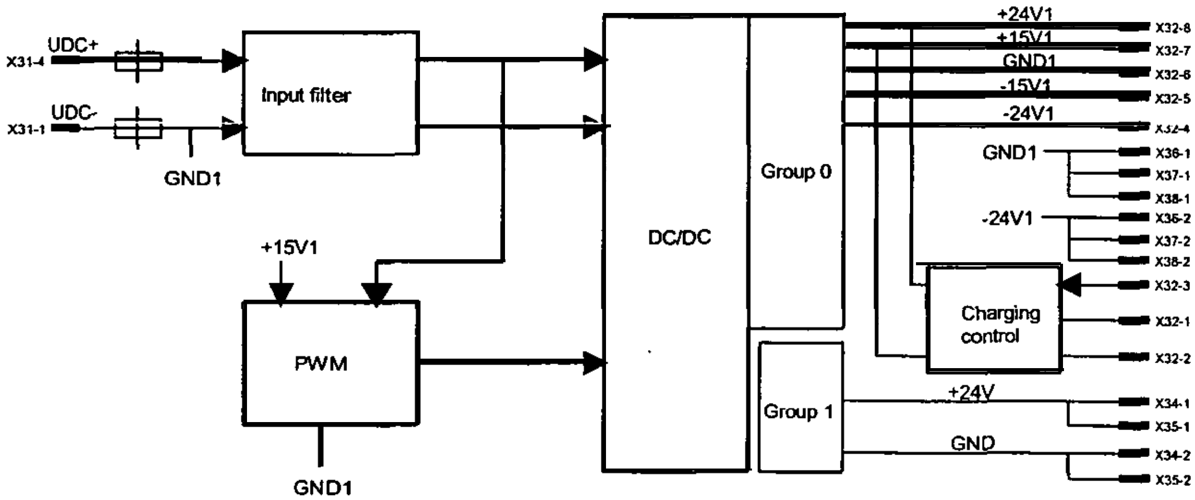

Figure 6-13. Block Diagram of the Power Supply Board NPOW-41

All outputs are short circuit proof. NPOW-41 and NPOW42 have a sot? start function in order to prevent primary current runaway during start up and **output** short circuit.

The power supplies are protected by fusible resistors at the input (both positive and negative input).

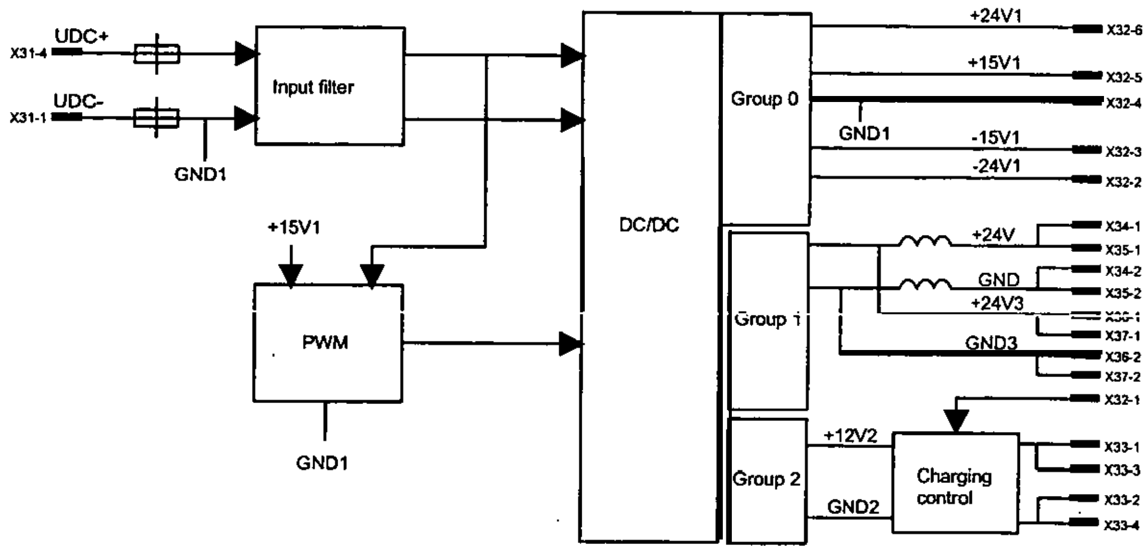

Figure 6-14. Block Diagram of the NPOW-42

Connections:

Connector X31 is for input voltage (= tbe DC-link voltage of the converter)

Connector X32 is for supplying the NINT-board, and X34 for supplying the NIOC- and NAMC-boards. X33 supplies the NINP-board in constructions R5-R9. Connectors X36, X37 and X38 are for cooling fans.

The charging control is done by a open collector signal (X32-l or X32-3) from the NINT-board.

All the connectors are male type located on tbe same side of the board.

2.5.3 Functions and block diagram, NPOW-43

The NPOW-43 is a flyback-type switched mode power supply whose input is connected to the converter DC-link voltage.

The NPOW-43 has only one output voltage: +24V, galvanically isolated from the input

The output is grounded to the frequency converter frame by a mounting pillar.

Electrical Ratings:

Nominal input voltage (U_{in})	250-900 V_{DC}, max load
Maximum input voltage (U_{max})	1000 VDC, 1s
Start up time (t_{start})	< 500 ms, Uin>300 V

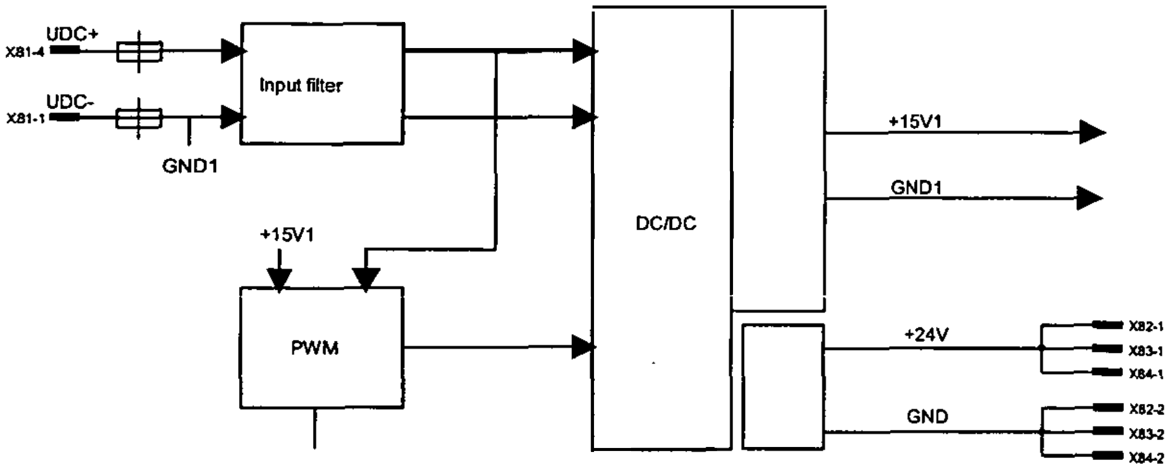

Figure 6-15. Block Diagram of the Power Supply Board NPOW-43

All outputs are short circuit proof. The NPOW-43 has a soft start function in order to prevent primary current runaway during start up and output short circuit.

The power supplies are protected with fusible resistors at the input (both positive and negative input)

Connections:

Connector X81 is for input voltage (= the DC-link voltage of the converter)

Connectors X82, X83 and X84 are for supplying the R7 cooling fans.

All the connectors are male type, located on the same side of the board.

2.6 Main Circuit Interface Card (NINT-xx)

The board is in the U_{DC}-potential. The board identity is A4.

Connections:

To the NAMC-board via fibre optic link V41/V42

To the GDR-board power supply and GDR controls, from the GDR-board U_{DC} and temperature measurements (X46-X49, X410, X41 1).

To the NPOW-board CH3-control, from the NPOW-board supply voltages (X42).

U- and W-phase current measurements (X41, X42), earth fault supervision (X43), U, V, W-phase voltage feedback (X44).

Functions:

- PPCC-ASK.
- AID-converter.
- Iu-, Iw-, U_{DC}- and temperature measurements.
- Measurement Hybrids.
- Earth fault and short circuit supervision.

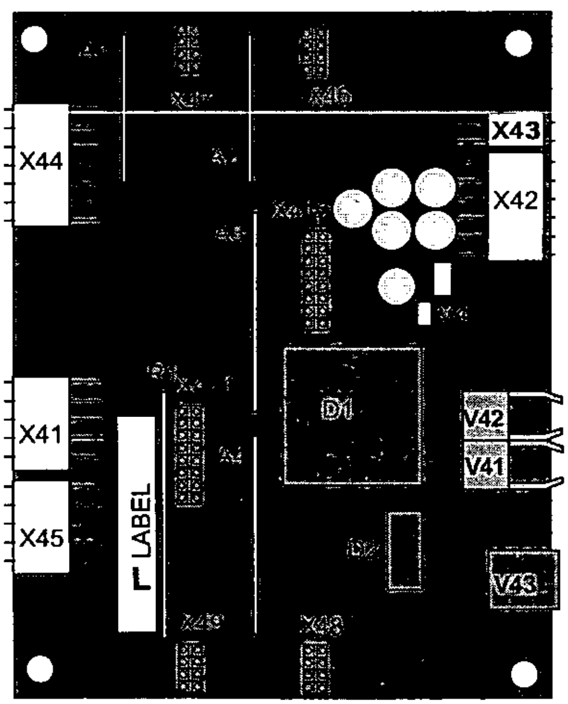

Figure 6-16. Main Circuit Interface Card (NINT-42)

2.7 input Protection Card (NINP-61)

The NINP (INPut bridge control) board is used in frames R5 ... R9 for controlling the thyristor-diode rectifier bridge.

Board identity is A7.

Connector (X71) to mains, (X72) to the thyristor-diode rectifier bridge and (X75) to UDC. Power supply (X73) from the NPOW board.

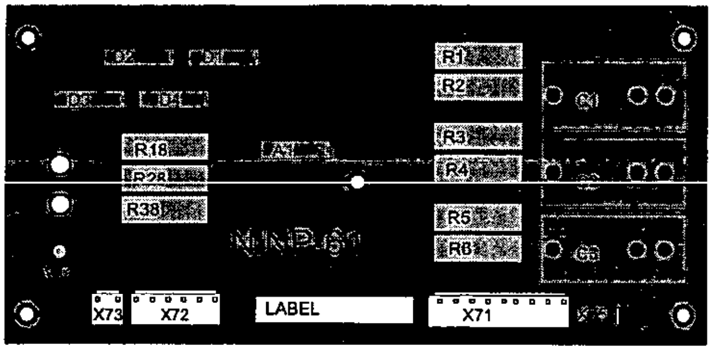

Figure 6-17. Input Protection Card (NINP-61)

2.6 Gate Driver Board (GDR-OX)

The NGDR (Gate DRiver) board is a galvanically isolated link between the NINT board and the IGBT module.

A frequency converter (six pack PP) uses two identical gate control boards (GDR). There are three gate controllers on each board. One board controls the IGBT connected to the minus potential of the DC-circuit (lower semiconductors) and the other controls the IGBT connected to the plus potential (upper semiconductors).

There are no cables between the PP, GDR's and the INT-board (Figure 6-18.).

There are two types of GDR-boards: the NGDR-02 and the NGDR-03. On the NGDR-02 and the NGDR-03 the galvanic isolation is made up of transformers, through which the auxiliary power to the gate circuit and the control signal are transferred simultaneously. These gate controllers include the soft tom-off switch. The NGDR-

02 controls the MPP's (medium power plates) and the NGDR-03 controls the LPP's (large power plates). See Table 6-l:.

Converter sizes	GDR type
230 V (R4 six pack. R5 six pack) 400 V (R4 six pack, R5 six pack. R8 two pack) 500 V (R4 six pack, R5 six pack, R8 two pack) 690 V (R4 six pack, R5 six pack, R8 two pack)	NGDR-02
230 V (R6 six pack) 400 V (R6 six pack, R9 two pack) 500 V (R6 six pack, R9 two pack) 690 V (R6 six pack. R9 two pack)	NGDR-03

Table 6-l: GDR boards in ACS 600 Converters

Two-pack-connected PP's use the same transformer connected gate controllers (NGDR-02 and NGDR-03) as the six-pack converters. In that case the V-phase gate controllers are connected directly to the INT-board. On the INT-board there are board connectors and two IO-pole flat cable connectors for the control and operating signals of the U- and W-phase gate controllers (via matching cards, NXPP-01). These signals are transferred via 15 cm long flat cables to the gate controllers of the U- and W-phases. See Figure 6-18.

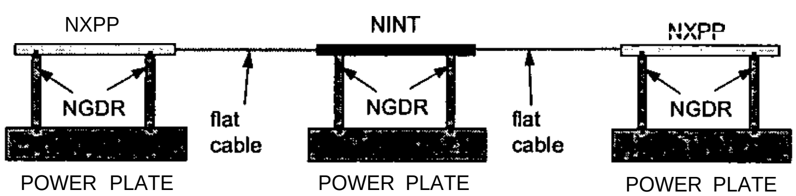

Figure 6-18. PP, NXPP and NINT boards.

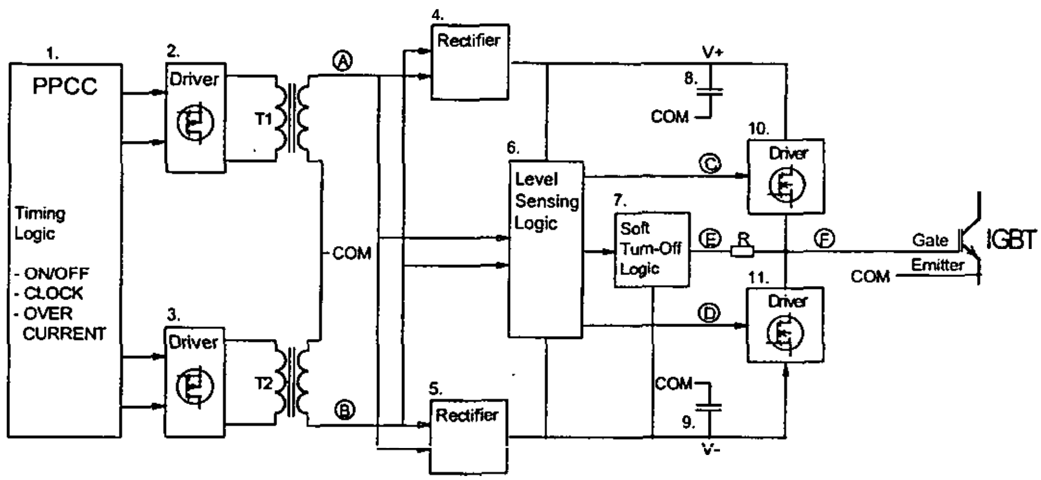

Figure 6-19. Block diagram of the NGDR-02 and the NGDR-03 gate controllers.

Parts of the block diagram (Figure 6-19.)

1) The Timing Logic of the INT-board's PPCC-ASIC synchronizes the ON/OFF signal that controls the gate's position and the over current warning signal (OVERCURRENT) to the common clock signal of all the gate controllers, (CLOCK (2 MHz)). Depending on the position of tbe ON/OFF-signal, the logic gives the clock signal to transformer T1 or transformer T2.

2) The control stage of T1 changes the level of the signals produced by the time logic to a level suitable for the primary control.

3) The control stage of T2 changes the level of the signals produced by the time logic to a level suitable for the primary control.

4) The rectifier forms a positive operating voltage from the secondary signals of T1 and T2.

5) The rectifier forms a negative operating voltage from the secondary signals of T1 and T2.

6) The level sensing logic examines the secondary signals of T1 and T2 and separates the signals needed by the short-circuit extinction control (7.) and the power controls (10. and 11.) from the positive and negative half-periods.

7) The short-circuit protection controller steers the gate on controlled speed, through the resistance R, in the negative direction.

8) The capacitor functions as an energy storage for the positive operating voltage.

9) The capacitor functions as an energy storage for the negative operating voltage.

10) The power control connects the positive energy storage to the gate that is to be controlled.

11) The power control connects the negative energy storage to the gate that is to be controlled.

Connected (Xl, X2, X3) to NINT board and to the power plate.

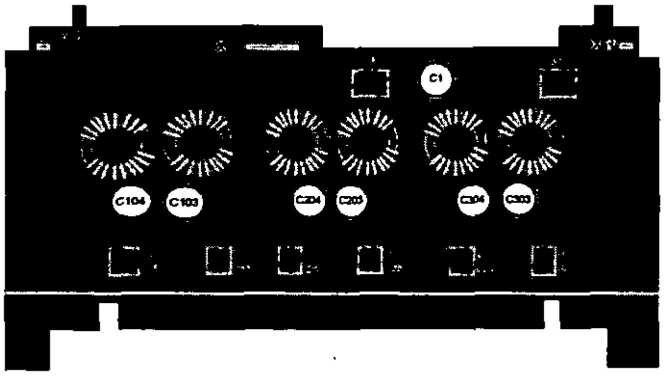

Figure 6-20. Gate Driver Board (GDR-02)

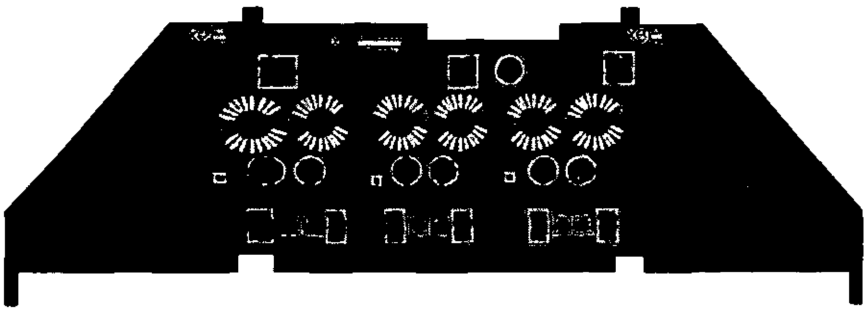

Figure 6-21. Gate Driver Board (GDR-03)

2.9 Matching Card (NXPP-01)

Used when more than two GDR boards are needed (see Figure 6-18. page **22).**

Connected to the NGRD and the NINT boards.

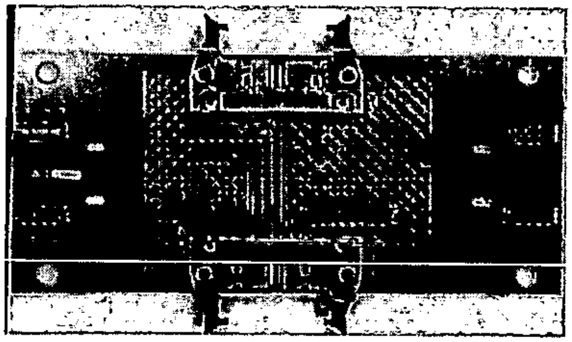

Figure 6-22. Matching Card (NXPP-01) (photo)

2.10 Connection Board (NDPI-02)

Connected to telephone jack (X19) on NAMC-11 board.

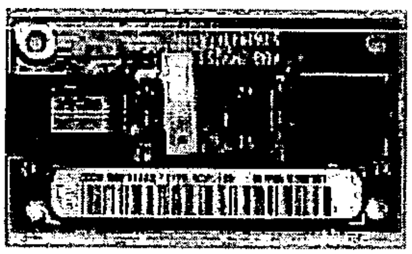

Figure 6-23. Connection Board (NDPI-02) (photo)

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	ACS100-US-01	ACS100 Sales Brochure, *AC Drives for speed control of 0-.5 to 3.0 HP AC Motors*				ACS100-US-05	Programming Guide		
	ACS100-US-04	ACS 100 User's Guide							
		ACS140							
	ACS140-US-01	ACS 140 SALES BROCHURE. AC *Drives for Adv Spd Cntrl of .5 to 3.0 HP (.37 to 3.7 kW) Induction* Motors (3AUA489002B4787R0101)				ACS140-US-04	ACS140 USERS GUIDE (3AUA489002B4591)		
	ACS140-US-05	ACS 140 PROGRAMMING MANUAL (3AUA489002B4592)							
		ACS300							
	ACS300-US-00	ACS 300 FLYER, AC *Drives for Speed Control of 0.75 to 15 HP (0.55 To f 1kW) Induction Motors* (3AUA489002R2235R0001)				ACS300-US-01	ACS 300 BROCHURE. AC *Drives for Speed Control of 0.7510 15 HP (0.55 To 11 kW) Induction Motors* (3AUA489002R2260R0001)		
	ACS300-US-04	ACS 300 USER'S MANUAL, *AC Drives for Speed Control of ½ HP To 15 HP Motors* (3AFY61229965R0125)							
		ACS500							
	ACS500-01	ACS 500 BROCHURE, *Superior AC Drives Made Simple, ACS 500 Series*				ACS500-02	ACS 500 BROCHURE. ACS *500 Series Adjustable Frequency AC Drives*		
	ACS501-04	ACS 501 INSTALLATION & START-UP MANUAL, ACS *501 Adjustable Frequency AC Drives 1 to 75 HP, Series B*				ACS502-04	ACS 502 INSTALLATION & START-UP MANUAL, ACS *5021504 Adjustable Frequency AC Drives 50 to 400 HP, series B*		
	ACS 500-05	*ACS 500 PROGRAMMING* MANUAL INCLUDING APPLICATION MACROS, ACS *500 Adjustable Frequency AC Drives 1 to 400 HP, series B*				ACS500-06	ACS 500 SPECIFICATION, *Sample Specification* for *Adjustable Frequendcy Drives (2 to 400 HP) for Variable* Torque *Applications* With Diskette		

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	ACS501-08	ACS 501 User's Manual, *ACS 501 with Option Pack*				~~ACS501-10~~	~~ACS 501 BROCHURE,~~ *Quick Start Manual, ACS 501 Adj. Frequency AC Drives 2 to 50 HP, Series B*		
ACS 500 (Continued)									
	SAGS700PAN-04	ACS 500 Users Manual. *Remote Panel SAGS 700* PAN (EN 80034869)							
ACS600									
	ACS600-US-00	ACS 600 SALES FLYER. ACS *500 AC Drives for speed 6 torque control Of 3 to 350 HP (2.2 to 315 kW) induction motors,* (3AUA489002B1450)				ACS600-US-01	ACS 600 SALES BROCHURE. AC.9 *600 AC Drive for speed & torque* control of 3 to 4000 *Hp (2.2* to *3000 kW) induction motors (3AUA489002B1451)*		
	ACS600-US-02	ACS 600 TECHNICAL BULLETIN. AC Drives for *Speed 6 Torque Control of 2 to 350 HP (2.2 to 315 kW) Induction Motors* (3AUA489002B1452)				ACS600-US-05	ACS 600 PROGRAMMING MANUAL, *ACS* 600 AC Drives 3 *to 350 HP (2.2 to 315 kW)* (3AUA489002B1456)		
	ACS601-US-04	ACS 601. INSTALLATION & START-UP MANUAL, ACS *601* AC Dries 2.2 *to 110 kW (2 to* 350 *HP),* 3AUA489002B1454				ACS607-US-04	ACS 600 INSTALLATION & START-UP MANUAL, ACS *604/607* AC *Drives 100* to *700 HP* 90 *to* 630 *kW,* (3AUA489002B4468)		
ACS1000									
	3BHT49020	ACS 1000 SALES FLYER. *ACS 1000 Medium-Voltage Drives for Speed & Torque Control Of 400-6700 HP Motors*				3BHT490243	ACS 1000 BROCHURE, *ACS 1000 Medium-Voltage Drives for Speed & Torque Control of 400-6700 HP Motors*		
DC									
	DCS500B-DE-11	DCS 500B SYSTEM DESCRIPTION MANUAL (3ADW 000 068)				DCS500B-DE-02	DCS 500B TECHNICAL DATA, *DCS* 500 *Thyristor* converter *for* DC *Drive* Systems 25 *to* 5150 A, *DCS 500/500B, DCF 500/500B, DCF 500* (3ADW 000054)		
	DCS500B-DE-04	DCS 500 OPERATING INSTRUCTIONS MANUAL (3ADW 000 055)				3AUA489002B4433	CC8 500B APPLICATION MACROS, *DCS 500 Thyristor* P o - e , *Converter for* DC *Drive Systems* 2 5 *to* 5 1 5 0 A		

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	DCS500B-DE-05	DCS 500B SOFTWARE DESCRIPTION MANUAL (3ADW 000 048)				DCS500B-DE-14	DCS 500B APPLICATION BLOCKS (3ADW 000 046)		
		DC (Continued)							
	DCS500-US-00	DCS 500 SALES FLYER				3AUA489002B1458	DC MOTORS & DRIVES BROCHURE Moving *Industry With Even Greater Efficiency*		
	3ADW WO 040	DCS 500 12-PULSE START UP, *Planning & Commissioning of 12-pulse Converters (parallel)*				DC-Catalog-US001	DC MOTOR CATALOG		
	ABB/DEIND/A97-01A	EC DECLARATION OF CONFORMITY				3ADW 000 064	DCF 501/502 OPERATING INSTRUCTIONS		
	3AFY61041486	DDC TOOL MANUAL				3ADW 000 032	DCS 500 EMC INSTALLATION		
	3ADW 000 043	DCS 500 INSTALLATION & START-UP GUIDE. *CS31* Adapter Module NCSA-01				3AFE61178775	DC DRIVES USERS MANUAL, *CMTIDCS500*		
	3ADW 000 051	DCS 500 INSTALLATION & START-UP GUIDE, *Modbus Adapter Module NMBA-01*				3ADW 000 044	DCS 500 INSTALLATION 8 START-UP *GUIDE, Profibus Adapater Module NPBA-02*		
	3ADw 000 056	DCS 500 Software Description				3ADW 000 049	DCS500 SYSTEM DESCRIPTION		
	DCB-PAD-6/7	Hardware Planning & Selection Guide, *Compact Dig 15 – 3000 Hp*				DCB101	VERITRON PAD 6/7 AND PSD 6/7 COLOR BROCHURE		
	DCS500-US-01	DCS 500 OVER HEAD PRESENTATION (3AUA489002B1550)							
		Communications							
	ACS500-MODBUS-US-00	ACS 500 MODBUS ™ INTERFACE FLYER. *Modbus RTU* Connection For *ACS500 Drives* From 1 HP to 400 HP				ACS500-04B-MODBUS-US-04	ACS 500 MODBUS PROTOCOL INSTALLATION & START-UP MANUAL		

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ACS140									
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	ACS300-US-04	ACS 300 USER'S MANUAL, AC ***Drives*** for ***Speed Control*** of ½ HP To 15 HP ***Motors*** (3AFY61229965R0125)							
ACH500/501									
	ABB-4-ACH500-SAMPLE-SPEC	ACH 500 SAMPLE SPECIFICATION DISK				ACH500-01	ACH 500 BROCHURE ***Superior Drives Mades Simple***		
	ACH500-02	ACH 500 PRODUCT BULLETIN, ***Adjustable Frequency AC Drives***				ACH500-05	ACH 500 PROGRAMMING MANUAL INCLUDING APPLICATION MACROS, ***Adjustable Frequency*** AC ***Drives*** 2 to 400 HP, ***Series B***		
	ACH500-06	ACH 500 SAMPLE SPECIFICATION ***Adjustable Frequency*** Drives (2 to 400 ***HP)*** for ***Variable Torque Applications***				ACH500-07	ACH 500 SUBMITTAL, ***Adjustable*** Frequency AC ***Drives***		
	ACH500-MB-07	ACH500 MINI BYPASS SUBMITTAL ***Adjustable*** Frequency AC ***Drives***				ACH500-10	ACH 501 WITH MINI BYPASS USERS MANUAL (3AUA489002B3979R0101)		
	ACH501-04	ACH 501 INSTALLATION & START-UP MANUAL ***Adjustable*** Frequency AC ***Drives*** 2 to 75 ***HP, Series B***				ACH501-08	ACH 501 WITH OPTION PACK USERS MANUAL		

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	ACH502-04	ACH 502/504 INSTALLATION & START-UP MANUAL, ***Adjustable Frequency AC Drives** SO to 401 HP, **Series B***				ACS501-09	ACS 501 SPARE PARTS LIST (3AUA489002B4149)		
	ACS-502-09	ACS 502 SPARE PARTS LIST (3AUA489002B4390)				ABB-5-FANSAVE/ PUMPSAVE	FANSAVE/PUMPSAVE ENERGY SAVINGS DISK		
				Communications					
	ACS500-MODBUS-us-00	ACS 500 MODBUS ™ INTERFACE FLYER, ***Modbus RTU Connection For ACS500 Drives** From f HP to 400 **HP***				ACS500-04B-MODBUS-US-04	ACS 500 MODBUS PROTOCOL INSTALLATION & START-UP MANUAL		

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				Communications (continued)					
	ACH500-N2 BUS-US-00	ACH 500 N2 BUS FLYER				ACH500-N2-US-04	ACH 500 N2 BUS INSTALLATION & START-UP MANUAL, ***N2 Protocol*** ACH 500 ***Drives***		
	ACH500-P1-FLN-00	ACH 500 FLYER, ***The Direct Connection*** TO ***Landis & Staefa** System **600™***				ACH500-P1-US-04	ACH 500 P1 LAN INSTALLATION & START-UP MANUAL. *Protocol for ACH 500 **Drives*** (3AUA489002B2467R0101)		
	DMT500PC-US-00	DMT500PC FLYER, A ***Remote Drive Monitoring** software for Standard AC **Drives** from **1 HP** to 400 **HP***				DPS-01	ACH 500 FLYER, ***"You'll** Notice The **Difference..."***		
	HONEYW-US-00	ACH 500 FLYER. *HONEYWELL **Excel** 5000 Building **Management***				LON078-US-04	LON078 USER'S MANUAL		
	LON078-US-00	LON078 FLYER, ***Lonworks*** CONNECTION							
				Miscellaneous					
	AR-HPAC	HPAC REPRINT, ***"Washington** State **Links** HVAC Drives **to DDC** System"*				AR-HVAC-PROBLEMS	HEALTH FACILITIES MGMT REPRINT, ***"Solving** HVAC Problems"*		

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	AR-NEWS	THE AIR CONDITIONING HEATING AND REFRIGERATION NEWS REPRINT, ***"Variable-Frequency Drives Help Reduce Electrical Load for Dallas Office Complex"***		
	ST-311-102	TECHNICAL GUIDE NO. 102, ***Effects of AC Drives on Motor Insulation – Knocking Down the Standing Wave***		
Policy				
	235	TERMS & CONDITIONS		
Training				
	ACFND-US-00	FLYER, ***Fundamentals Of AC Drives***		

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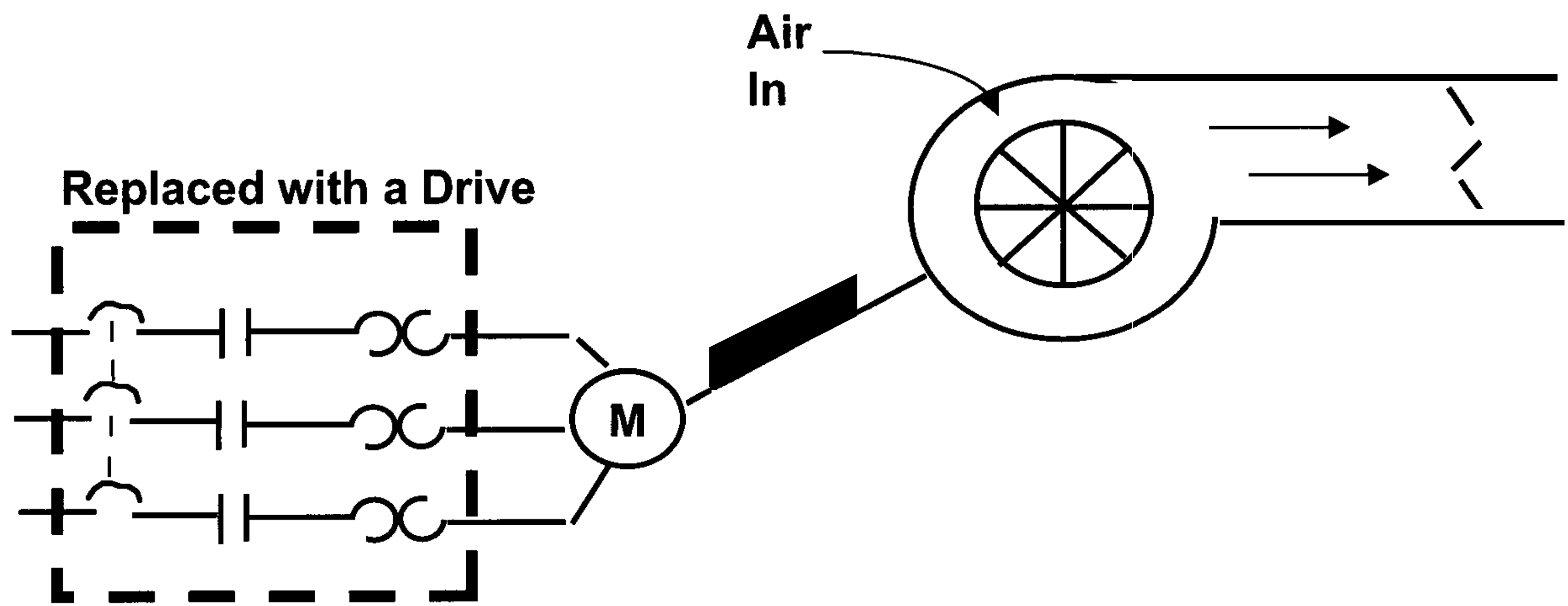
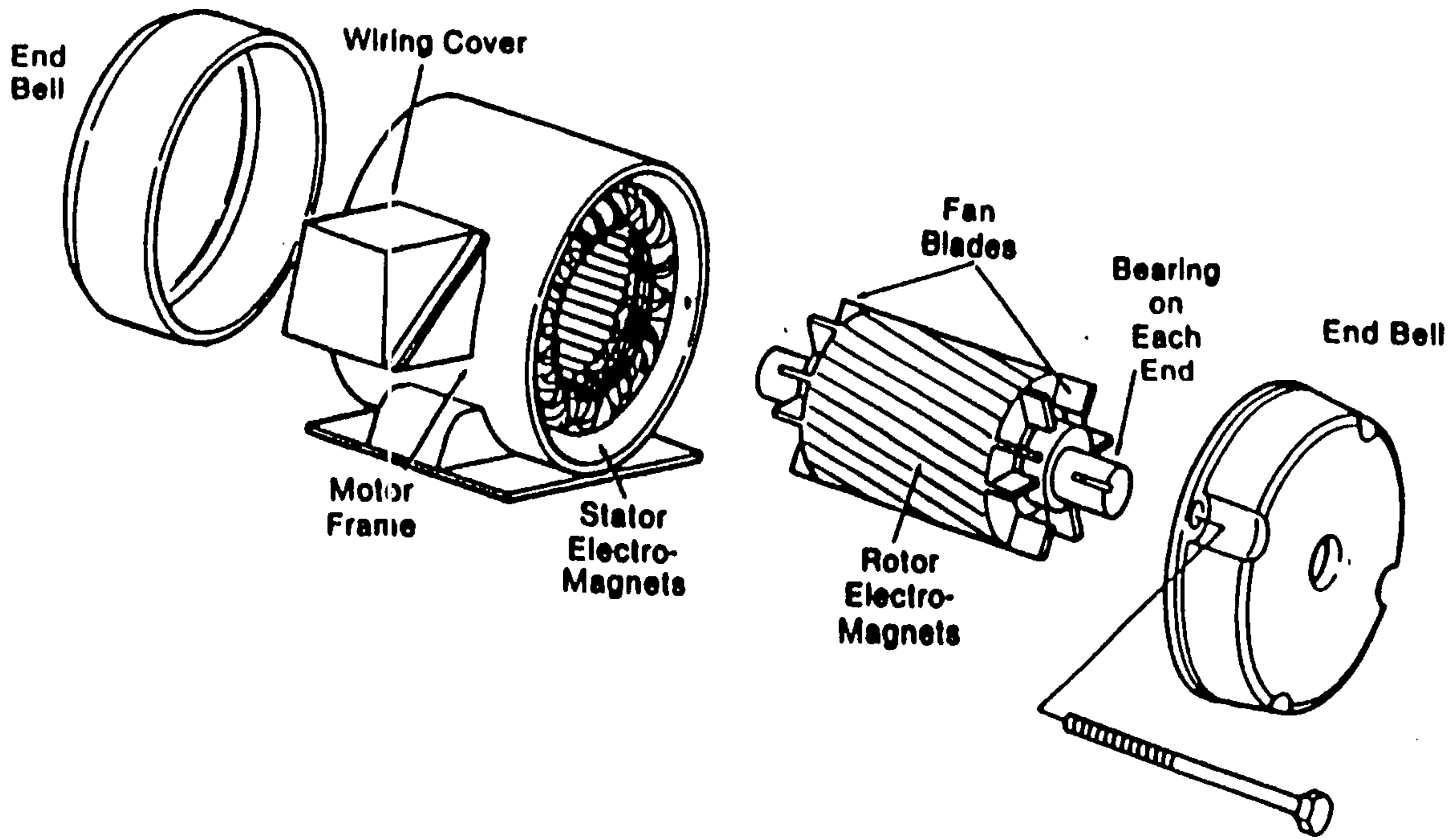
Tab 3
PWM Basic Theory

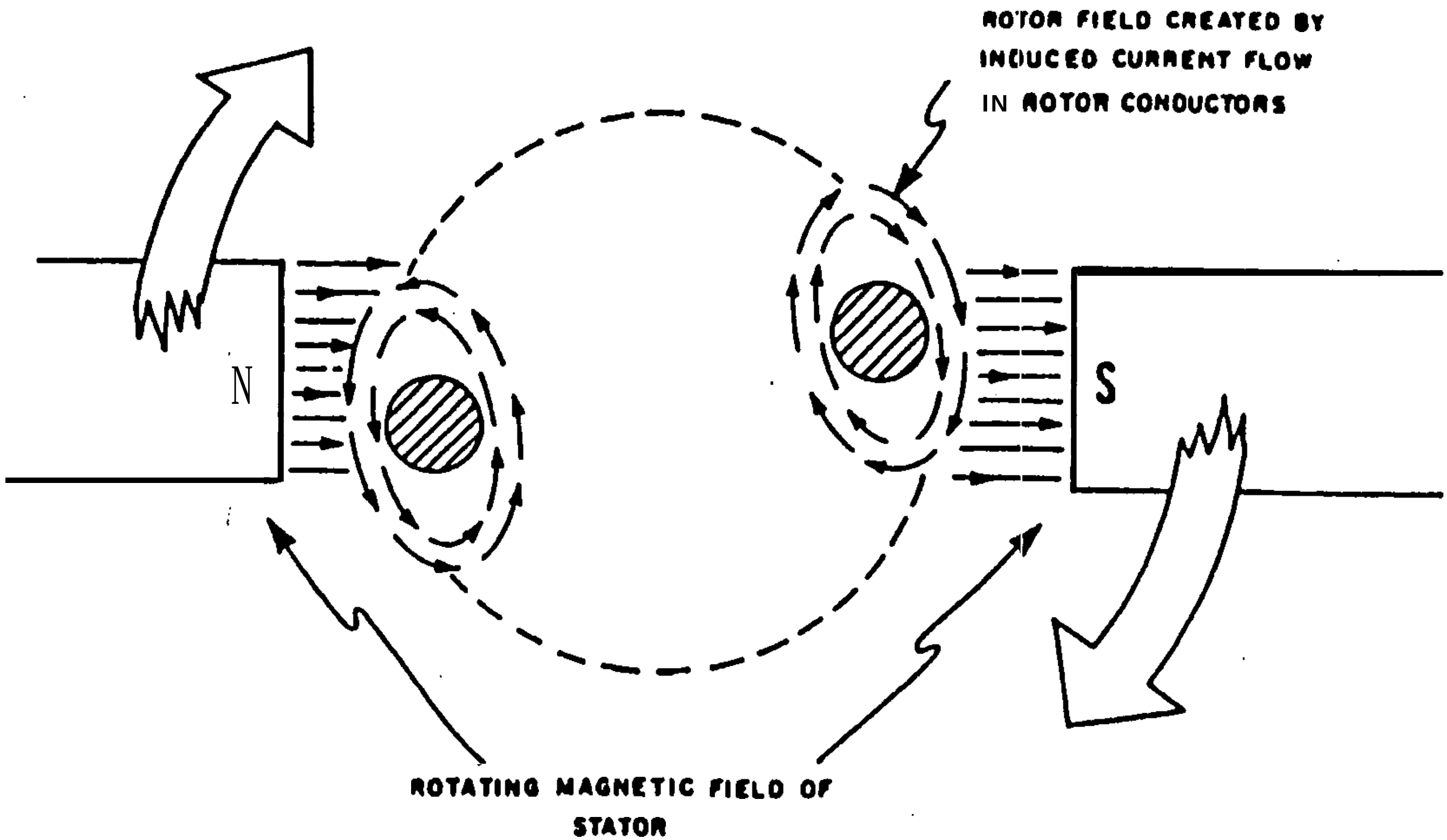
PWM Basics



PWM Basics


End Bell
Wiring Cover
Motor Frame
Stator Electro-Magnets
Fan Blades
Bearing on Each End
End Bell
Rotor Electro-Magnets

PWM Basics


ROTOR FIELD CREATED BY
INDUCED CURRENT FLOW
IN ROTOR CONDUCTORS
N
S
ROTATING MAGNETIC FIELD OF
STATOR

PWM Basics

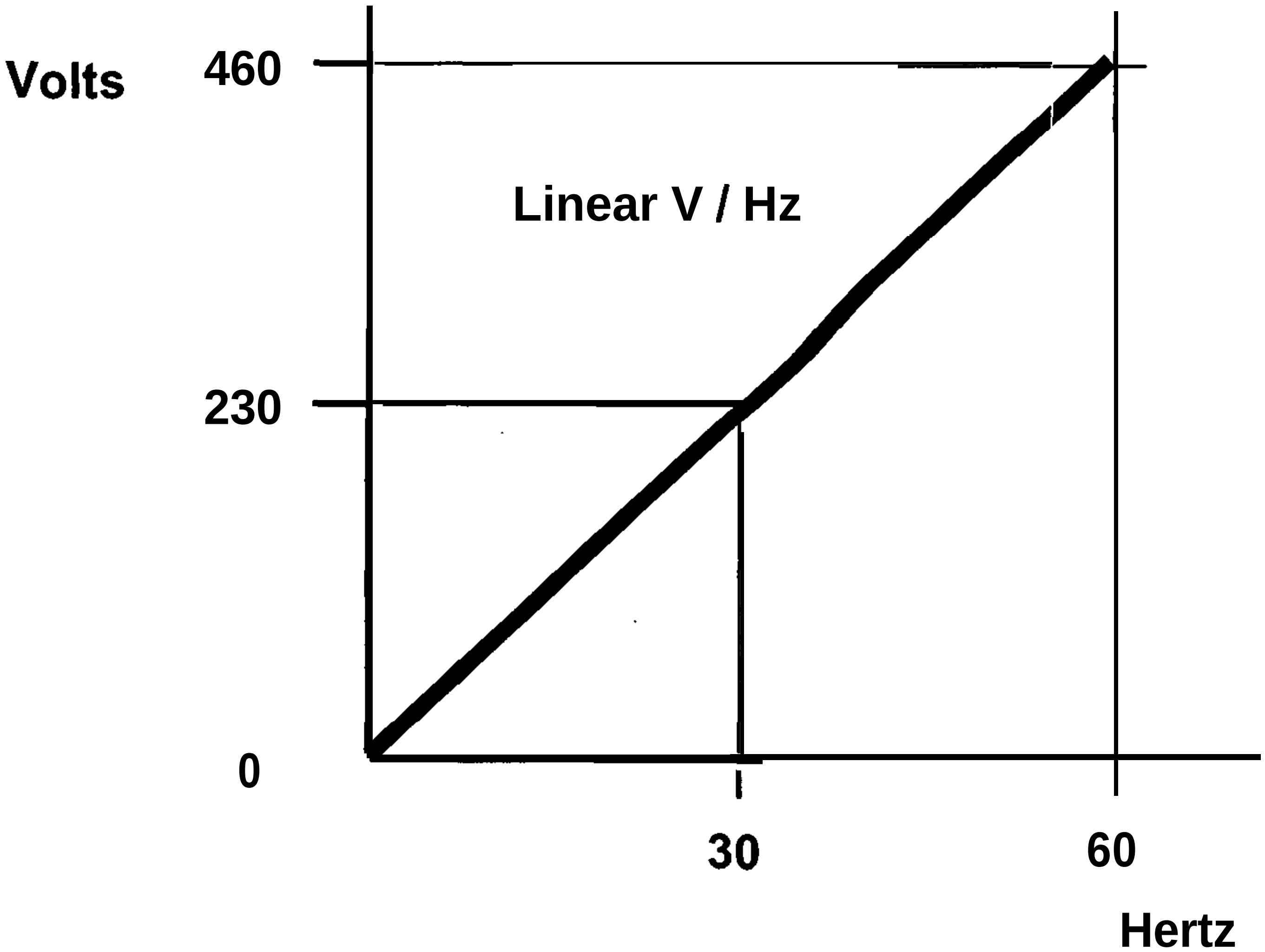
$$\text{Shaft Speed} = \frac{1210 \times F}{P} - \text{Slip}$$

Slip for NEMA B Motor = 3 to 5% of Base Speed (1800 RPM) at Full Load

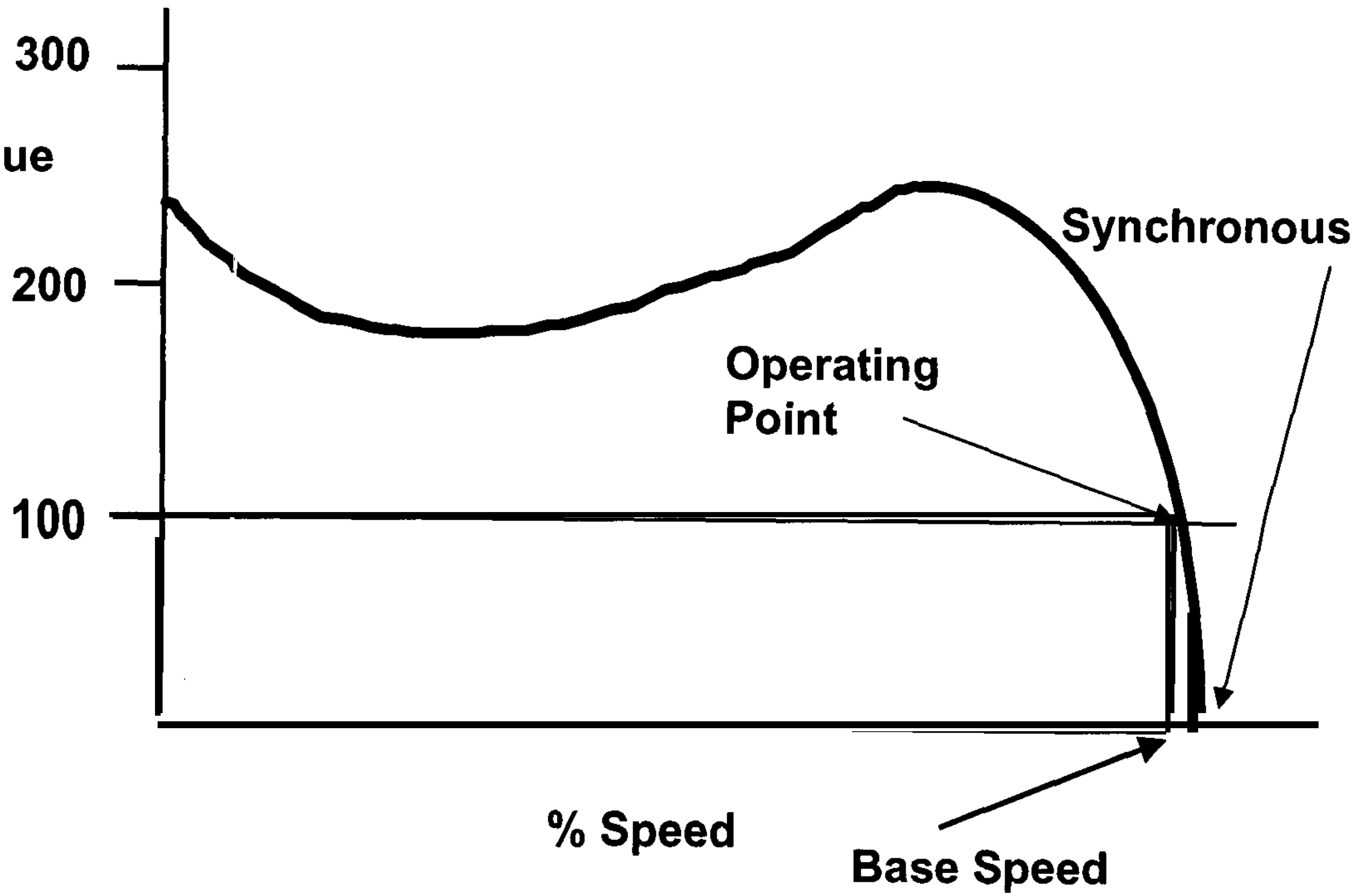
Example:

$$\text{Shaft Speed} = \frac{120 \times 60\ \text{Hz}}{4} - 50 = 1750\ \text{RPM}$$

PWM Basics

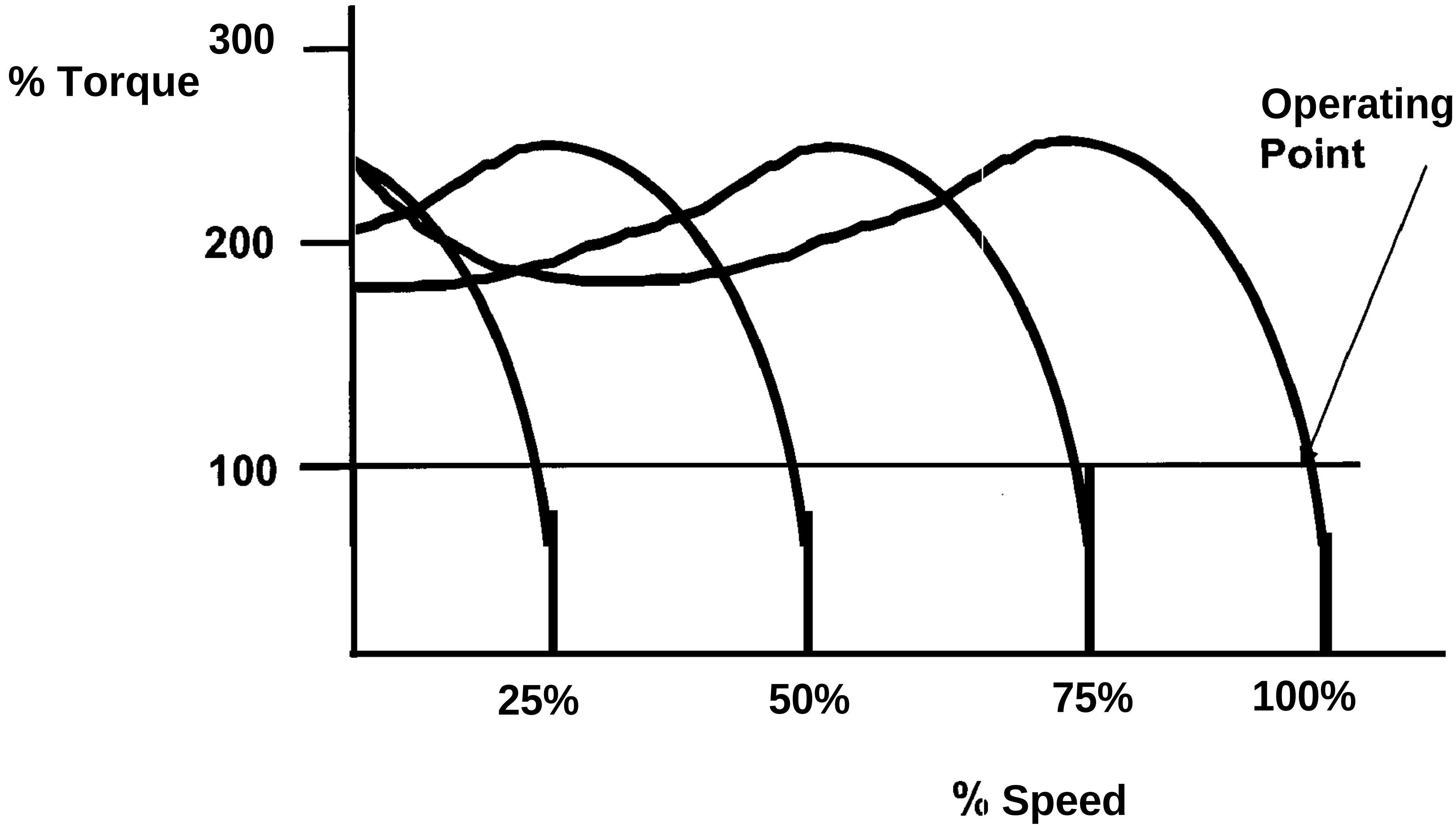


PWM Basics

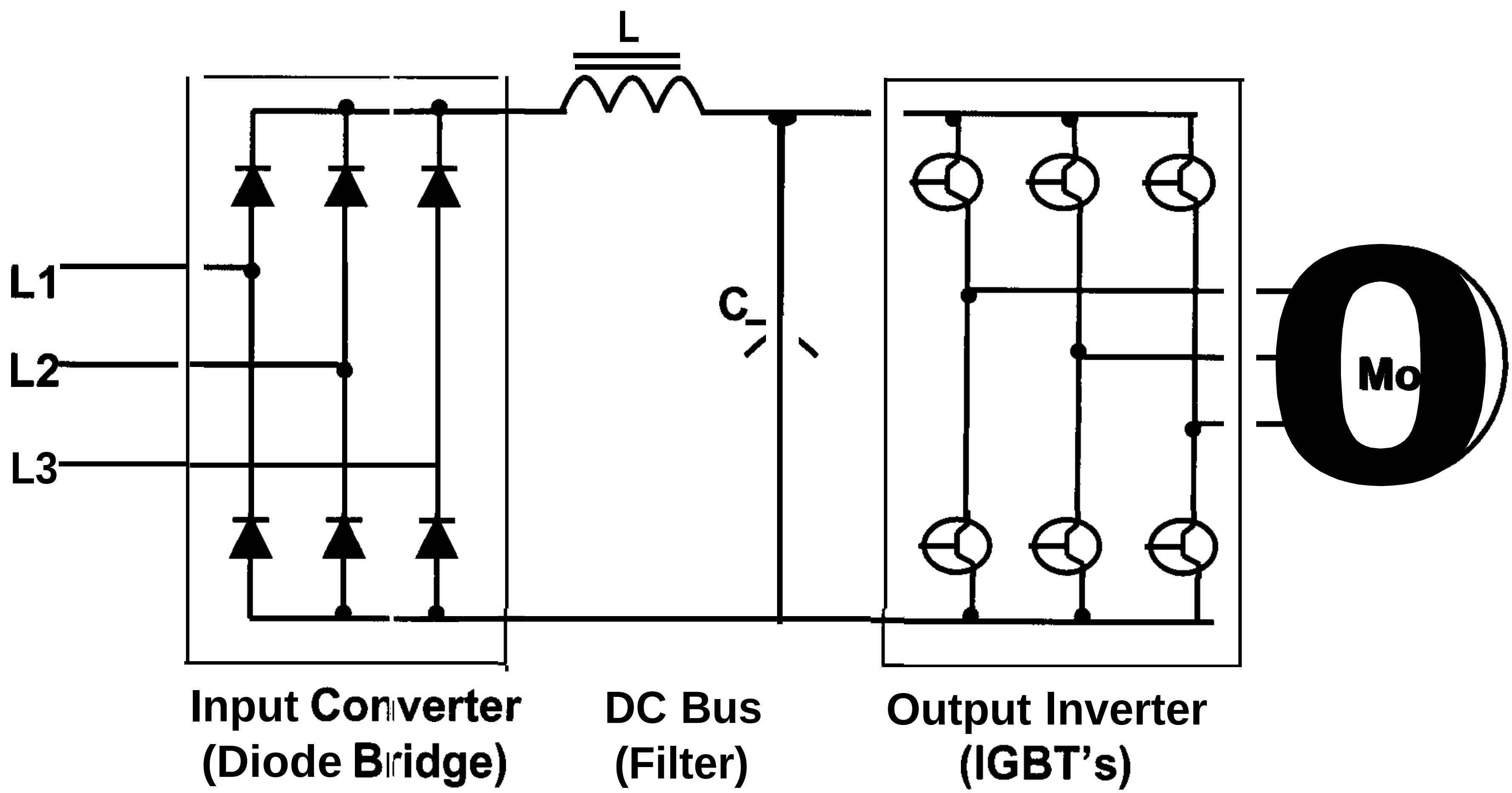


300
% Torque
200
100
Synchronous
Operating
Point
% Speed
Base Speed

PWM Basics



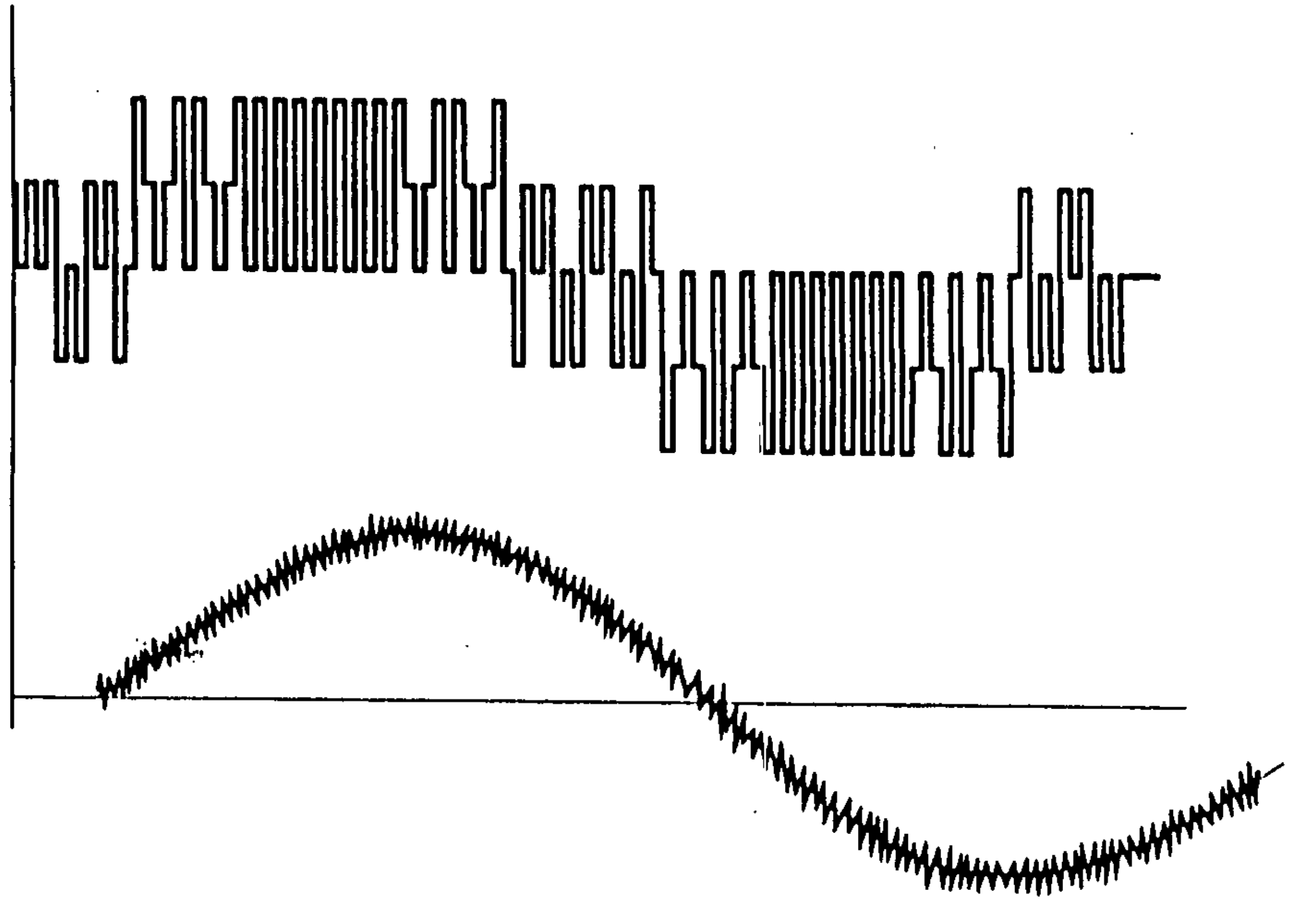
PWM Basics


L
L1
L2
L3
C
Mo
Input Converter
(Diode Bridge)
DC Bus
(Filter)
Output Inverter
(IGBT's)

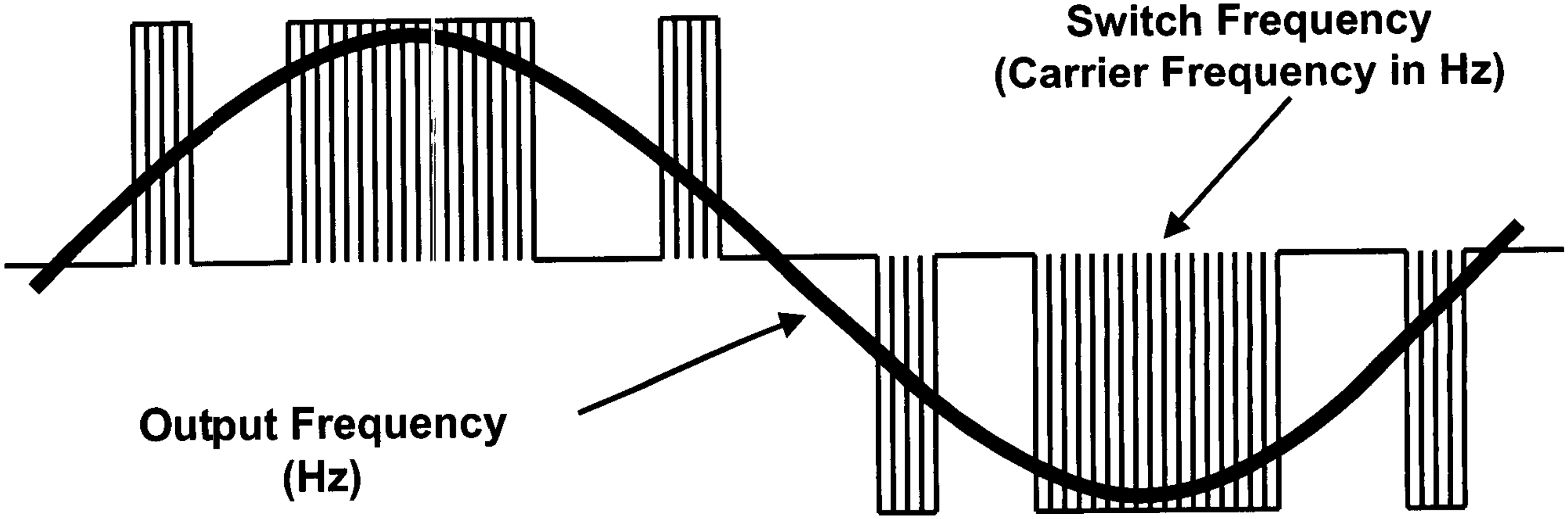
PWM Basics

Line to Neutral
Voltage

Line to Neutral
Current



PWM Basics


Switch Frequency
(Carrier Frequency in Hz)
Output Frequency
(Hz)

ntal
ntat

dc group sm
1977 west river road north
minneapolis, mn 55411
telephone 612-529-9516
toll free 1-800-838-7927
fax 612-529-9518
www.dc-group.com

FAX

To:	Vannessia Wheeler
Fax:	**919-981-8150**
From:	Mohammed Shah
Re:	**Parts Break down of Parts Kit**
Date:	**08/29/02** 8.00 AM
#Pages including cover sheet:	,

Dear Vannessia Wheeler,

Kindly provide us the break down for the following park **kits** and fax us. Your earliest action on this regard will be highly appreciated.

Parts Kit # 106-711-l 22
Parts Kit # 106-71 l-l 23

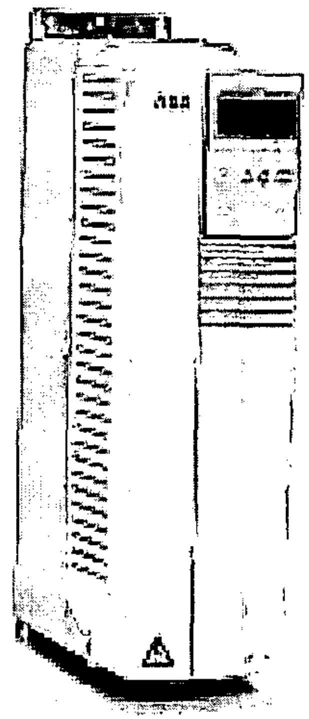
Thanks
Mohammed Shah

10KVAR 120 125 079 120 125 078
120 125 079 8KVAR
6
4 120

ACS 400 Adjustable Speed AC Drives

from 3 HP to 40 HP for constant torque **applications** and

from 3 HP to 50 HP for variable torque applications



Input voltage: 3 phase, 200...240 V, +/- 10%

3 phase, 380...480 V, +/- 10%

Input frequency: **From 48 to 63 Hz**

Output voltage: **From 0 to V_N**

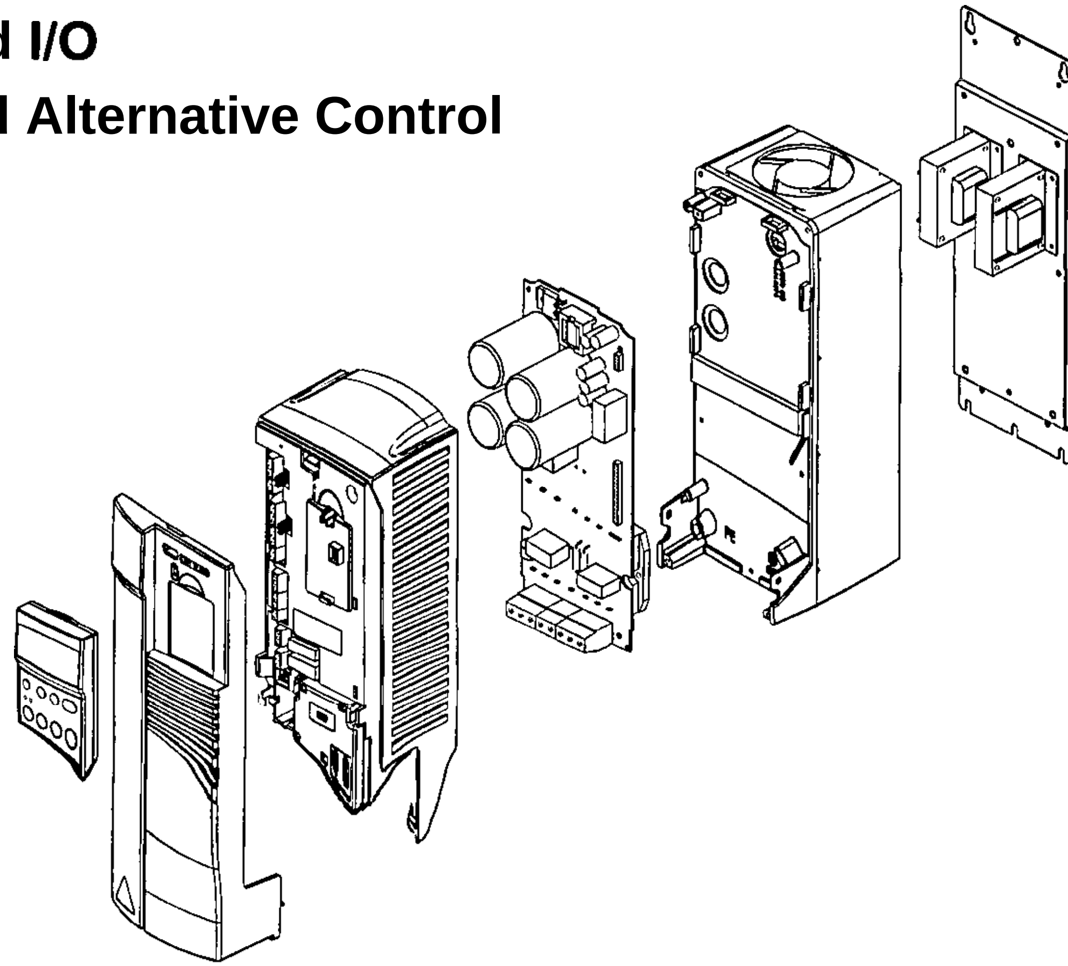
Output frequency: **From 0 to 250 Hz**

ABB

ACS 400

- **Easily Integrated**
  - No Need for Conversion Logic (source or sinking logic)
  - Galvanically Isolated I/O
  - Standard, 3-Wire and Alternative Control Connections
  - Bookshelf design

Standards
  - UL, cUL, CSA, CE
  - Production certified to IS09001 and ISO14001



ACS 400 Environment

Ambient operating temperature:

Switching frequency 4,0 kHz

0...40 C (104°F), no derating

0...50 C (122°F), with 10% derating

Switching frequency 8,0 kHz

0...40 C, derate 20%

Altitude: < 1000 m (3300 ft) for 100 % loadability

Derate 1,0 % every 100 m (333 ft)

above 1000 m

Storage

temperature:

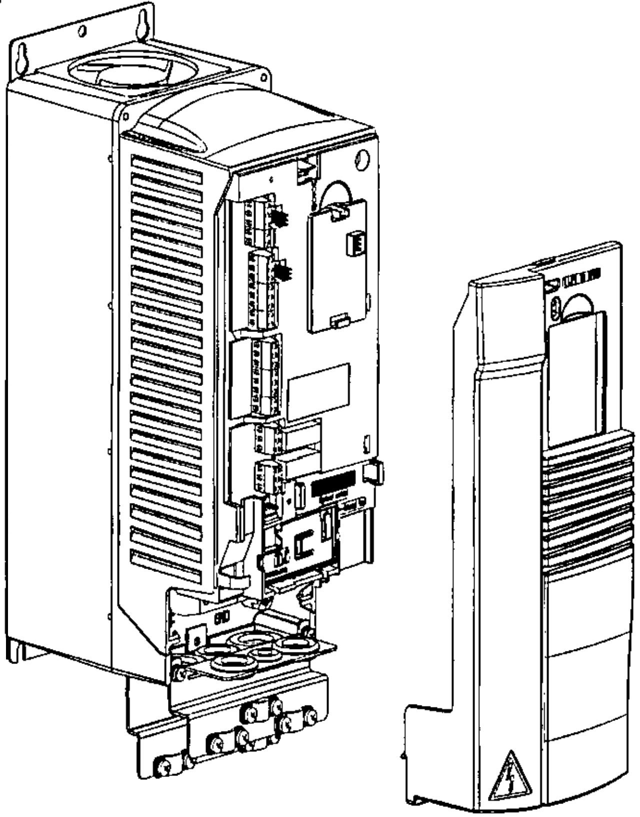
-20...70 C (-4 to
ll 58°F)

Relative humidity:

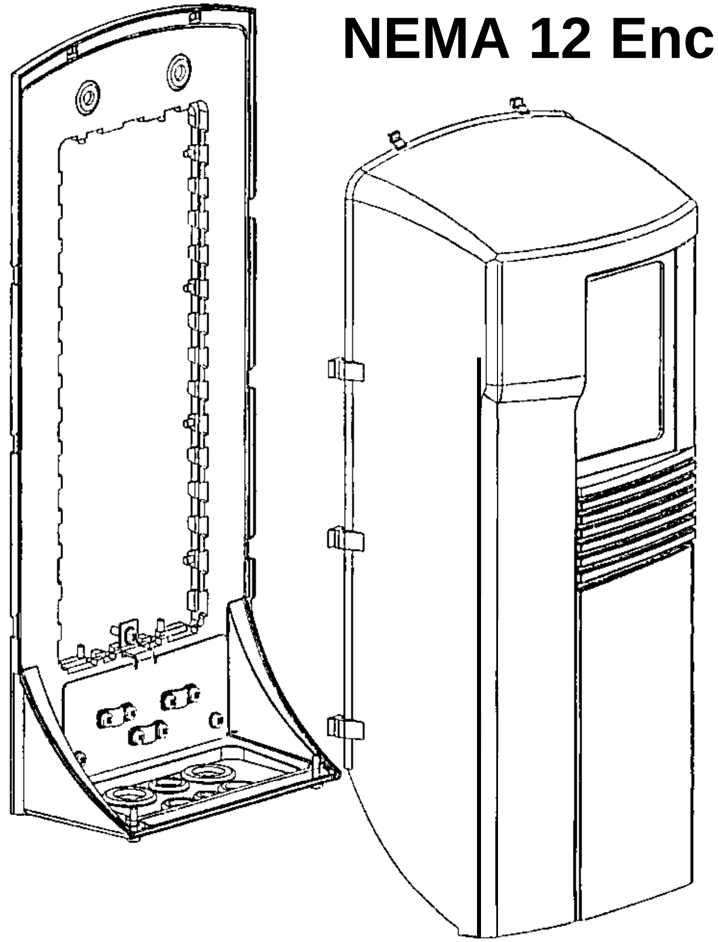
< 95%, non condensing

ACS 400

NEMA 1 Enclosures



NEMA 12 Enclosures



Options available:

EMI/RFI filters (IP54)

Brake units

DDCS module

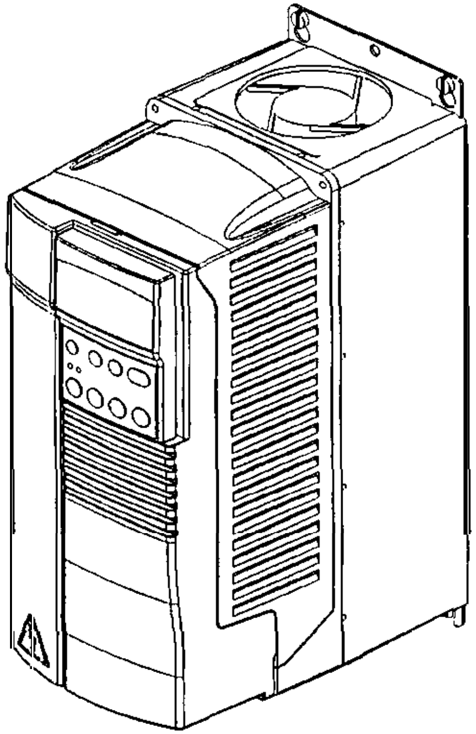
Fieldbus modules

Nominal Power

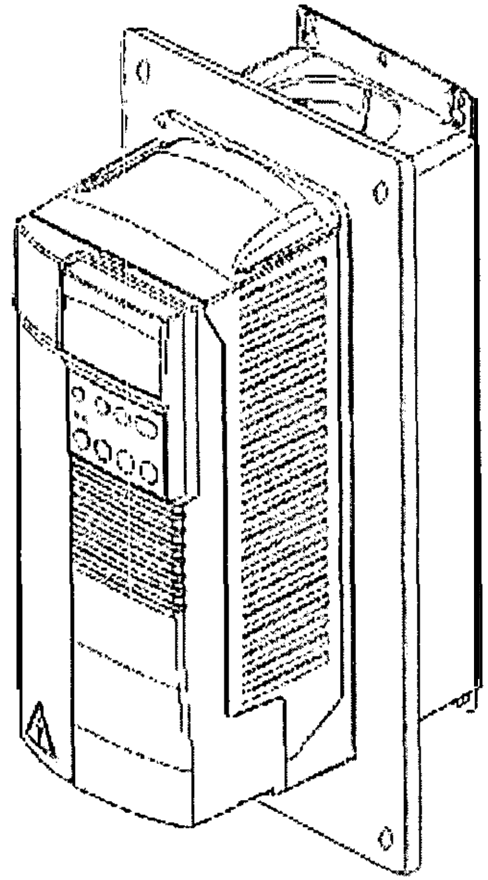
CT:	**3 HP to 40 HP (480V)**
VT:	**3 HP to 50 HP (480V)**

ACS 400 Mounting

Wall mounting



Flange m'ounting (option)



Mounting clearance

- **1.97 in on each side**
- **7.87 in above and below**

ACS 400 Current ratings

Standard ratings, ambient temperature 40 °C Constant Torque applications

Rated motor power P_n (HP)	Rated output Rated current I_2 (A)	Current I, Maximum (1 minute) I_{max} (A)
2	4.9	7.4
3	6.6	9.9
5	8.8	13.2
7.5	11.6	17.4
10	15.3	23
15	23	34.5
20	30	45
25	38	57
30	44	66
40	59	88.5

ABB

ACS 400 Current ratings

Standard ratings, ambient temperature 40 °C Variable Torque **Applications**

Rated motor power P_n (HP)	Rated output Rated current I_2 (A)	Current I, Maximum (1 minute) I_{max} (A)
3	6.6	7.3
5	8.8	9.7
7.5	11.6	12.8
10	15.3	16.8
15	23	25.3
20	30	33
25	38	41.8
30	44	48.4
40	59	64.9
50	72	79.3

ABB

ACS 400 Types

Standard ratings, ambient temperature 40 °C Variable Torque Applications

Rated motor power P_n (HP)	Type designation	Rated input current	Fuse (A)	CU terminal size (mm2)
3	ACS 401-0004-3-X	6.2	10	2.5
5	ACS 401-0005-3-X	8.3	10	2.5
7.5	ACS 401-0006-3-X	11.1	16	6
10	ACS 401-0009-3-X	14.8	16	6
15	ACS 401-0011-3-X	21.5	25	10
20	ACS 401-0016-3-X	28.8	35	10
25	ACS 401-0020-3-X	35	50	18
30	ACS 401-0025-3-X	41.2	50	16
40	ACS 401-0030-3-X	55.7	63	25
50	ACS 401-0041-3-X	68.1	80	25

ACS 400 Protective functions

Inverter protection

Protective function	Trip limit
Overcurrent	3,5 * I_N instantaneously
Over voltage	1,35 * rated voltage, 1,3 * U480
Under-voltage	0,65 * selected rated voltage
Over temperature	95 °C heatsink
Output short circuit	
Output ground fault	
Input phase loss	
Serial communication error	
Loss of analog input signal	

Motorprotection

Protective function	Programmable
Motor stall	Parameter protected (current, frequency and time)
Current regulation	0,5...1,5*I_N adjustable
Motor overload	I2T model (UL approved) parameter
Over current	Parameter

Application protection

Protective function	Programmable
Serial communication error	
I/O terminal short circuit	
Under load	Parameter

Relay outputs can be programmed to indicate fault conditions

ABB

400V Unit Overview

Protected					
NEMA 1					
NEMA12					
Frame Size	R0 ACS140	R1 ACS400	R2	R3	R4
CT: HP	1 1.5 2 3	2 3 5	7.5 10	15 20	25 30 40
VT: HP		3 5 7.5	10 15	20 25	30 40 50

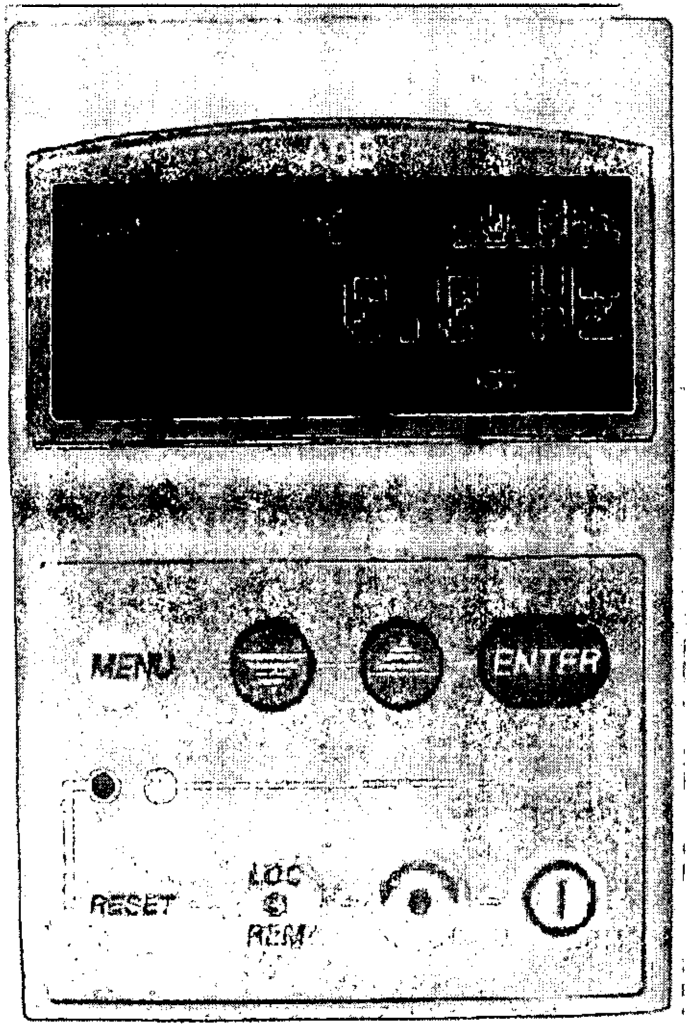
CT: Constant torque applications

VT: Variable torque applications

ACS 400 Options

- Control Panels : ACS100-PAN
ACS-PAN-A
- EMC/RFI Filters (Input)
- Brake units
- DDCS module
- Fieldbus adapters (from ACS600 family):
  - Profibus(NPBA-02),
  - Modbus (NMBA-Ol),
  - Modbus + (NMBP-01),
  - CS31 (NCSA-01),
  - Interbus (NIBA-01),
  - DeviceNet (NDNA-01)

ACS Panel



ACS-PAN-A, control panel

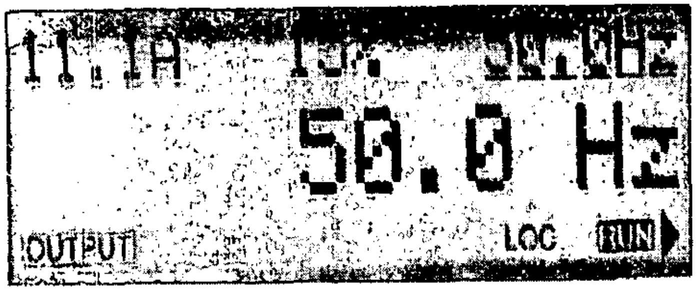
- alphanumeric panel
  - 20 + 10 character LCD display
  - multiple languages (ENG(UK&US), SWE, FIN, DE, FRA, ES, PR, IT, NL, DK, RUS)
- Parameter upload & download

ACS 400 Output display

Absolute output current

Output Curr. relative to I_{max}

Frequency setpoint



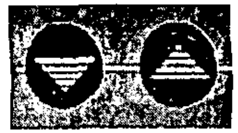
output frequency

Drive running Direction

output display indicator

Local I remote control

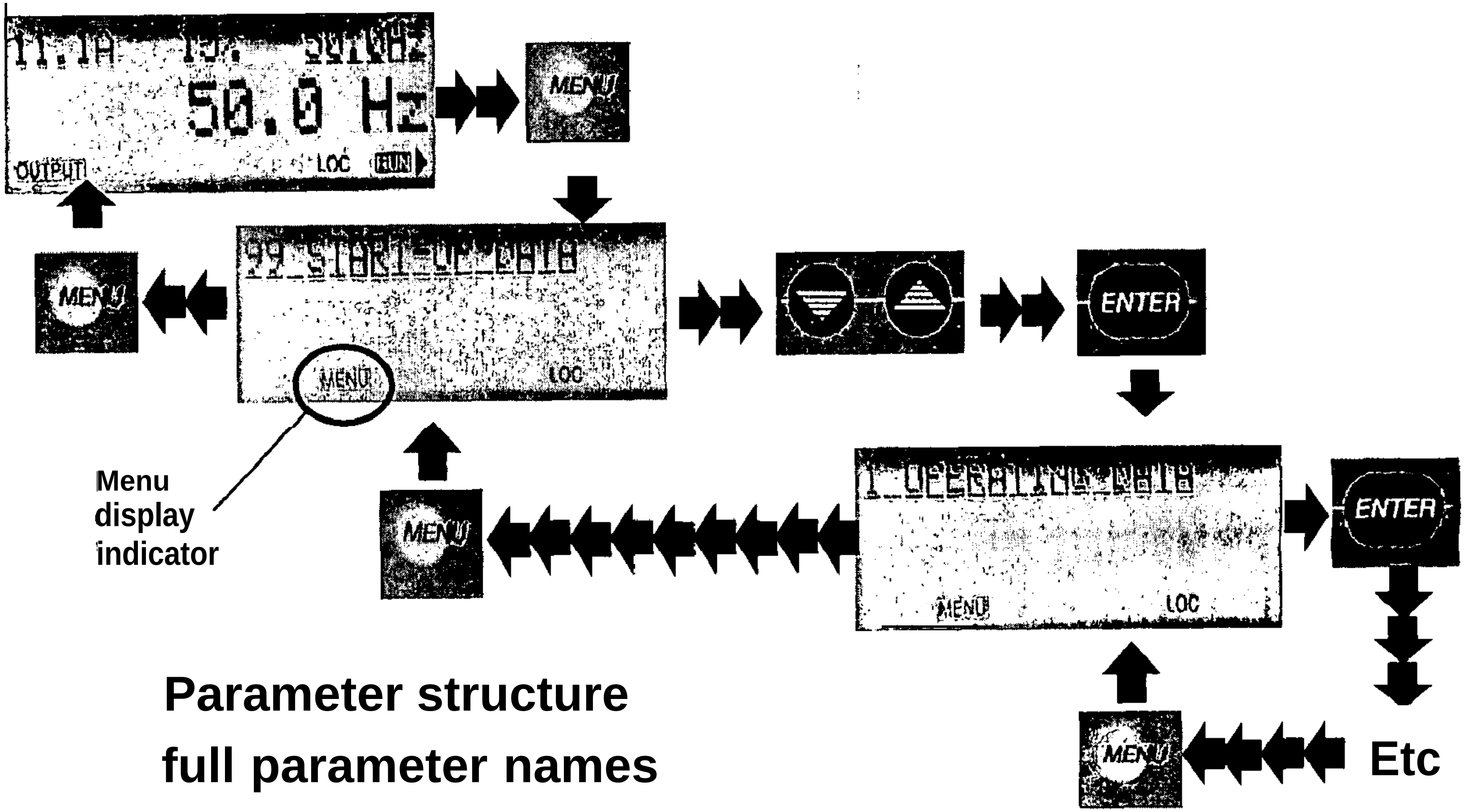
Frequency setpoint can be increased or decreased by pressing



Alterations are confirmed by pressing

New menu level is selected by pressing

ACS 400 Parameter Navigation

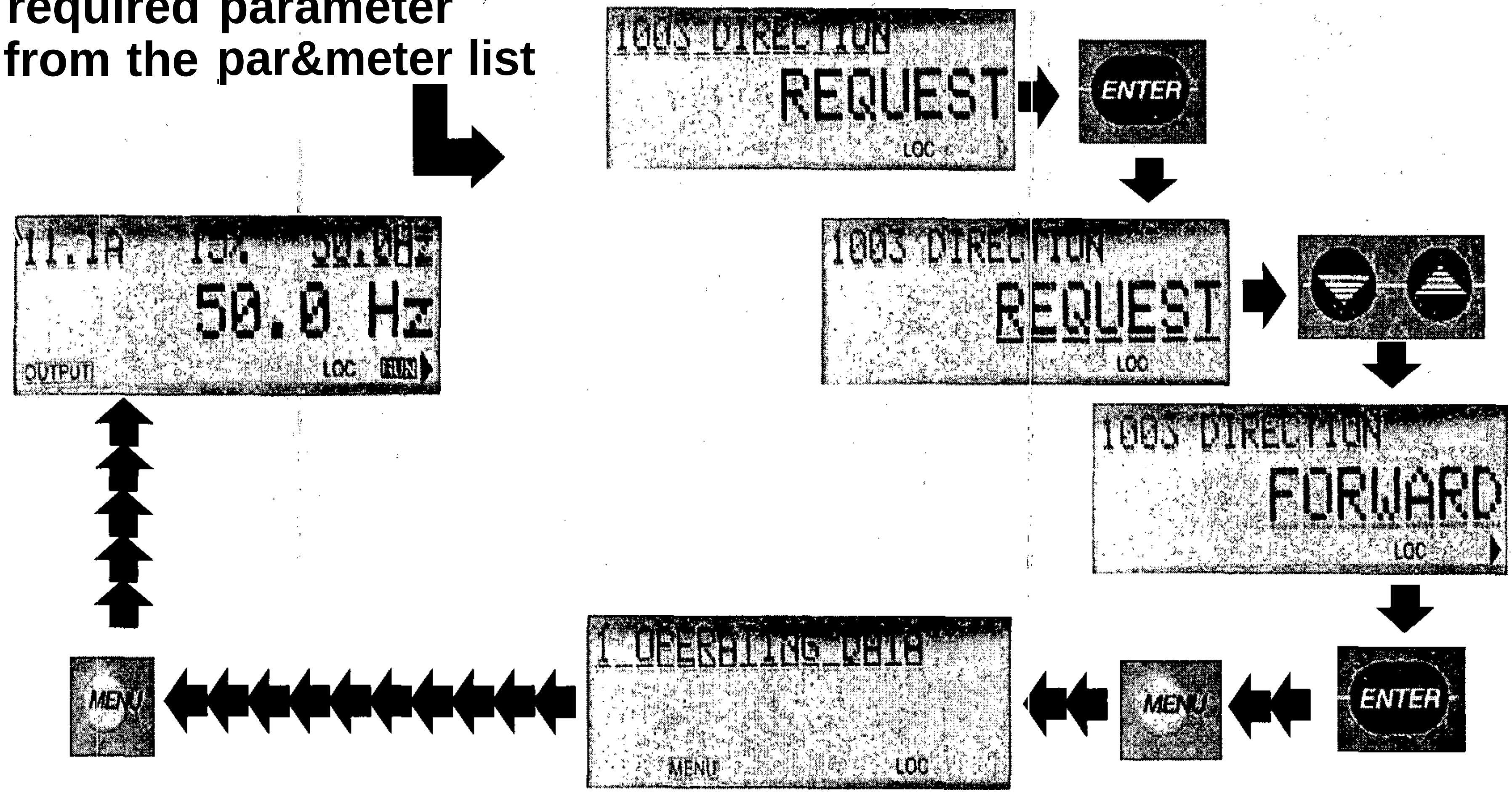


Parameter structure

full parameter names

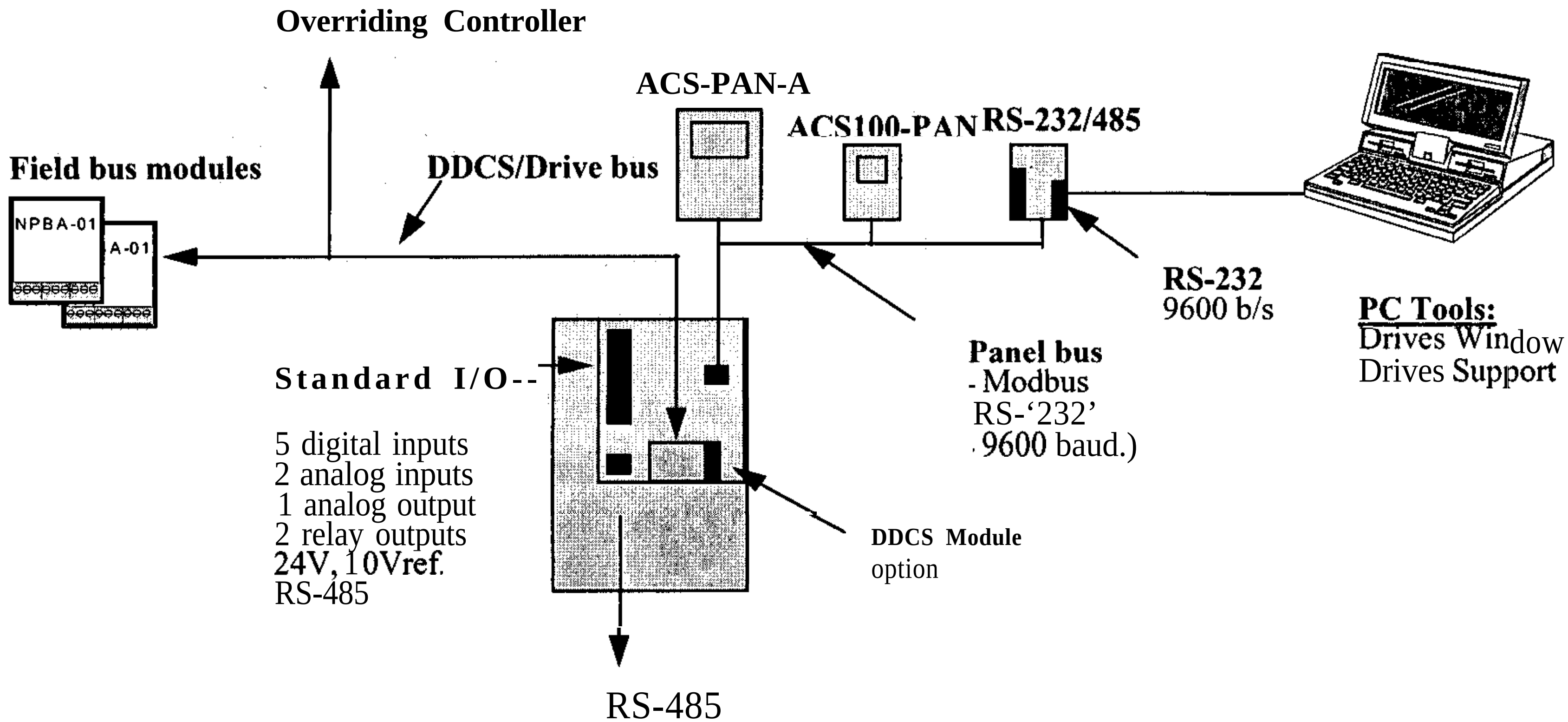
ACS 400 Parameter setting

After finding the required parameter from the par&meter list

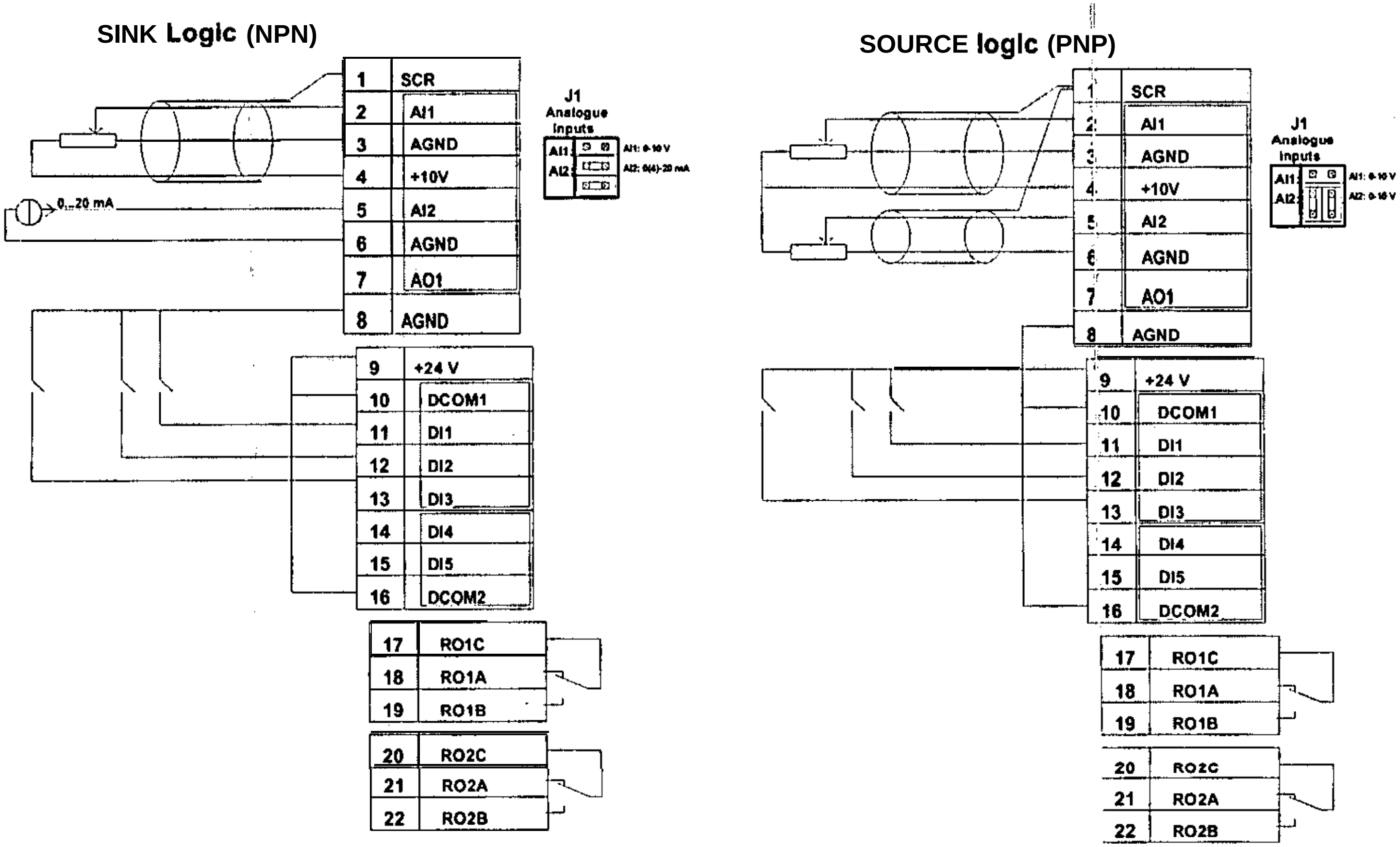


ABB

ACS 400 Drive control methods



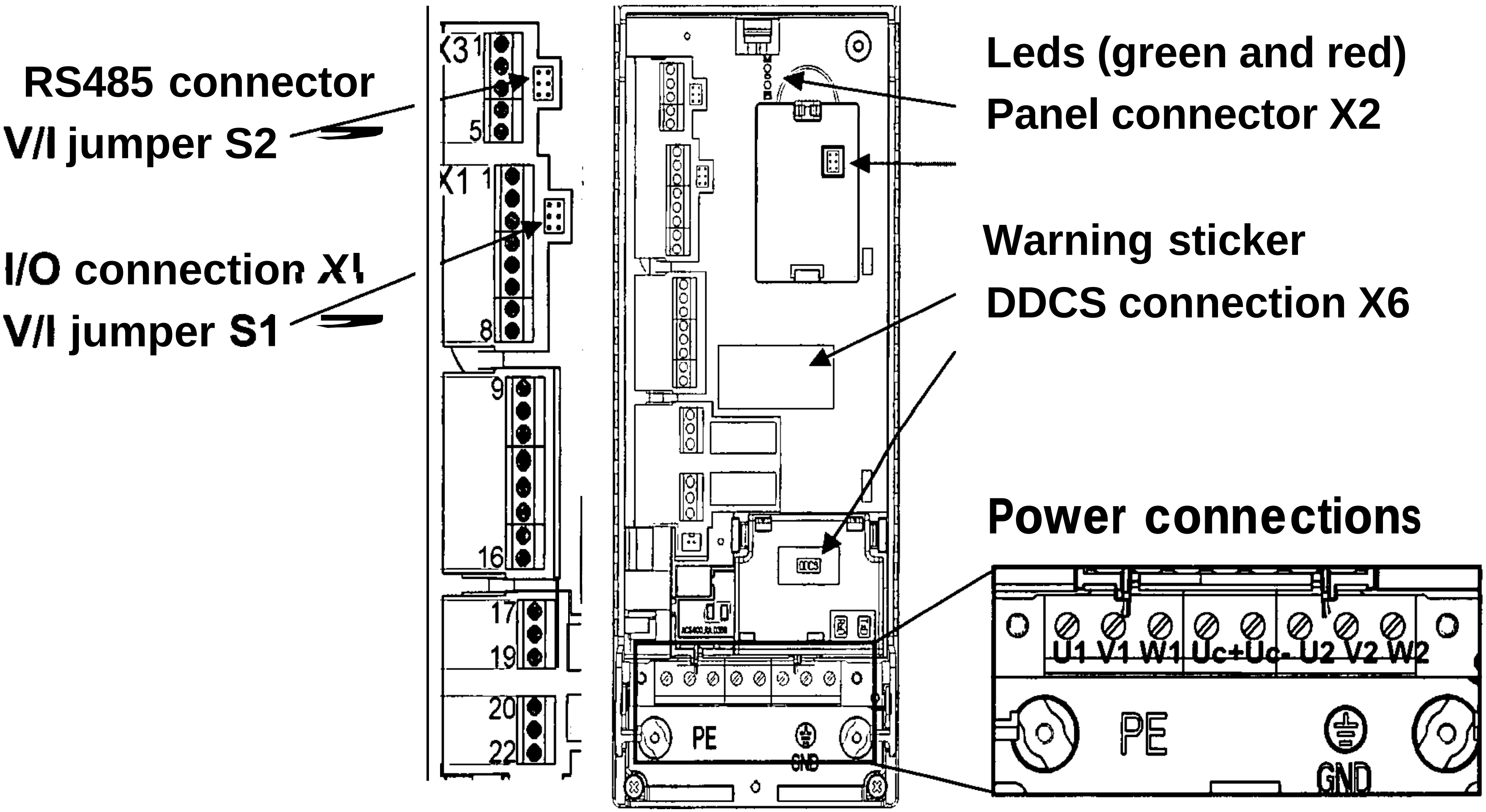
ACS 400 Control methods I/



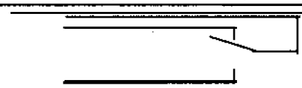
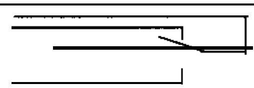
No Need for Conversion Logic - - - -

The ACS 400 Can Handle Both Without any Additional Logic

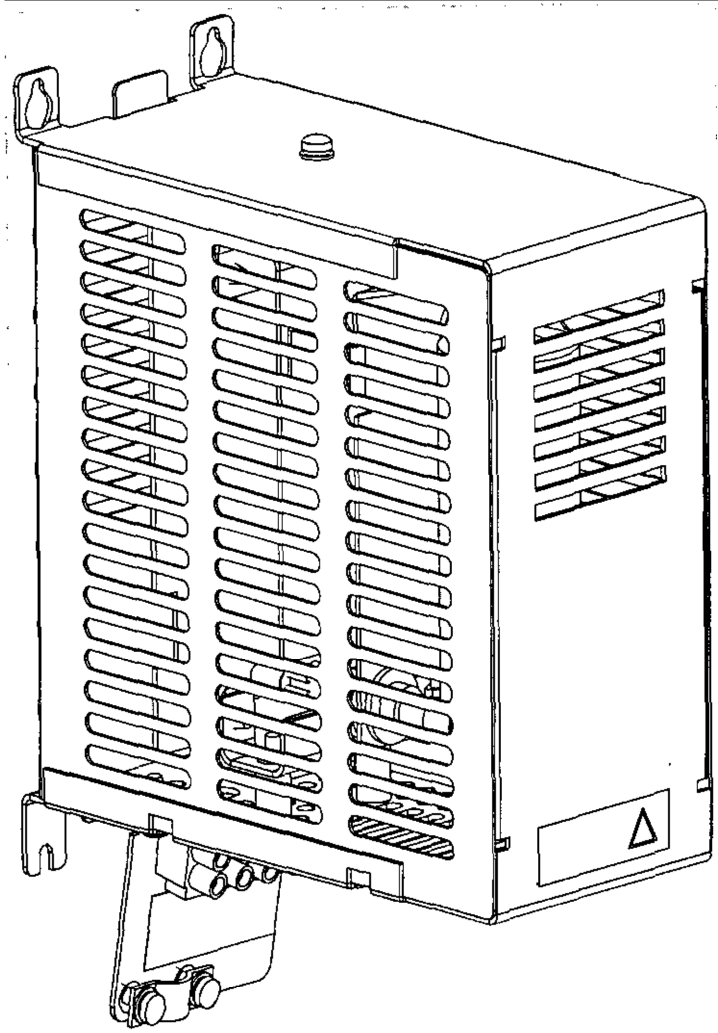
ACS 400 Terminal Interface



ACS 400 I/O Configuration

X1	Identification	Description	
1	SCR	Terminal for signal cable shield (connected internally to chassis	
2	AI1	Analog input channel 1, programmable Default: 0-10 V (Ri=200kohm)(s1:1:U) <==> 0 - fnom output frequency, 0-20 mA (Ri =500 ohm) (s1:1:I) <==> 0 - fnom output frequency resolution 0.1 %, accuracy +1 %	
3	AGND	Analog input circuit common. (Connected internally to chassis ground through 1 Mohm)	
4	10V	10V/10 mA reference voltage output for analog input potentiometer, accuracy +2 %	
5	AI2	Analog input channel 2, programmable Default:0-20 mA (Ri =500 ohm) (s1:2:U) <==> 0 - fnom output frequency 0-10 V (Ri=200kohm)(s1:2:U) <==> 0 - fnom output	
6	AGND	Analog input circuit common. (Connected internally to chassis groung through 1 Mohm)	
7	AO	Analog output, programmable. Default:0-20 mA / output frequency (load <500 ohm)	
8	AGND (Ground)	Common for DI return signals	
9	24V_OUT	24 V/250 mA auxillary voltage output (reference to AGND). Short circuit protected	
10	DCOM1	DCOM1 digital input common 1 (for DI1, DI2 and DI3)To activate digital input, there must be +12 V (or -12 V) between that input and DCOM1. 24 V supply may be provided by the ACS400 (X1:9) or from external 12-24 V source.	
Digital input configuration		**Factory (0)**	**Factory (1)**
11	DI1	Start/StopActivate to start. Motor will ramp up to frequency reference. Deactivate to stop. Motor will coast to stop.	Start If DI2 is activated, momentary activation of DI1 starts the ACH400.
12	DI2	ReverseActivate to reverse rotation direction.	Stop Momentary deactivation always stops the ACH400.
13	DI3	JogActivate to set output frequency to constant 5Hz.	ReverseActivate to reverse rotation direction.
14	DI4	Has to be deactivated.	Has to be activated.
15	DI5	Acceleration/deceleration selection	Acceleration/deceleration selection
16	DCOM2	DCOM2 digital input common 2 (for DI4, DI5)	
2E+05	RO1		Relay output 1 programmable (default: fault => 17 connected to 18) 12-250 V AC /30 V DC, 10 mA - 2 A
2E+05	R02		Relay output 2 programmable (default: running => 20 connected to 22) 12-250 V AC /30 V DC, 10 mA - 2 A

ACS-BRK Brake units



features

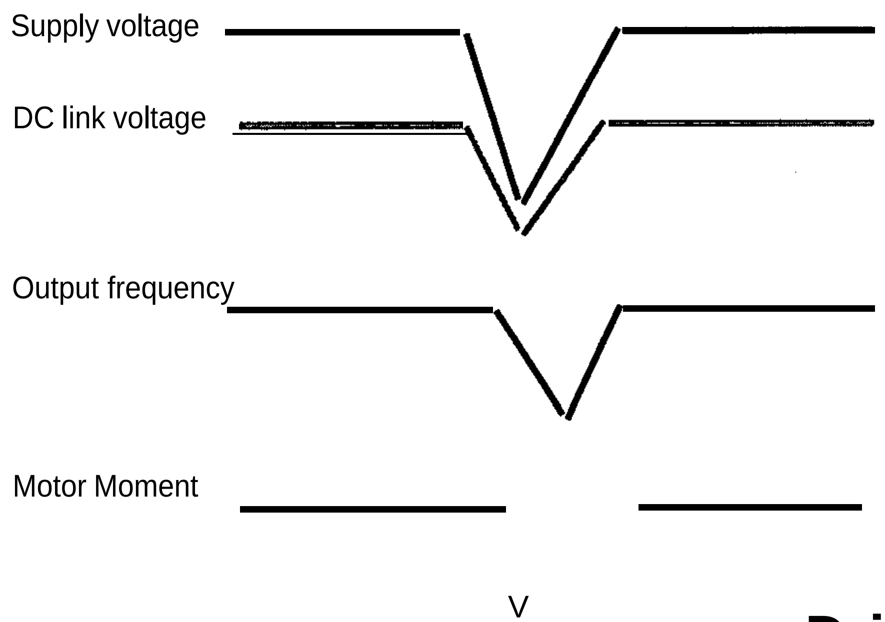
- Dynamic Braking
- Protected chasis
- Chopper and resistor integrated
- Cable length between brake unit and inverter: 1.5 ft
  - for longer distances additional fuses are needed (max. cable length with fuses 15 ft)
- Chopper average power up to 8 kW

ACS 400 Programmable features

- Output current and frequency limit
- Versatile start and stop modes
- 2 programmable Acc/Dec ramps
- Programmable V/f ratio
- IR compensation
- Power loss ride through
- DC hold
- Sleep function
- 7 preset speeds
- 2 jump frequencies
- Parameter upload/download

ABB

Power loss ride through



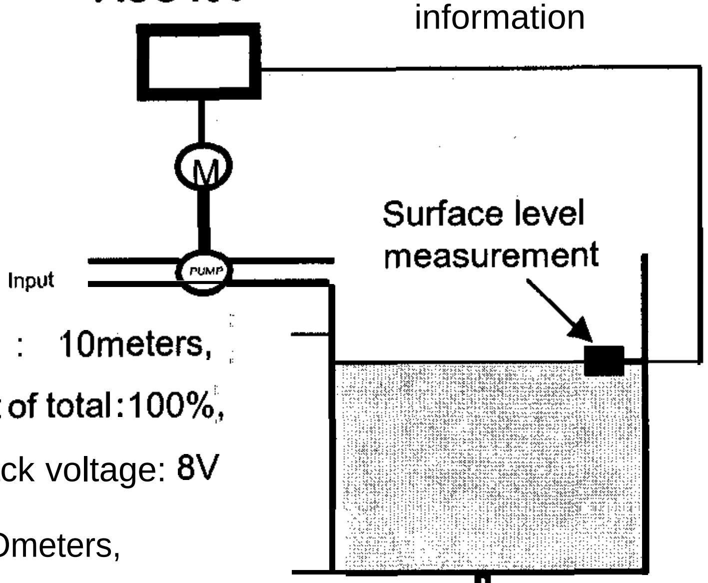
Parameter 2006
=0 disable
=1 enable 500 ms
- 2 enable without time limit
(Deprends of the kinetic energy)

Drive behavior during power failure:

- **Power is recovered from the kinetic energy of the load**

PID-regulator P- control

- Level control is normally P only
- Averaging level : Low gain
- Tight level: High gain



High: 10meters,

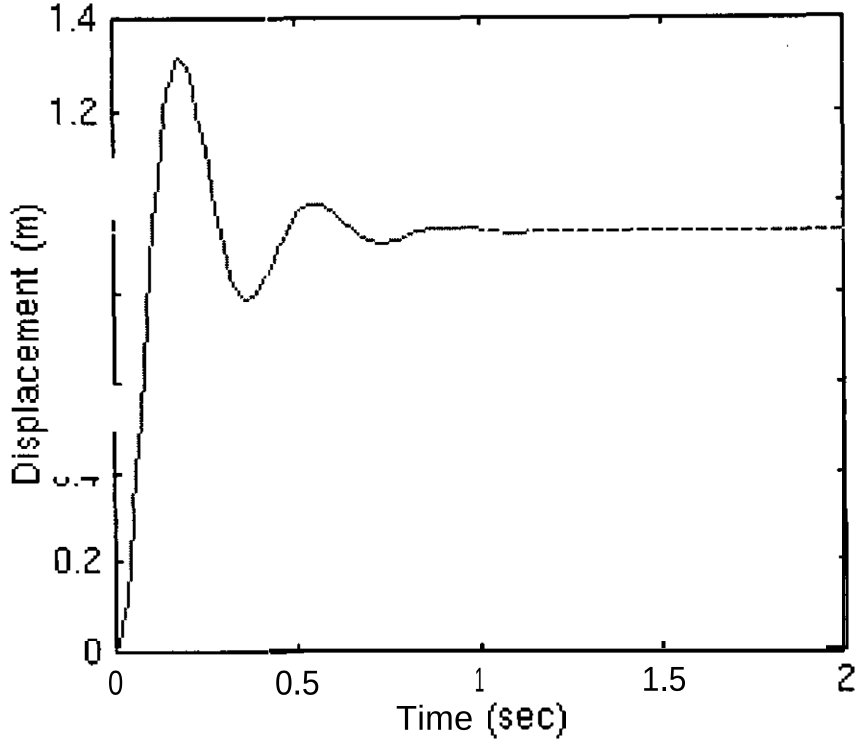
Percent of total:100%,

Feedback voltage: 8V

High: Ometers,

Percent of total: 0%,

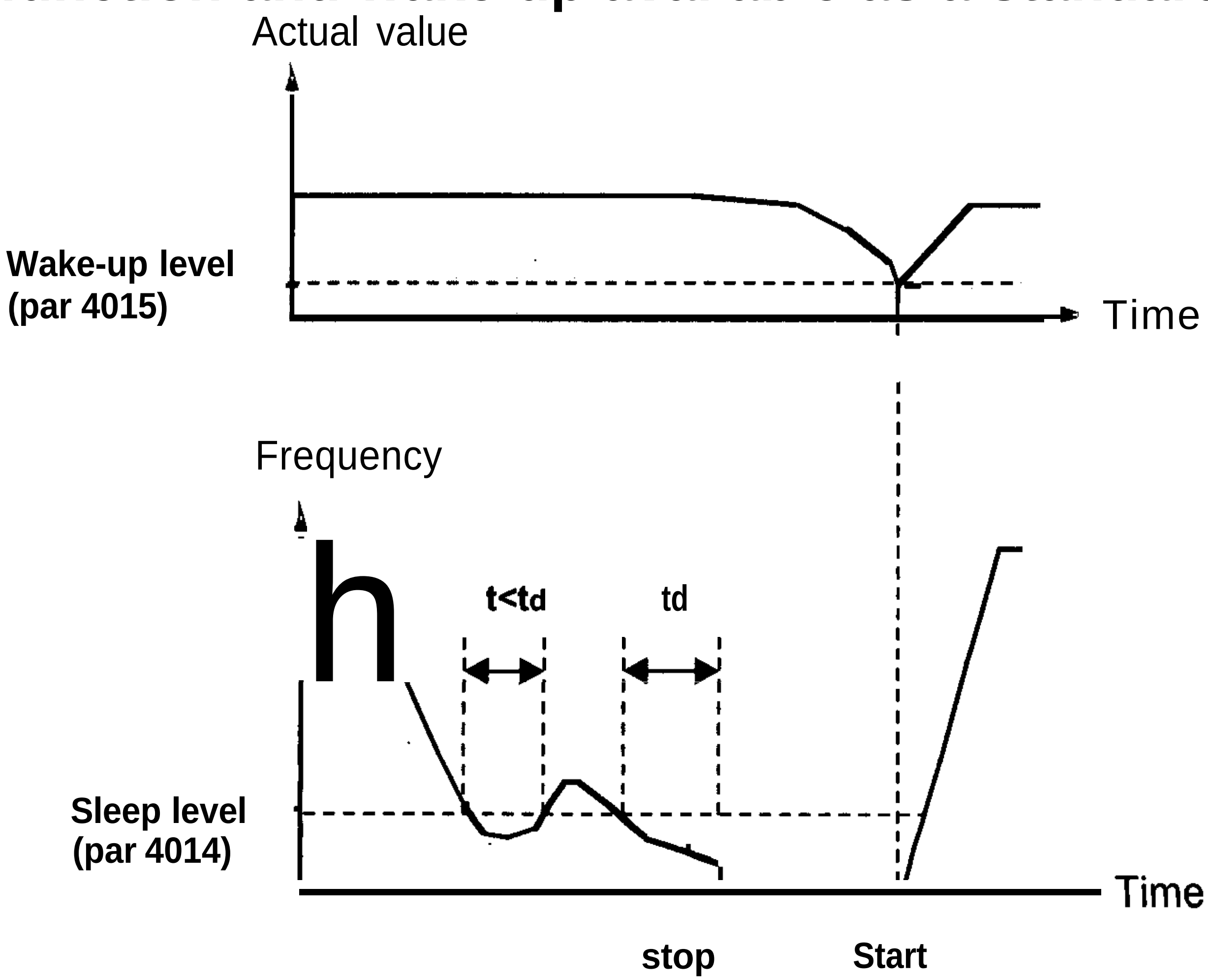
Feedback voltage: 4V



ABB

PID-regulator Sleep function

Sleep function and wake-up available as a standard (Parameter 4015)



ACS 400 Application macros

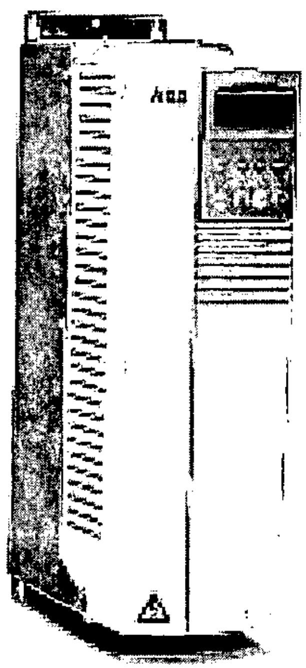
- Factory
- ABB Standard
- 3-wire
- Alternate'
- Motor potentiometer
- Hand-Auto
- PID-control
- Premagnetize

- Designed to make the adaptation to customers application as easy as possible

ABB

ACS 400 Adjustable Speed AC Drives

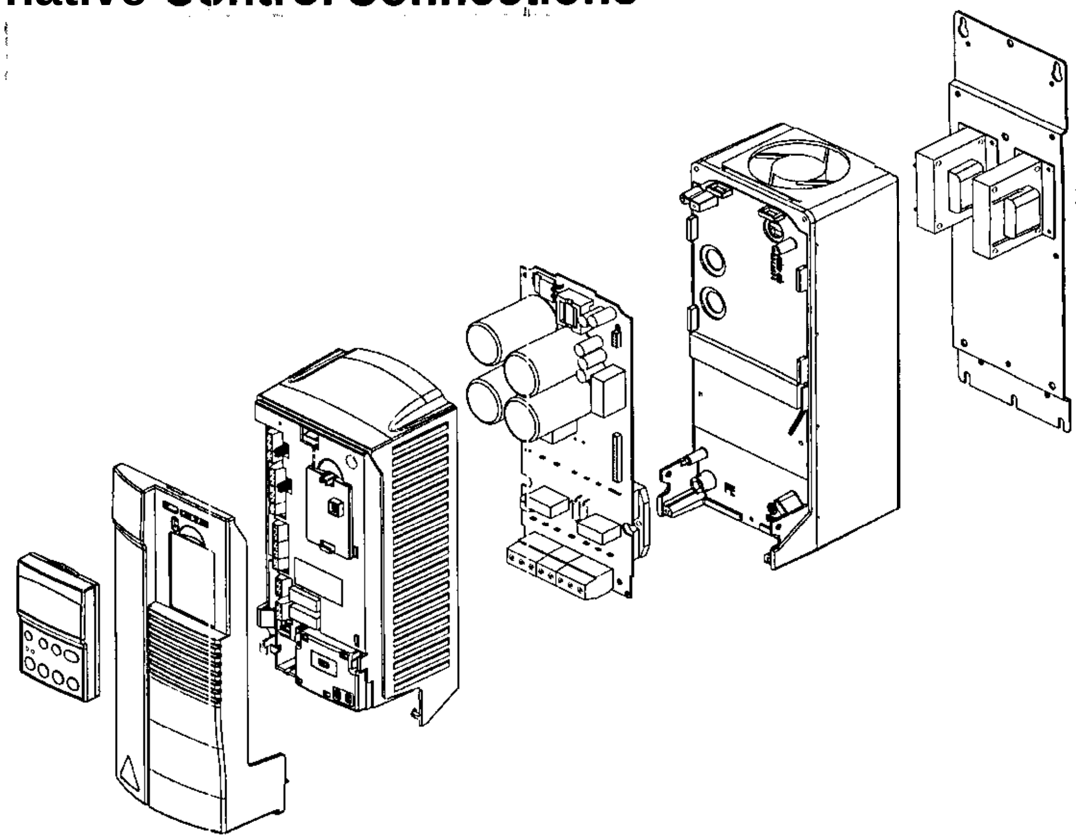
from 3 HP to 40 HP for constant torque applications and
from 3 HP to 50 HP for variable torque applications



Input voltage:	**3 phase, 200...240 V, +/- 10%** **3 phase, 380...480 V, +/- 10%**
Input frequency:	**from 48 to 63 Hz**
Output voltage:	**From 0 to V_N**
Output frequency:	**from 0 to 250 Hz**

ACS 400

- **Easily Integrated**
  - No Need for Conversion Logic (source or sinking: logic)
  - Galvanically Isolated I/O
  - Standard, &Wire and Alternative Control Connections
  - Bookshelf design
- **Standards**
  - UL, cUL, CSA, CE
  - Production'certified to IS09001 and IS014001



ACS 400 Type code

AC S 4 0 1 - 0005 - 3 - 2

AC drive

Product type
S = Standard product
X=OEM

ACS400 Product Family

input Bridge
0 = 6-pulse rectifier

Enclosure Type
1 = Wall mounted

Rated Output Power in kVA
See ACS400 rating tables

Voltage Rating
1 = 200...240Vac
3 = 380...480Vac

Enclosure Class
2 = IP21 (NEMA1)
5 = IP54 (NEMA12)

ACS 400 Environment

Ambient operating temperature:

Switching frequency 4,0 kHz

0...40 C (104°F), no derating

0...50 C (122°F), with 10% derating

Switching frequency 8,0 kHz

0...40 C, derate 20%

St&age temperature:

-20...70 C (-4 to 158°F)

Altitude: < 1000 m (3300 ft) for 1100 % loadability

Derate 1,0 % every 100 m (333 ft) above 1000 m

Max altitude 2000 m (6666 ft)

Relative humidity:

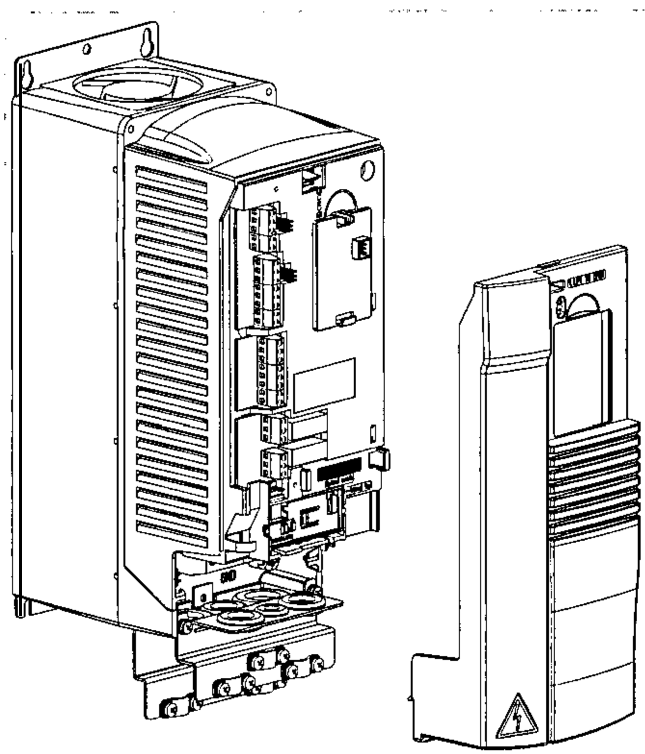
< 95%, non condensing

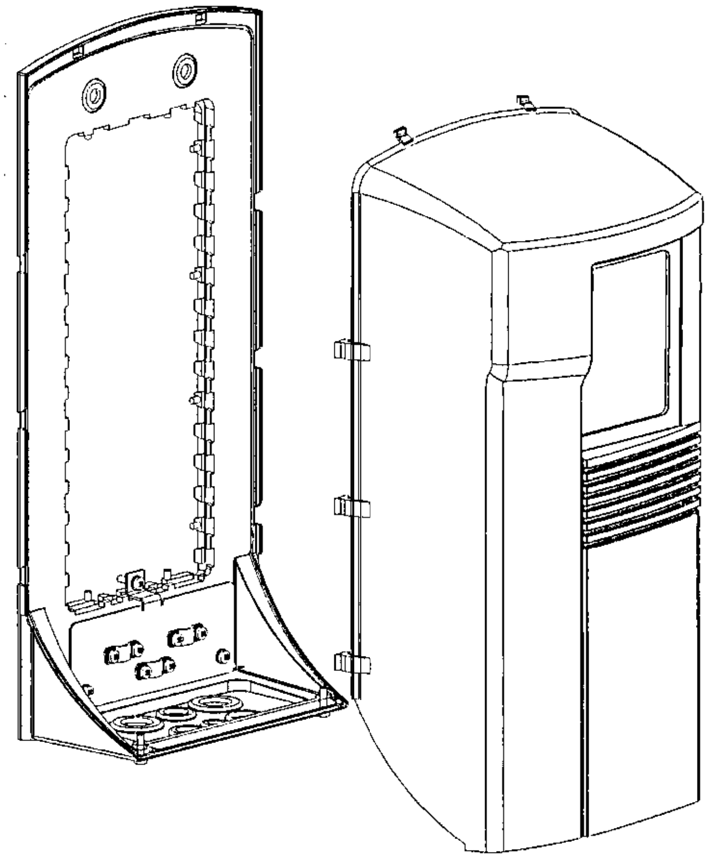
ABB

ACS 400

NEMA 1 Enclosures

NEMA 12 Enclosures





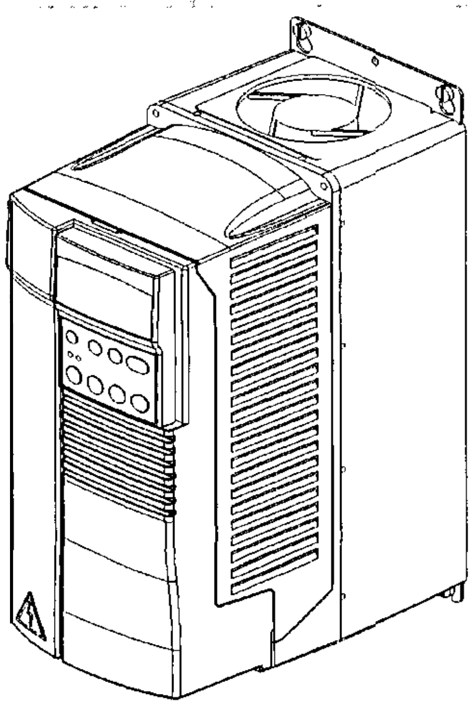
Options available:
EMI/RFI filters (IP54)
Brake units
DDCS module
Fieldbus modules

Nominal Power

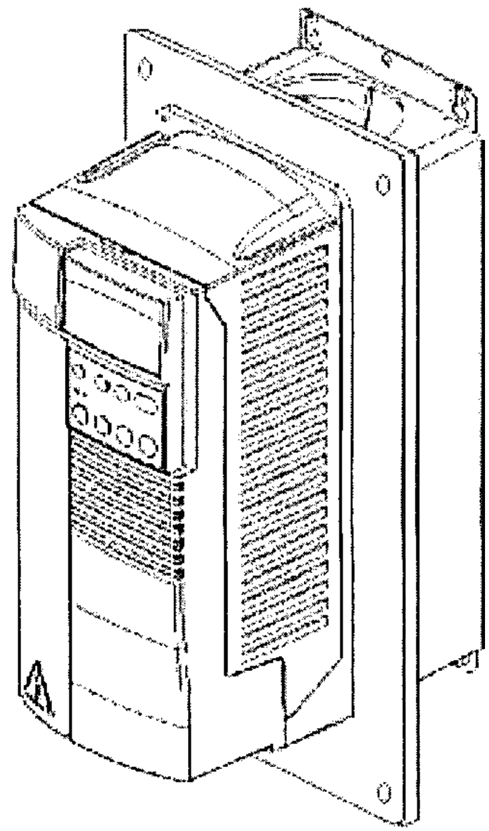
CT: 3 HP to 40 HP (480V)
VT: 3 HP to 50 HP (480V)

ACS 400 Mounting

Wall mounting



Flange mounting (option)

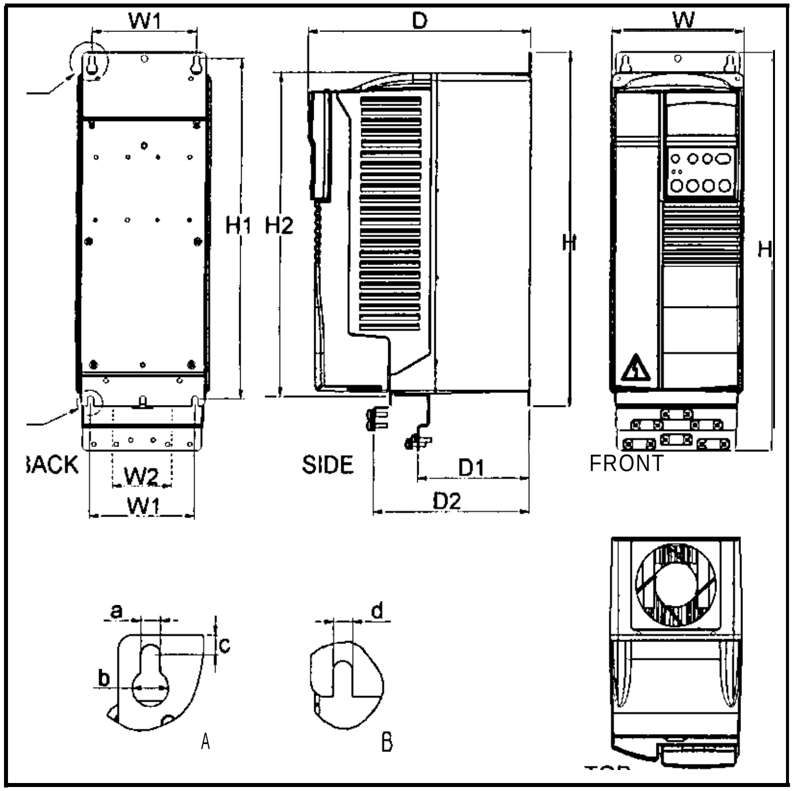


Mounting clearance

- 1.97 in on each side
- 7.87 in above and below

ACS 400 Dimensions

NEMA 1 enclosure



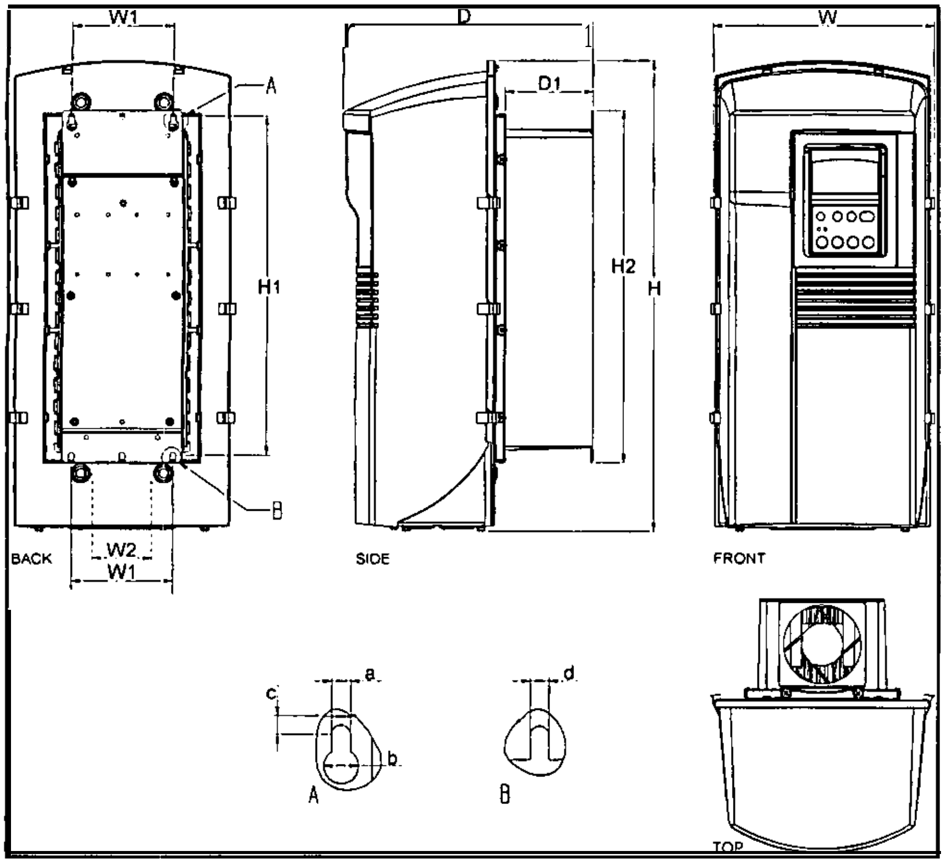
Dimension reference (mm)	Frame R1	Frame R2	Frame R3	Frame R4
Width W	4.92	4.92	7.99	7.99
Height H	12.99	16.93	21.46	25.04
Depth D	8.23	8.7	9.72	11.02
H1	12.52	16.42	20.79	24.37
H2	11.81	15.75	19.69	23.62
W1	3.86	3.86	6.3	6.3
a (=d)	0.217	0.217	0.256	0.256
b	0.394	0.394	0.512	0.512
c	0.217	0.217	0.512	0.256
Weight (lbs)	12.76	19.8	40.7	59.4

High Power/Volume ratio

-> EFFICIENCY

ACS 400 Dimensions

NEMA 12 enclosure



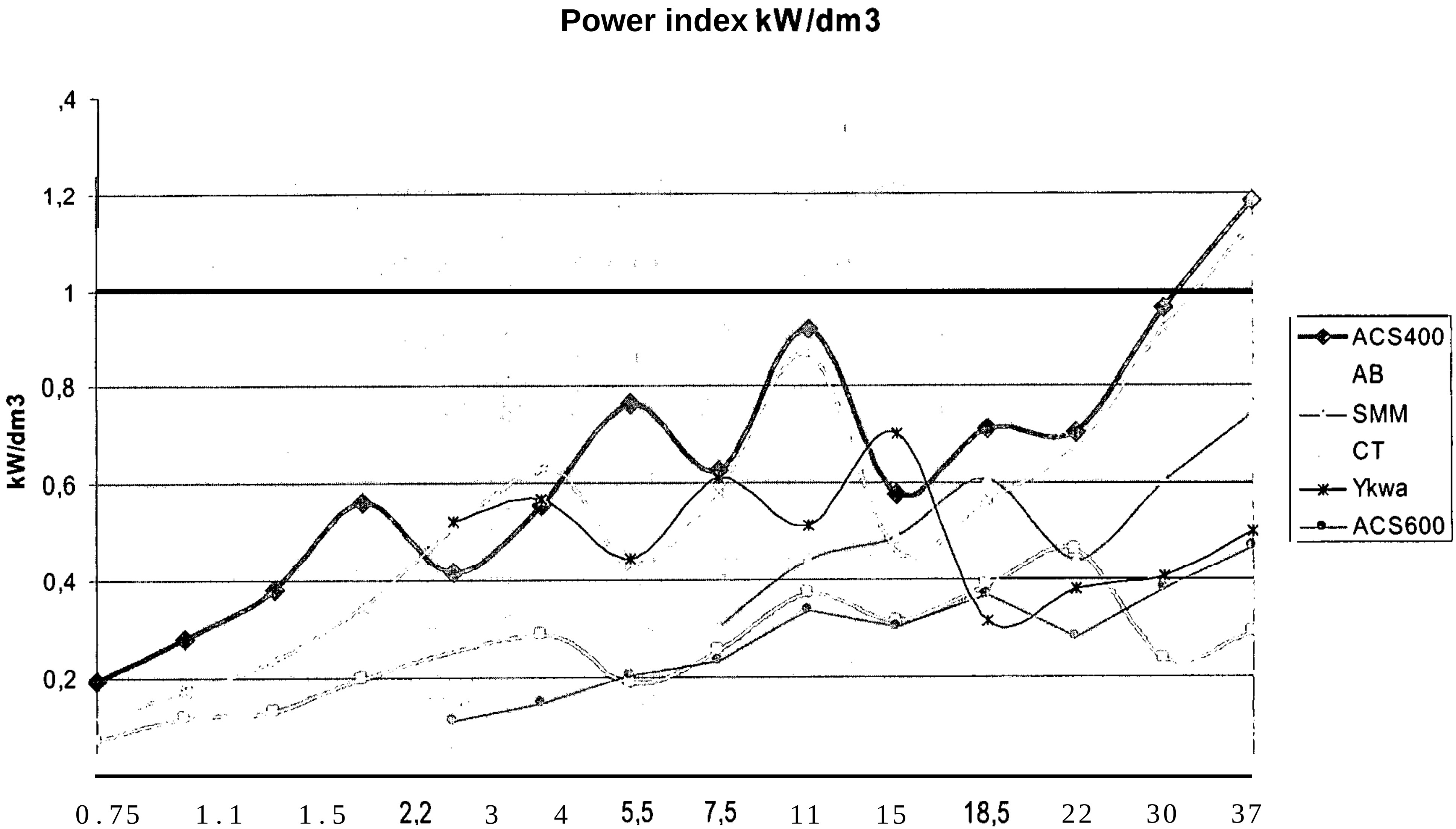
Width W	8.46	8.46	10.12	10.12
Height H	17.72	21.65	25.58	29.21
Depth D	9.49	9.96	10.98	12.28
H1	12.52	16.42	20.79	24.37
H2	12.99	16.93	21.46	24.04
a (=d)	0.217	0.217	0.256	0.256
b	0.394	0.394	0.512	0.512
c	0.217	0.217	0.256	0.256
weight lbs	12.76	19.8	40.7	61.6

NEMA12 requires

- Extra internal fan
- Factory installed (no kits)

IP54 allows 100% loadability!

Power/Volume Ratio



ACS 400 Current ratings

Standard ratings, ambient temperature 40 °C Constant Torque applications

Rated motor power P_n (HP)	Rated output Rated current I_2 (A)	Current I, Maximum (1 minute) I_{max} (A)
2	4.9	7.4
3	6.6	9.9
5	8.8	13.2
7.5	11.6	17.4
10	15.3	23
15	23	34.5
20	30	415
25	38	57
30	44	66
40	59	68.5

ACS 400 Current ratings

Standard ratings, ambient temperature 40 °C Variable Torque Applications

Rated motor power P_n (HP)	Rated output Rated current I_2 (A)	Current I, Maximum (1 minute) I_{max} (A)
3	6.6	7.3
5	8.8	9.7
7.5	11.6	12.8
10	15.3	16.8
15	23	25.3
20	30	33
25	38	41.8
30	44	48.4
40	59	64.9
50	72	79.3

ACS 400 Types

Standard ratings, ambient temperature 40 °C Constant Torque applications

Rated motor power P_n (HP)	Type designation	Rated input 3 phase	Fuse (A)	CU terminal size (mm2)
2	ACS 401-0004-3-X	, 5.8	10	2.5
3	ACS 401-0005-3-X	6 . 2	10	2.5
5	ACS 401-0006-3-X	8.3	10	2.5
7.5	ACS 401-0009-3-X	11.1	16	6
10	ACS 401-0011-3-X	14.8	16	6
15	ACS 401-0016-3-X	21.5	25	10
20	ACS 401-0020-3-X	28.8	35	10
25	ACS 401-0025-3-X	35	50	16
30	ACS 401-0030-3-X	41.2	50	16
40	ACS 401-0041-3-X	55.7	63	25

ACS 400 Types

Standard ratings, ambient temperature 40 °C Variable Torque Applications

Rated motor power P_n (HP)	Type designation	Rated input current	Fuse (A)	CU terminal size (mm2)
3	ACS 401-0004-3-X	6.2	10	2.5
5	ACS 401-0005-3-X	8.3	10	2.5
7.5	ACS 401-0006-3-X	11.1	16	6
10	ACS 401-0009-3-X	14.8	16	6
15	ACS 401-0011-3-X	21.5	25	10
20	ACS 401-0016-3-X	28.8	35	10
25	ACS 401-0020-3-X	35	50	16
30	ACS 401-0025-3-X	41.2	50	16
40	ACS 401-0030-3-X	55.7	63	25
50	ACS 401-0041-3-X	68.1	80	25

ACS 400 Protective functions

Inverter protection

Protective function	Trip limit
Overcurrent	3,5 * I_N instantaneously
Over voltage	1,35 * **rated voltage,** 1,3 * U480
Undervoltage	0,65 * selected rated voltage
Over temperature	95 °C heatsink
Output short circuit	
Output ground fault	
Input phase loss	
Serial communication error	
Loss of analog input signal	

Motorprotection

Protective function	Programmable
Motor stall	Parameter protected (current, frequency **and time)**
Current regulation	0,5...1,5*I_N adjustable
Motor overload	I2T model (UL approved), parameter
Over current	Parameter

Application protection

Protective function	Programmable
Serial communication error	
I/O terminal short circuit	
Under load	Parameter

Relay outputs can be programmed to indicate fault conditions

ACS 400 Supervisions

Code	*Description*
AL1	Panel upload/download failed
AL2	Panel operation canceled because drive is running
AL3	Panel operation canceled because drive is in Remote mode
AL5	Panel is not the source of start/stop/dir/ref commands
AL6	Operation disabled due to: parameter lock, panel lock, use of factory macro, parameter value is inconsistent
AL7	Operation disabled due to use of factory macro
AL10	Overcurrent alarm. Overcurrent controller controls output frequency
AL11	Overvoltage alarm. Overvoltage controller controls output frequency
AL12	Undervoltage alarm. Undervoltage controller controls output frequency
AL13	Direction lock ON. Direcrion request differs from locked direction
AL14	MODBUS loss alarm. Drive continues operation
AL15	MODBUS exception message was generated
AL16	Analog input 1 loss alarm. Drive continues operation
AL17	Analog input 2 loss alarm. Drive continues operation
AL18	Panel loss alarm. Drive continues operation
AL19	Overtemperature alarm. Drive is about to trip due to overtemperature
AL20	Motor overtemperature alarm (setting 2 = WARNING). Drive is about to trip due to motor overtemperature (setting 1= FAULT)
AL21	Motor underload alarm (setting 2 = WARNING). Drive is about to trip due to underload (setting 1 = FAULT)
AL22	Stall alarm. Drive continues operation, but stall indication is ON
AL23	DDCS link loss alarm. Drive continues operation
AL24	Application dependent alarm. Drive continues operation
AL25	OFF button pressed in HVAC panel

ACS 400 Faults

FL1	Overcurrent. Overcurrent trip detected
FL2	Overvoltage (1) Overvoltage trip detected (2) Start command detected when the DC voltage is above overvoltage controller limit
FL3	Inverter overtemperature. Inverter temperature too high. Trip level depends on the type
FL4	Fault current. Fault current trip detected
FL5	Overload. Integral of current squared is too high
FL6	Undervoltage (1) DC voltage drops below threshold when start is ON (2) Start command detected when the DC voltage is below undervoltage controller limit
FL7	Analog input 1 loss. Analog input 1 drops below limit
FL8	Analog input2 loss. Analog input2 drops below limit
FL9	Motor overtemperature. Motor model integral is too high
FL10	Panel loss. Panel loss detection ON when panel controls start/stop/dir or reference
FL11	Parameter error. Inconsistent parameter values
FL12	Stall. Stall protection trips
FL13	MODBUS loss. MODBUS loss detection ON when controlled over MODBUS
FL14	External fault. Digital input configured to external fault input is low
FL1 5	Ground fault. Ground fault trip detected
FL16	UC ripple. DC capasitor voltage ripple too high (bad capasitors)
FL17	Underload. Underload detection trips
FL16	Application dependent fault. Fault detection ON when application controlled
FL19	Comm loss, DDCS protocol. Loss detection ON when controlled over DDCS link or link in communication module, in DDCS link
FL20-26	*Hardware error, contact factory*

Fault codes 20-26 (contact factory)

nr	perm	source	params	fault word bits		legend
params 0128 .. 0130	yes/no	HW/SW	yes/no	param 0305	param 0306	
20	yes	SW	no		bit 11	Sad analog input. Invalid pulse count when transforming reference or ground
21	yes	SW	no			Bad or new FPROM
					bit 8	(1) Sad FPROM detected (FPROM didn't store data written)
					bit 9	(2) New FPROM detected during boot
22	yes	SW	no		bit 12	Type code error. Type code input out of valid slots
23	yes	SW	no		bit 13	Sporadic fault interrupt. Collected fault interrupt detected, but no accompanying fault interrupt (overcurrent, overvoltage, fault current, earth fault)
24	yes	SW	no		bit 14	Assert. SW assert expires. SW assumes certain internal state
25	yes	SW	no		bit 15	Modulator. Modulator stalled
26	yes	SW	no		bit 10	Unsuccessful Flash prom download

400V Unit Overview

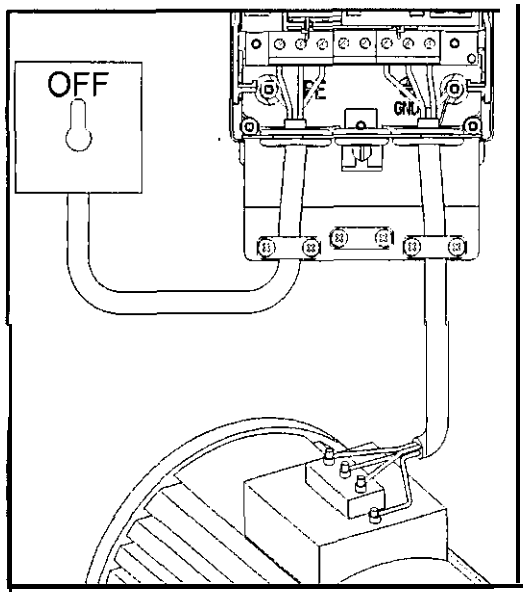
Protected																
NEMA 1																
NEMA 12																
Frame Size		**R0** ACS140				**R1** ACS400				**R2**		**R3**			**R4**	
CT: HP	1	1.5	2	3	2	3	5	7.5	10	15	20	25	30	40		
VT: HP					3	5	7.5	10	15	20	25	30	40	50		

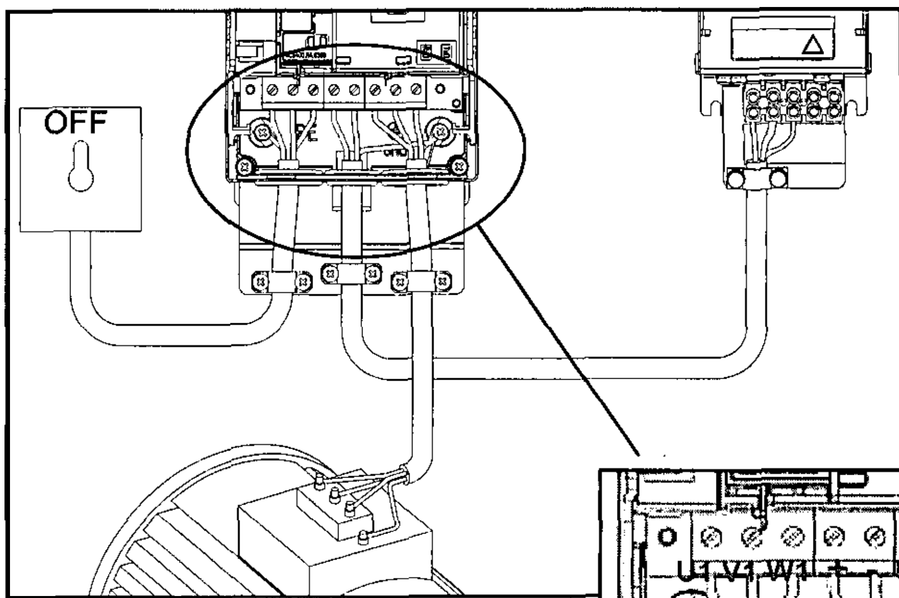
CT: Constant torque applications

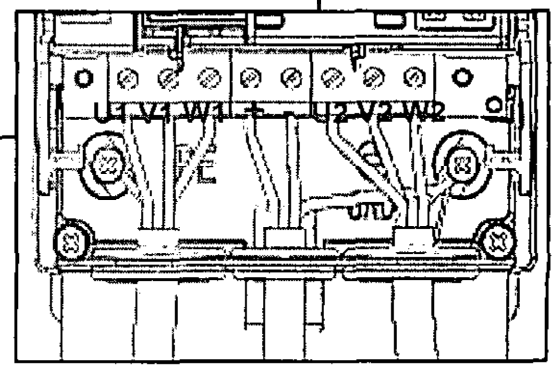
VT: Variable torque applications

ABB

ACS 400 Power connections (2nd environment.)



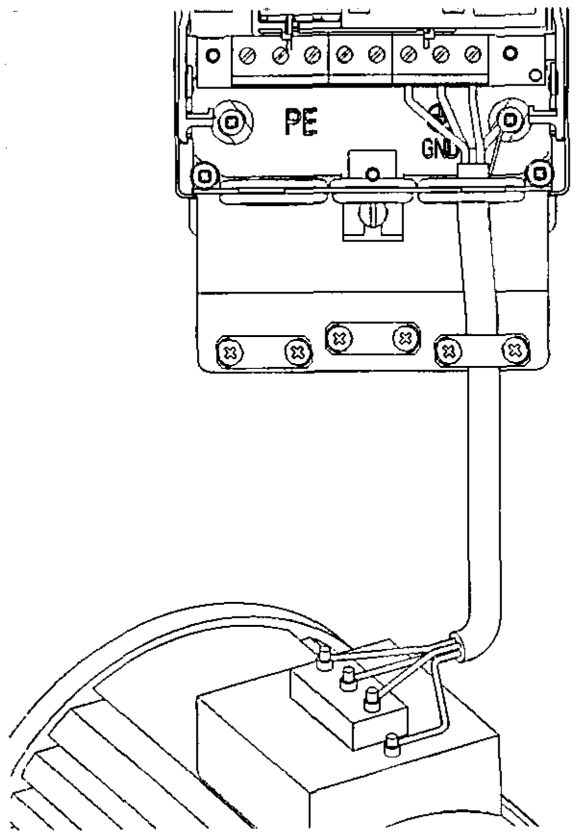




Without brake unit | **With brake unit**

- **Connect the input power to terminals U1, VI and WI**
- **Connect motor cable to terminals U2, V2 and W2**
- **If applying a brake unit connect it to terminals Uc+ and Uc-**
- **An input contactor should be applied for power connections when a brake unit is applied**

Motor Cables lengths for CE requirements

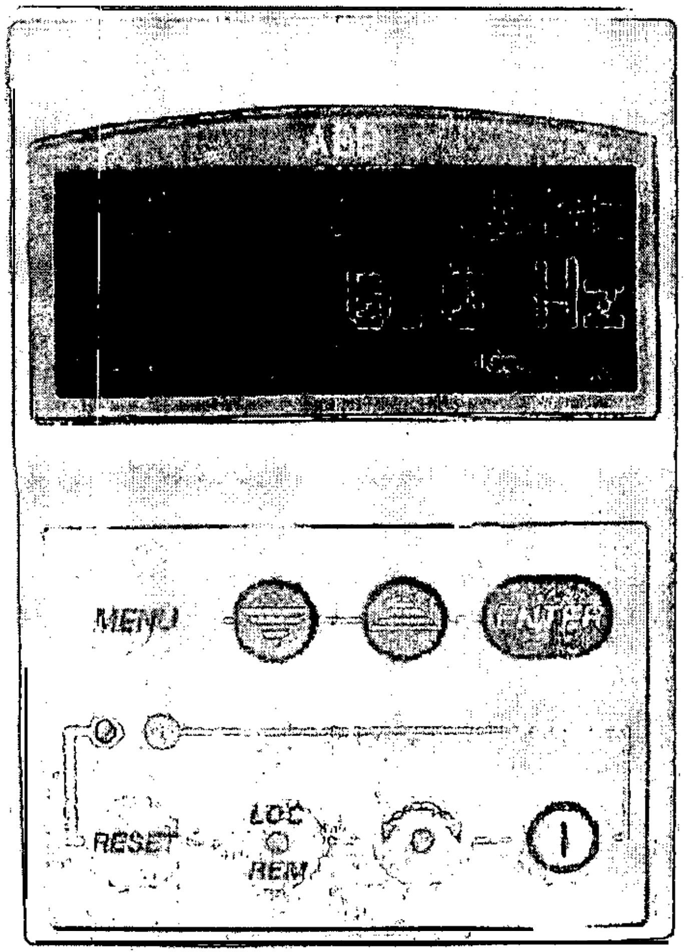


- Different maximum cable lengths for different frame sizes
  - 100 meters (333 ft) for R1
  - 200 meters (666 ft) for R2
  - 300 meters (999 ft) for R3
  - 300 meters (999 ft) for R4
- With an output choke the maximum cable length is roughly double the length shown above

ACS 400 Options

- Control Panels : ACS100-PAN
  ACS-PAN-A
- EMC/RFI Filters (Input)
- Brake units
- DDCS module
- Fieldbus adapters (from ACS600 family):
  - Profibus(NPBA-02),
  - Modbus (NMBA-OI),
  - Modbus + (NMBP-OI),
  - CS31 (NCSA-OI),
  - Interbus (NIBA-01),
  - DeviceNet (NDNA-01)

aCS Panel



ACS-PAN-A, control panel

- alphanumeric panel
  - 20 + 10 character LCD display
  - multiple languages (ENG(UK&US), SWE, FIN, DE, FRA, ES, PR, IT, NL, DK, RUS)
- Parameter upload & download

ACS 400 Output display

Absolute output current

output current relative to I max

Frequency setpoint

output frequency

Drive running Direction

output display indicator

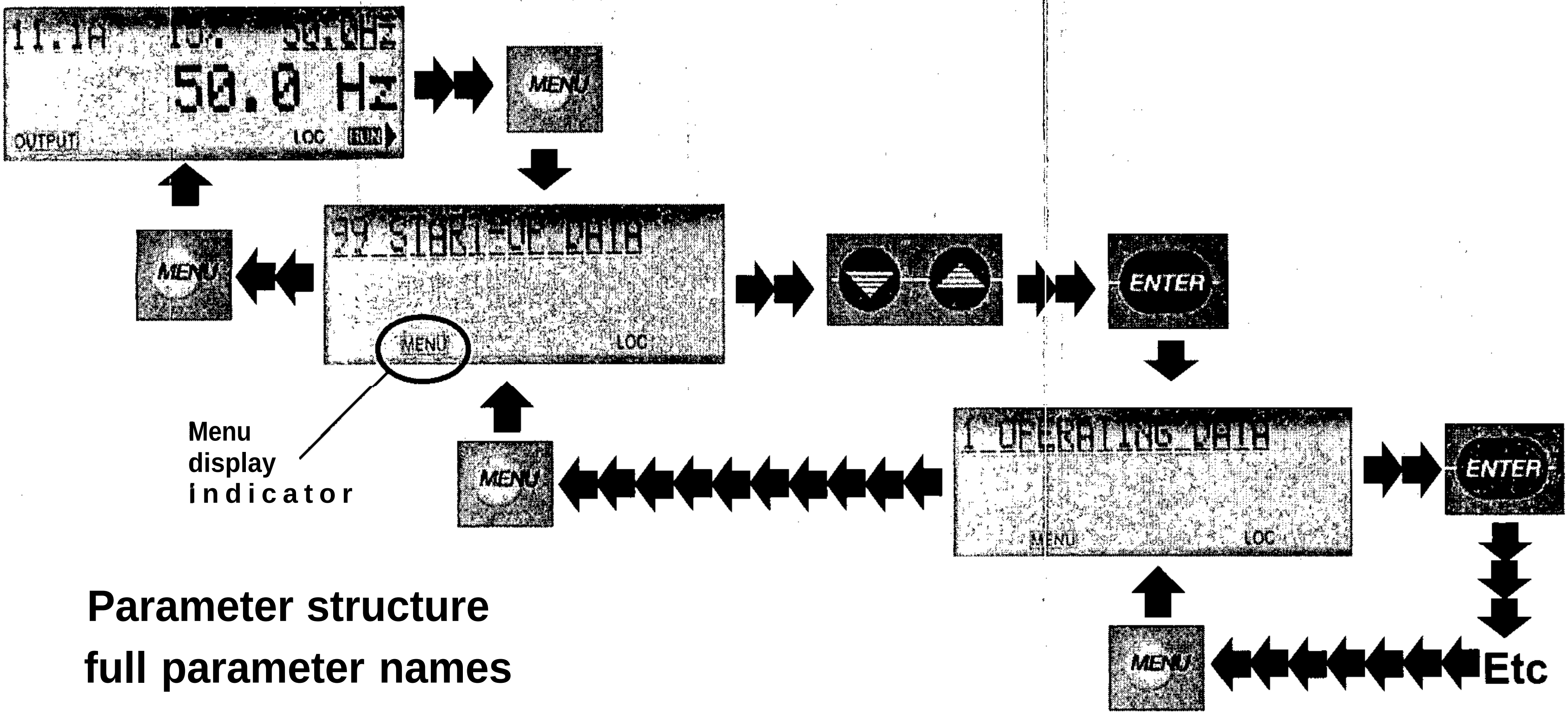
Local / remote control

Frequency **setpoint** can be increased or decreased by pressing

Alterations are confirmed by pressing

New menu level is selected by pressing

ACS 400 Parameter Navigation



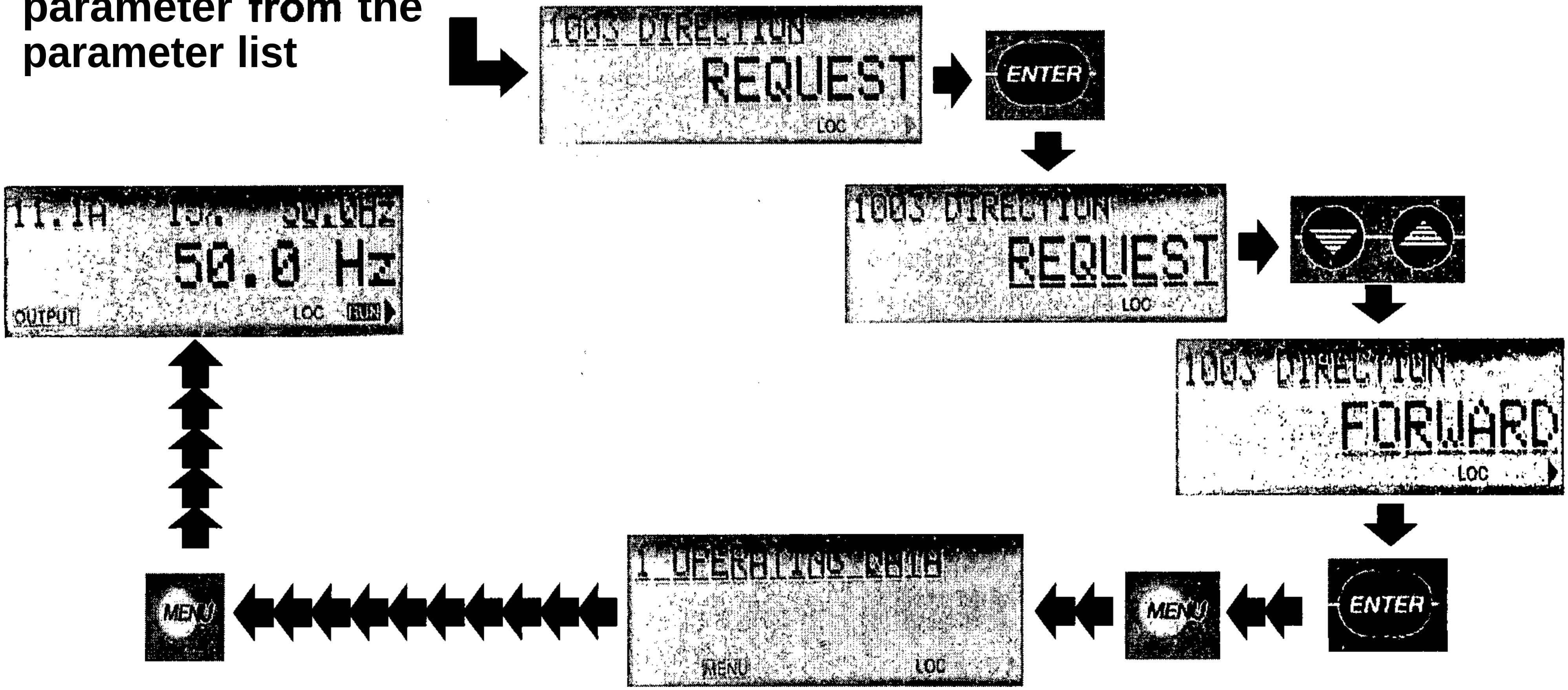
Parameter structure

full parameter names

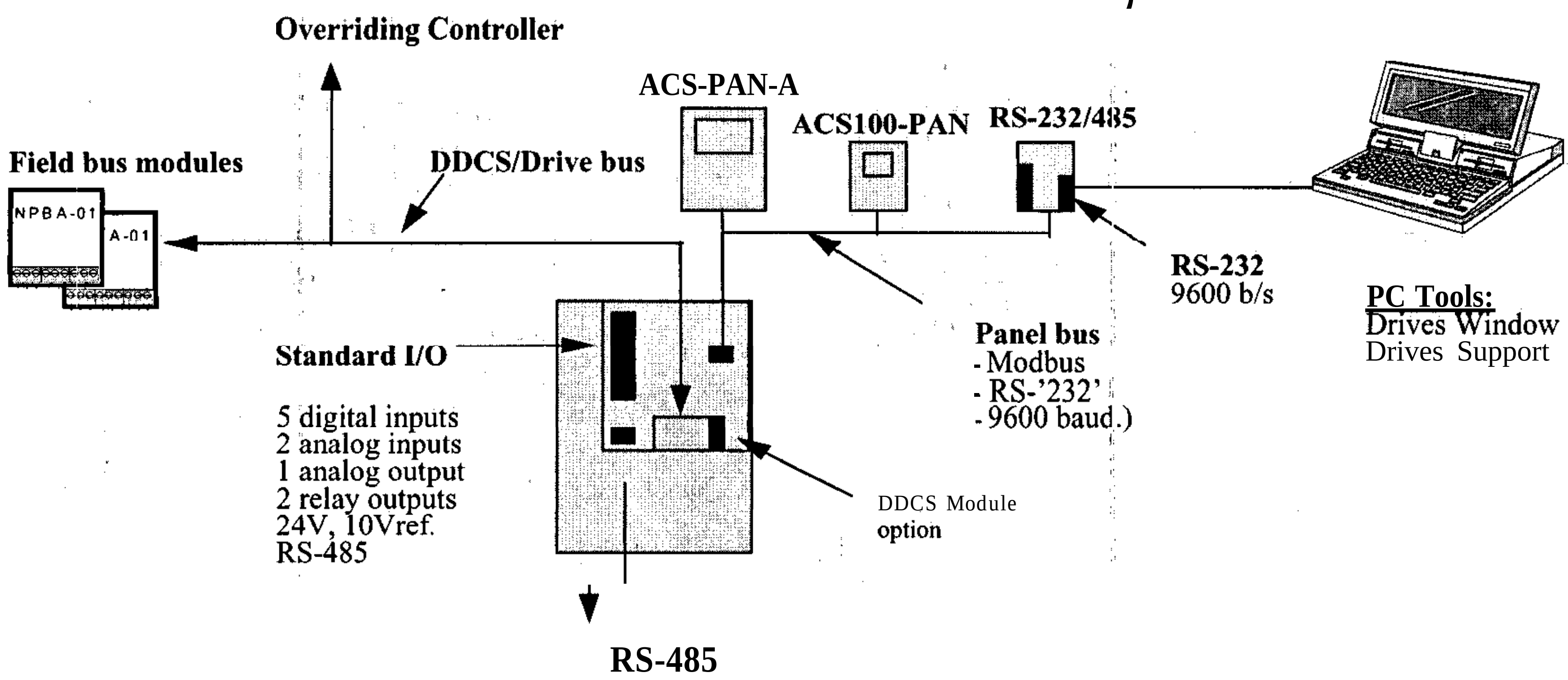
ABB

ACS 400 Parameter setting

After finding the required parameter from the parameter list



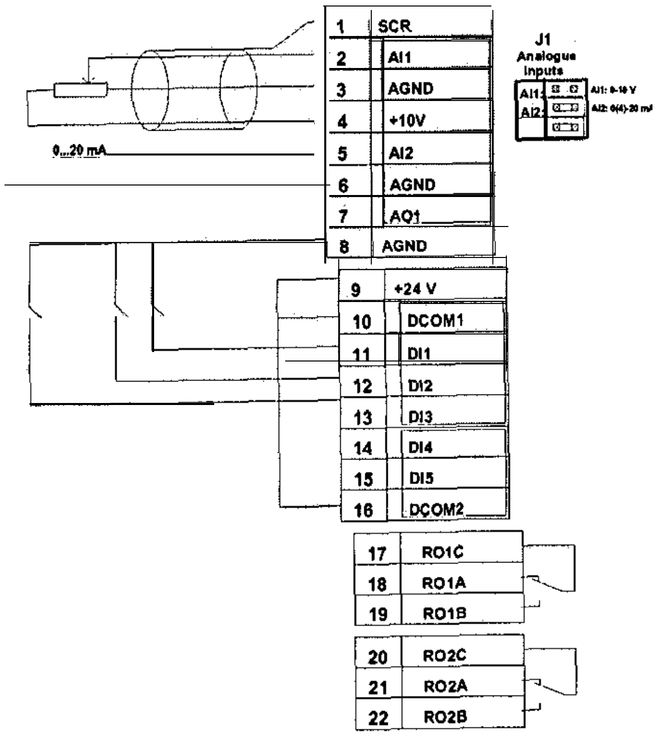
ACS 400 Drive control methods



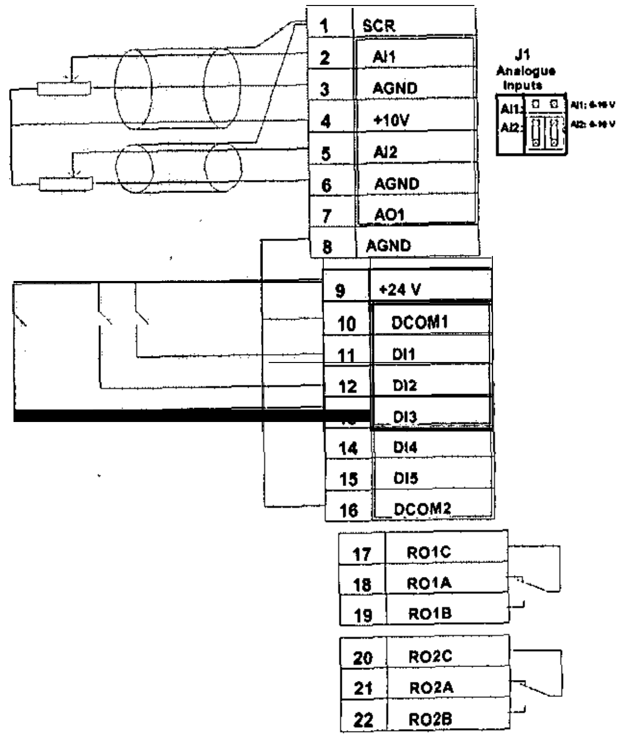
ACS 400 Control methods

- No Need For Conversion Logic

SINK Logic (NPN)



SOURCE logic (PNP)

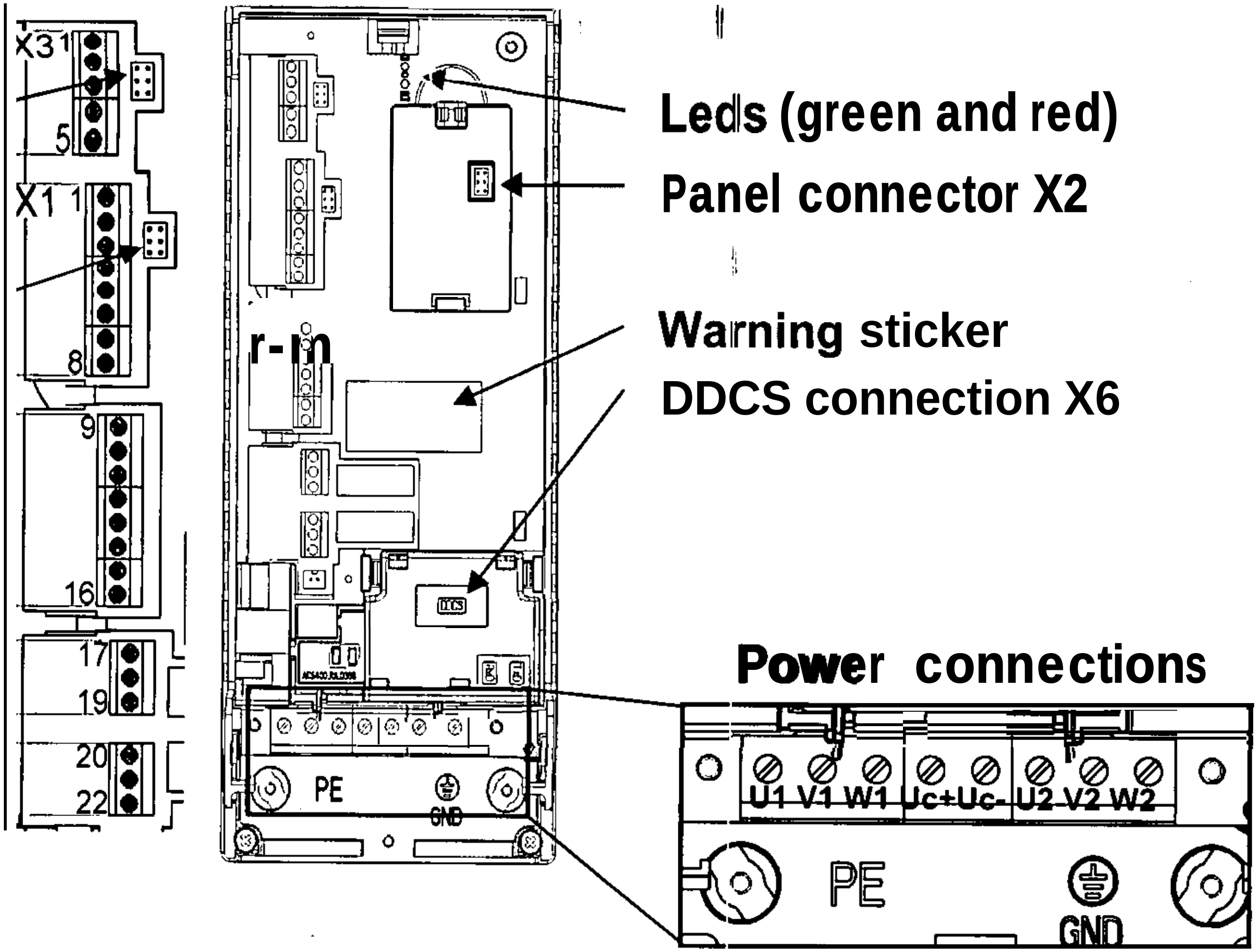


The ACS 400 Can Handle Both Without Any Additional Logic

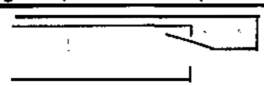
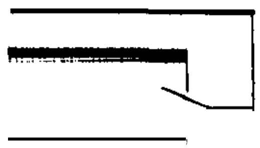
ACS 400 Terminal Interface

- RS485 connector X3
- V/I jumper S2

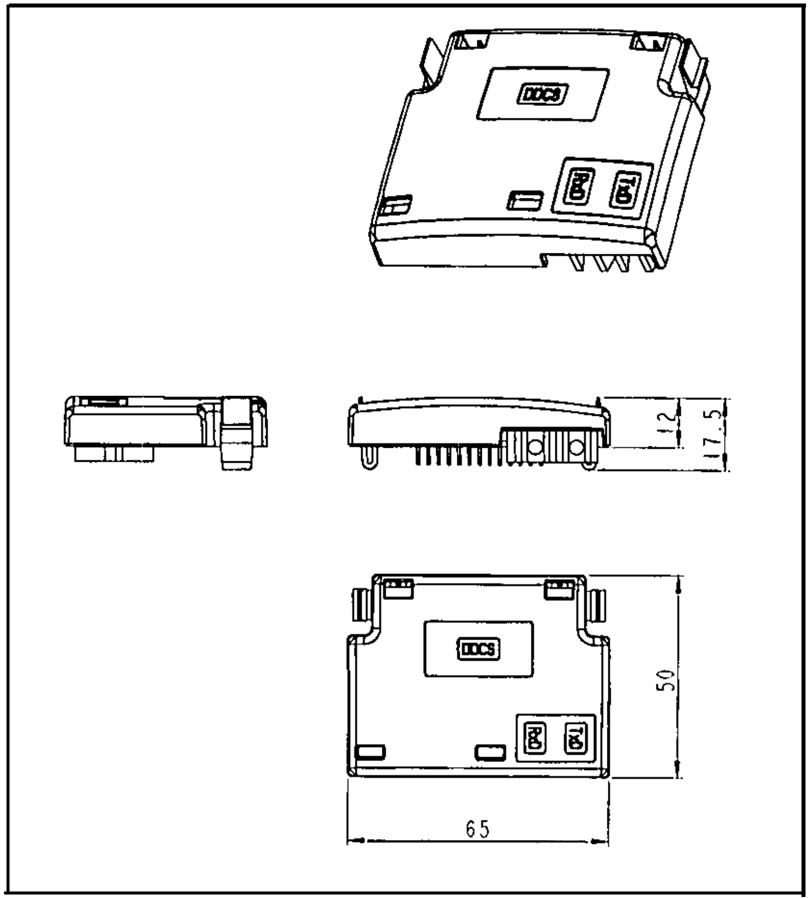
- I/O connection X1
- V/I jumper S1



ACS 400 I/O Configuration

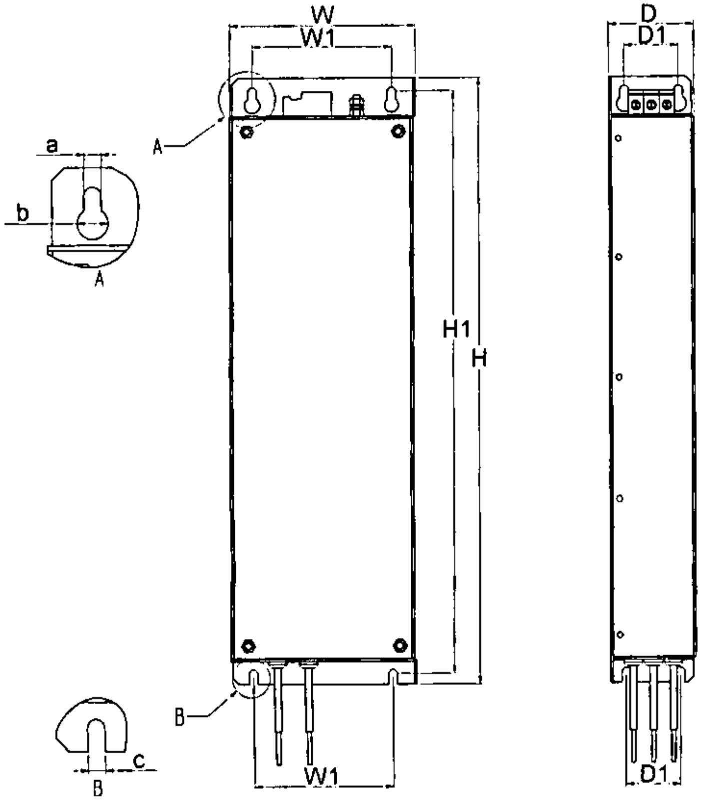
X1	Identification	Description	
1	SCR	Terminal for signal cable shield (connected internally to chassis	
2	AI1	Analog input channel 1, programmable Default: 0-10 V (Ri=200kohm)(s1:1:U) <==> 0 - from output frequency, 0-20 mA (Ri =500 ohm) (s1:1:I) <==> 0 - from output frequency resolution 0.1 %, accuracy +1 %	
3	AGND	Analog input circuit common. (Connected internally to chassis ground through 1 Mohm)	
4	10V	10V/10 mA reference voltage output for analog input potentiometer, accuracy +2 %	
5	AI2	Analog input channel 2, programmable Default:0-20 mA (Ri =500 ohm) (s1:2:U) <==> 0 - from output frequency 0-10 V (Ri=200kohm)(s1:2:U) <==> 0 - from output	
6	AGND	Analog input circuit common. (Connected internally to chassis groung through 1 Mohm)	
7	AO	Analog output, programmable. Default:0-20 mA / output frequency (load <500 ohm)	
8	AGND (Ground)	Common for DI return signals	
9	24V_OUT	24 V/250 mA auxiliary voltage output (reference to AGND). Short circuit protected	
10	DCOM1	DCOM1 digital input common 1 (for DI1, DI2 and DI3)To activate digital input, there must be +12 V (or -12 V) between that input and DCOM1. *24 V supply may be provided by the ACS400* (X1:9) or from external 12-24 V source.	
Digital input configuration		**Factory (0)**	**Factory (1)**
11	DI1	Start/StopActivate to start. Motor will ramp up to frequency reference. Deactivate to stop. Motor will coast to stop.	Start if DI2 is activated, momentary activation of DI1 starts the ACH400.
12	DI2	ReverseActivate to reverse rotation direction.	Stop Momentary deactivation always stops the ACH400.
13	DI3	*JogActivate to set output frequency to constant 5Hz.*	*ReverseActivate to reverse rotation* direction.
14	DI4	Has to be deactivated.	Has to be activated.
15	DI5	Acceleration/deceleration selection	Acceleration/deceleration selection
16	DCOM2	DCOM2 digital input common 2 (for DI4, DI5)	
2E+05	RO1		Relay output 1 programmable (default: fault => 17 connected to 18) 12-250 V AC /30 V DC, 10 mA - 2 A
2E+05	RO2		Relay output 2 programmable (default: running => 20 connected to 22) 12-250 V AC /30 V DC, 10 mA - 2 A

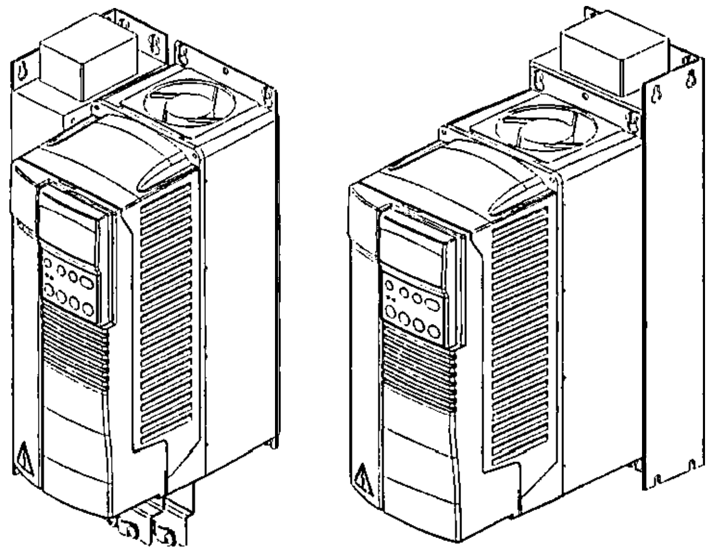
DDCS Module



Converts the messages from the internal databus into DDCS-protocol messages that are sent and transmitted using fiber optical cables. The fiber optic cables are then connected to fieldbus modules.

ACS400-IF EMC/RFI Filter



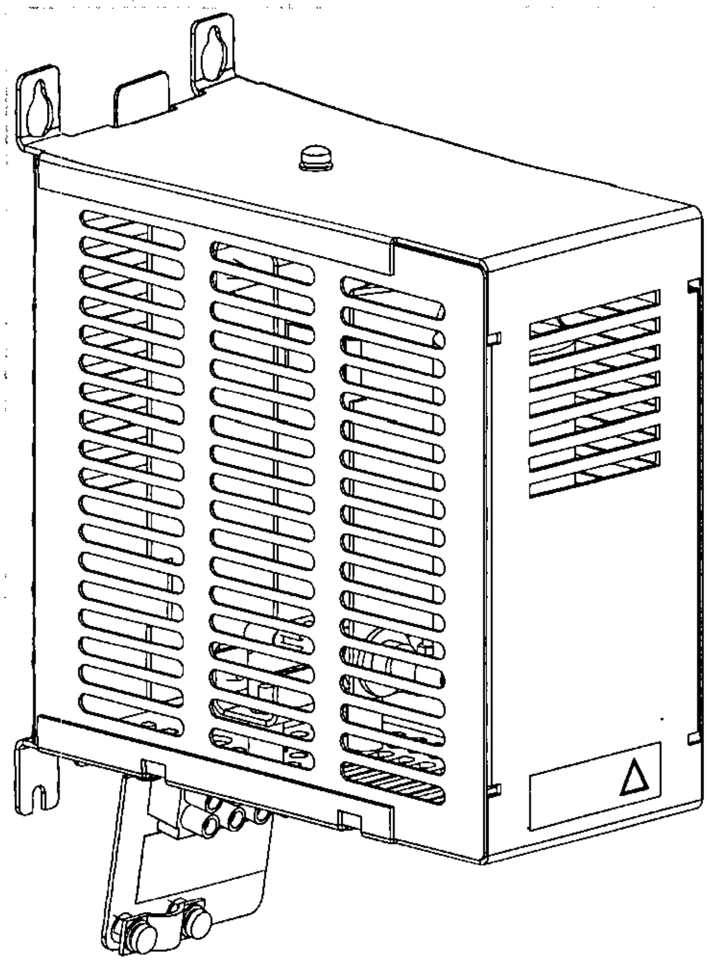


EMC according to EN 61800-3

- 2nd (industrial) environment as standard
- 1st (EN 50081-2 residential power) requiresfilter

- **NEMA 12 enclosure**

ACS-BRK Brake units



features

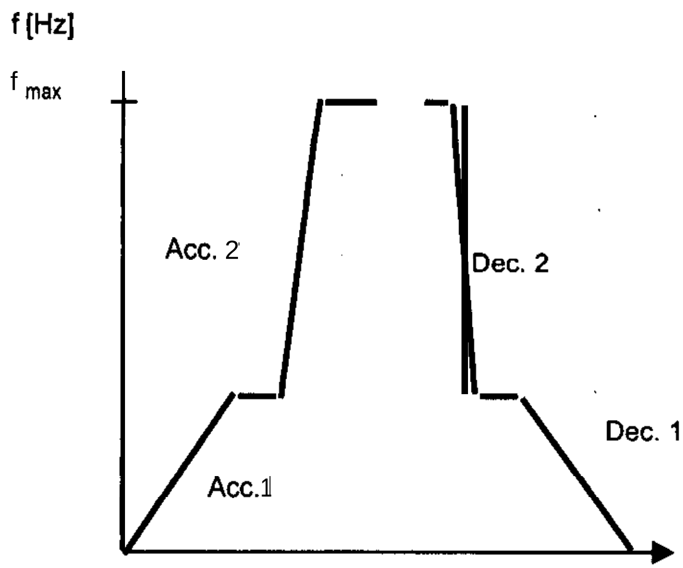
- Dynamic Braking
- Protected chasis
- Chopper and resistor integrated
- Cable length 'between brake unit and inverter: 1.5 ft
  - for longer distances additional fuses are needed (max. cable length with fuses 15 ft)
- Chopper average power up to 8 kW

ACS 400 Programmable features

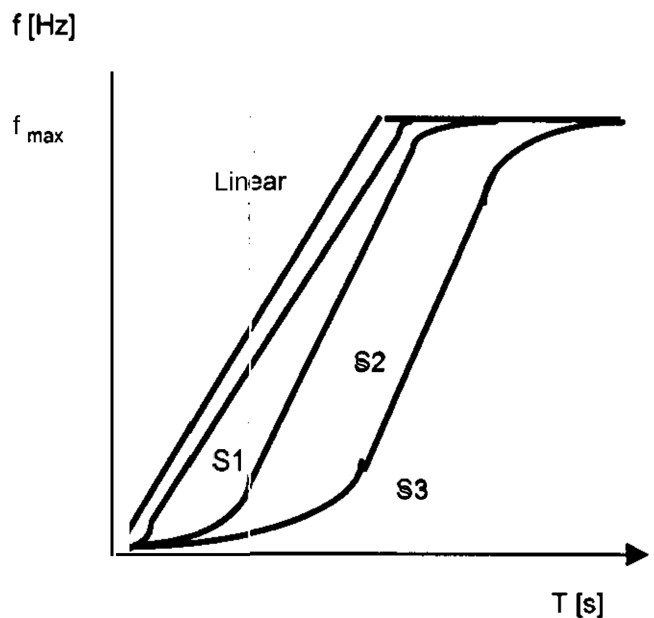
- Output current and frequency limit
- Versatile start and stop modes
- 2 programmable Acc/Dec ramps
- Programmable V/f ratio
- IR compensation
- Power loss ride through
- DC hold
- Sleep function
- 7 preset speeds
- 2 jump frequencies
- Parameter upload/download

Acceleration / Deceleration

- two different acc / dec ramp settings can be selected by digital input



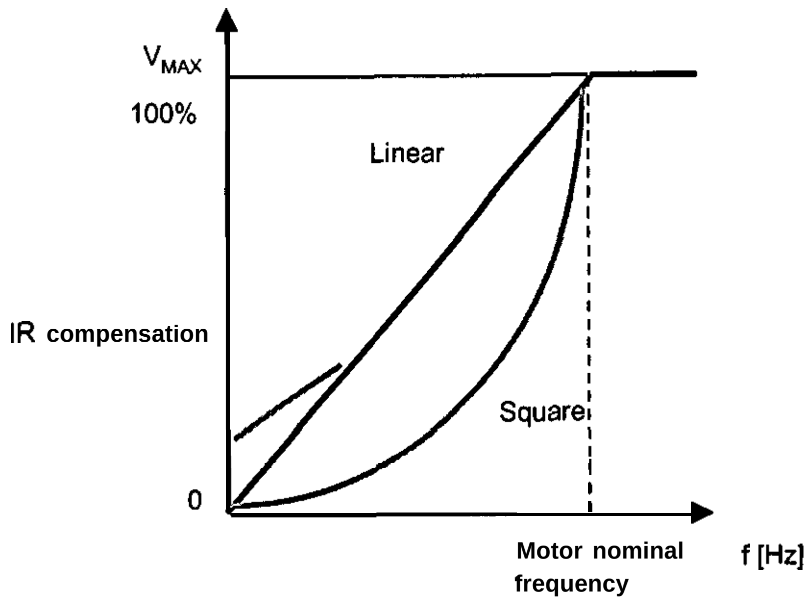
Parameter 2201 ramp pair selection
parameters 2202-2205 **Acc / Dec** parameters



Ramp times S1 < 1 s
Ramp times S2 < 1.5 s
Ramp times S3 < 15 s

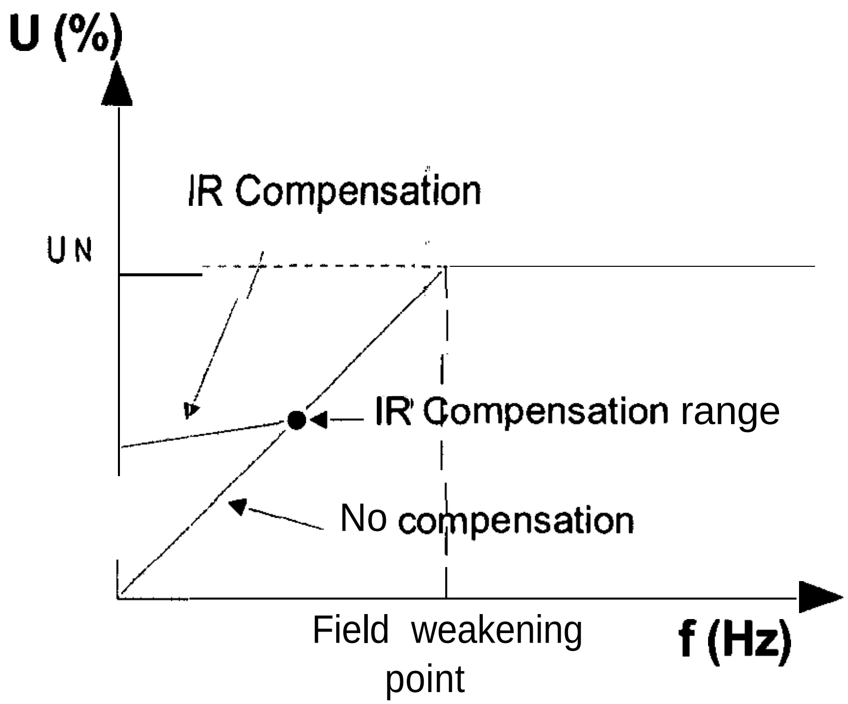
V/F Ratio

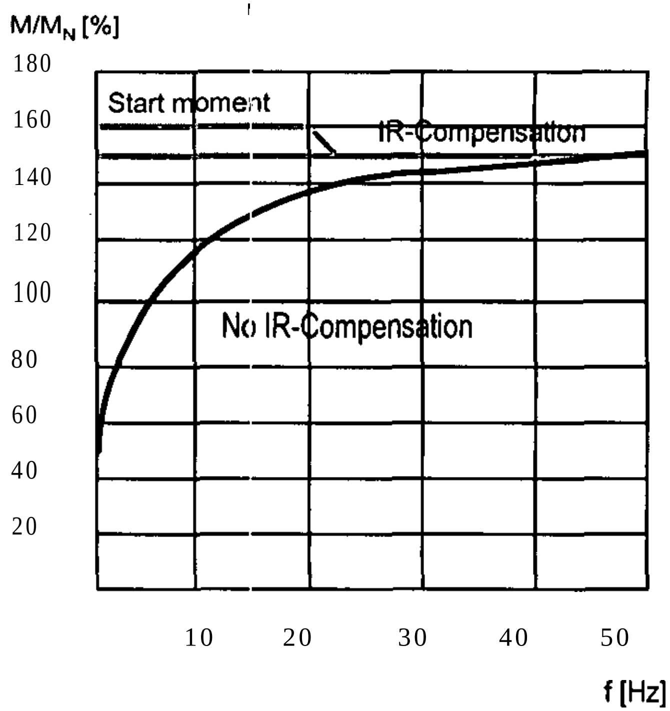
- **Selectable**
  - **Linear**
  - **Square**



Parameter 2606

IR-compensation

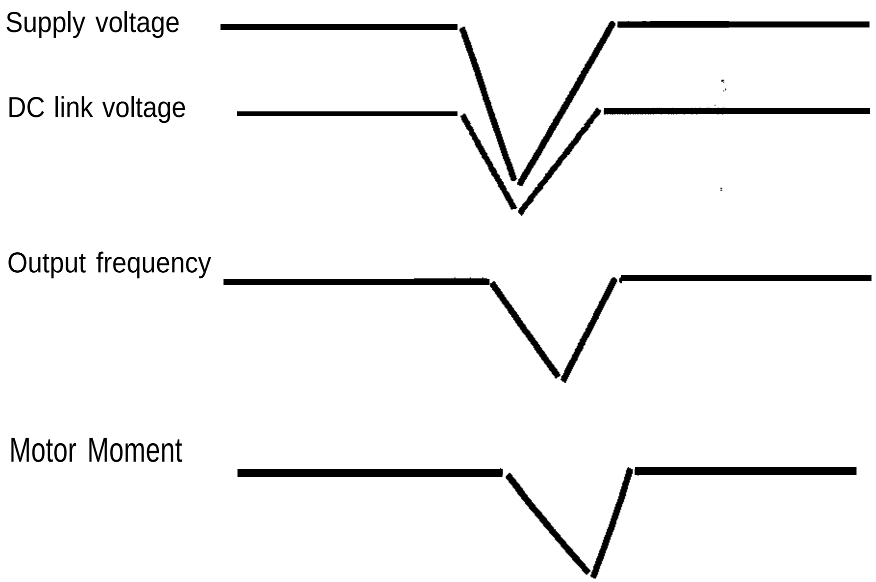




Adjustable

- **compensatiion range 0 - f_{set}**
- **compensatiion voltage**

Power loss ride through

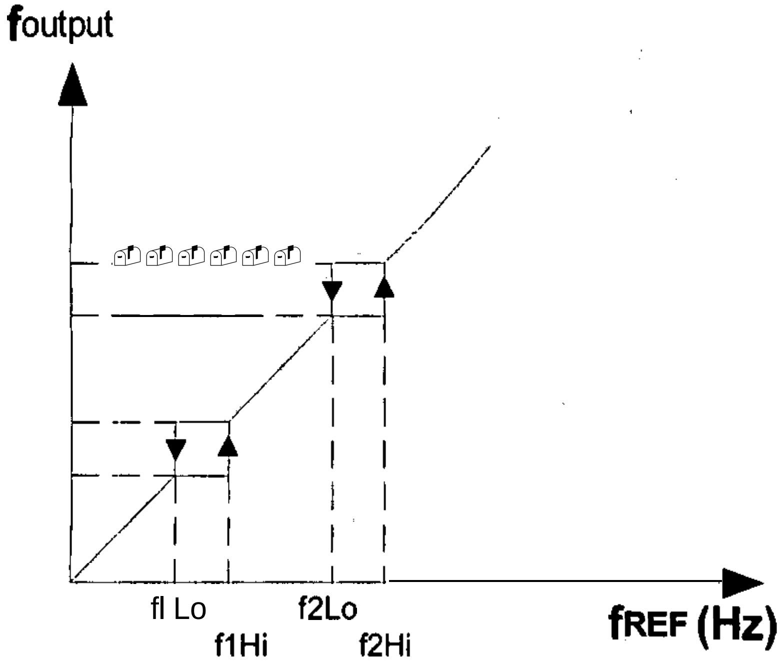


Parameter 2006
=0 disable
=1 enable 500 ms
=2 enable without time limit
(Deprends of the kinetic energy)

Drive behavior during power failure:

- **Power is recovered from the kinetic energy of the load**

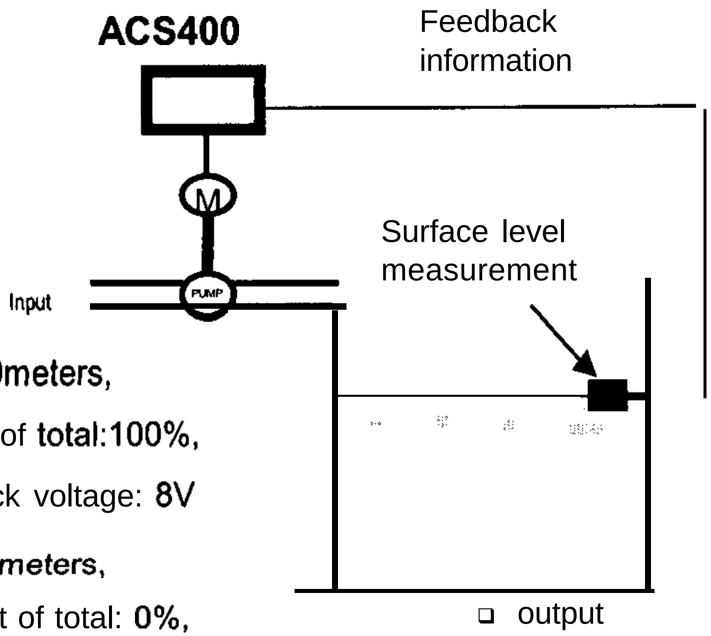
Critical frequency



- To avoid resonance problems in certain speed ranges
- Two adjustable jump speeds.
- Individual settings for
  - skip frequency low limit
  - skip frequency high limit

PID-regulator P- control

- Level control is normally P only
- Averaging level : Low gain
- Tight level: High gain



High: 10meters,

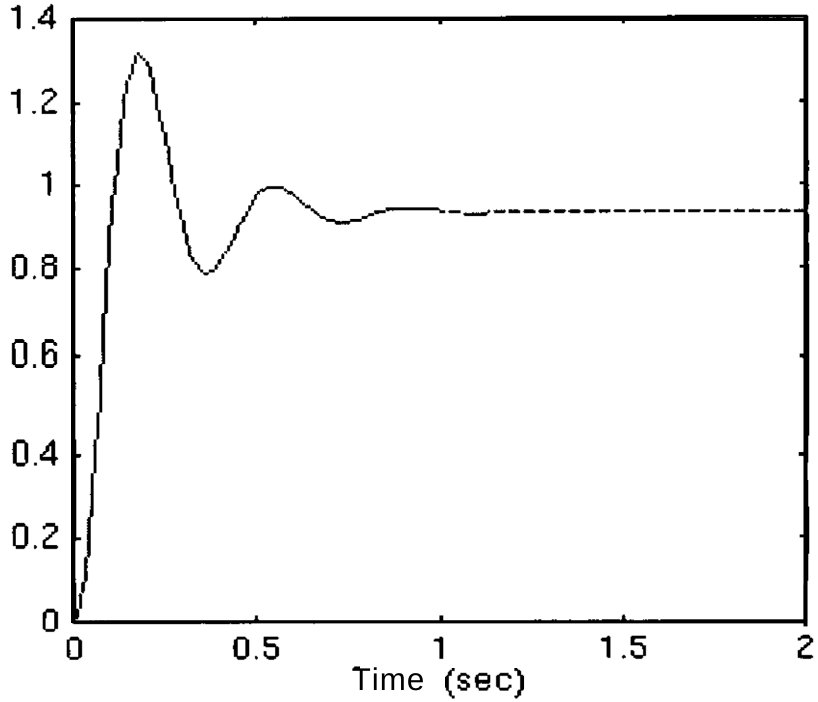
Percent of total:100%,

Feedback voltage: 8V

High: 0meters,

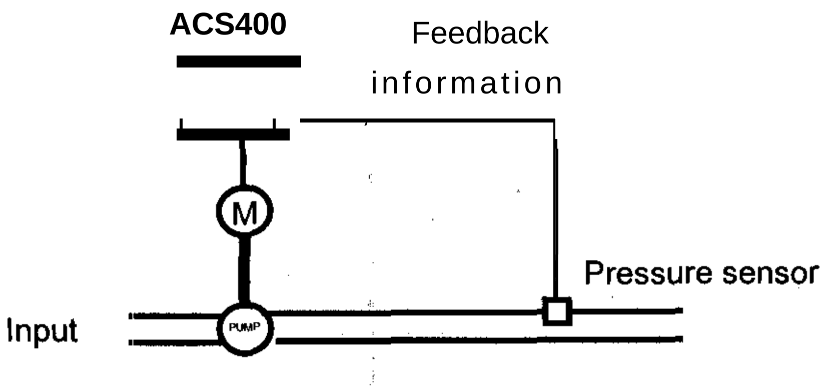
Percent of total: 0%,

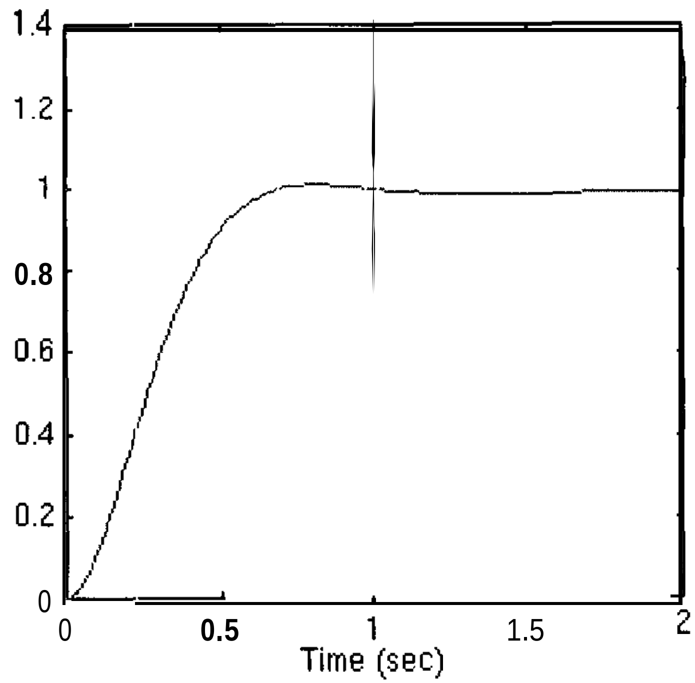
Feedback voltage: 4V



PID-regulator PI - Control

- Flow and pressure controls are normal PI.
- In ‘flow control low gain, fast integral time (T_i)
- In pressure control depends of the system

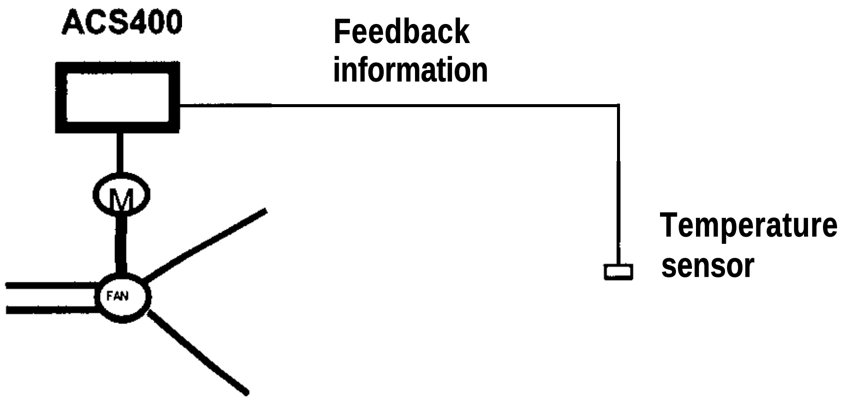




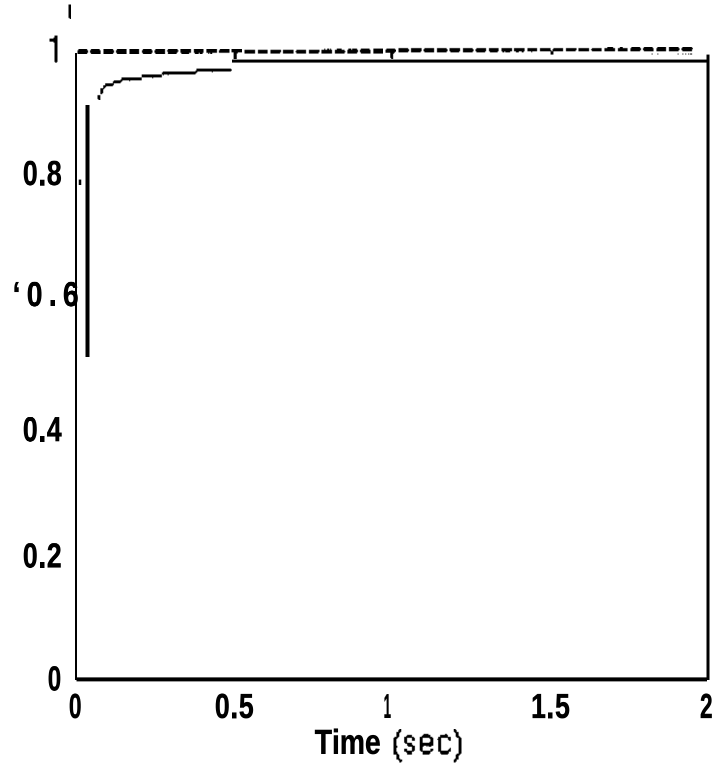
Integration time parameter 4002

PID-regulator PID - Control

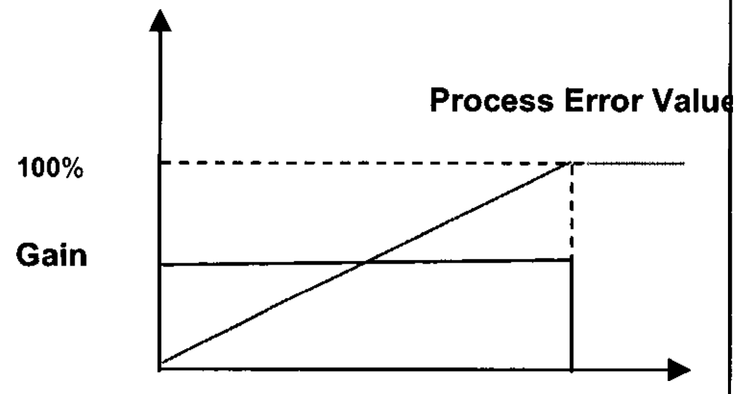
- Temperature control is normally PID
- Gain 20-60; T_i = 2-5 min, Td = T_i/4



Derivation time parameter 4003



PID-regulator Derivation time



PID derivation time

PID controller derivation time.

- If the process error value changes linearly, D part adds a constant value into the PID controller output.
- The derivative'is filtered with a I-pole filter.
- The time constant of the filter is defined by parameter (4004).

ACS 400 macro: Factory (0)

Analog input

Frequency (All)

Digital input

Start / Stop (DI1: contact closed / open)

Direction (D12)

Constant speed (D13)

Ramp pair 1/2 selection (DE)

Analog output

Frequency (AO)

Relay output

Fault (RO1)

Running (R02)

For applications no panel available

- Motor nominal values are 230/400V, 50 Hz and 1440rpm
- Signals scaled according to 50 Hz
- Max output frequency 50 Hz
- Activate DI4 for US settings (460V, 60Hz and 1750rpm)

ACS 400 macro: ABB standard (1)

Analog input

Frequency (AI1)

Digital input

Start / Stop (DI1: contact closed / open)

Direction (DI2)

Constant: speed (DI3)

Constant: speed (DI4)

Ramp pair 1/2 selection (DI5)

Analog output

Frequency (AO)

Relay output

Fault (RO1)

Running (RO2)

General purpose macro for constant speed (three) applications

ACS 400 macro: 3-wire (2)

Analog input

Frequency (All)

Digital input

Start (DI1)

Stop (DI2)

Direction (DI3)

Constant speed (D14)

Constant speed (DE)

For applications the drive is controlled using momentary push buttons

ACS 400 macro: Alternate (3)

Analog input

Frequency (AI1)

Digital input

Start / Stop (DI1: contact closed / open)

Direction (D12)

Constant speed (D13)

Constant speed (DI4)

Ramp pair 1/2 selection (DE)

'Analog output

Frequency (AO)

'Relay output

Fault (RO1)

Running (R02)

Offers an I/O configuration that is adopted to a sequence of DI control signals when alternating the direction of rotation of the drive

ACS 400 macro: Motor potentiometer (4)

Analog input

Frequency (All)

Digital input

Start / Stop (DI1: contact closed / open)

Direction (DI2)

Reference up (D13)

Reference down (D14)

Constant speed (D15)

Analog output

Frequency (AO)

Relay output

Fault (RO1)

Running (R02)

Most effective interface for PLCs that vary the speed of the drive using only digital signals

ACS 400 macro: Hand-auto (5)

Analog input

Hand, (AI1)

Auto (AI2)

Digital input

Start/Stop (DI1 hand; DI5 auto)

Control location selection (D13)

Analog output

Frequency (AO)

Relay output

'Fault (RO1)

Running (R02)

- ers two external control locations
- Typically in HVAC applications

ACS 400 macro: PID-control (6)

Analog input

Analog reference (All, Extl or Ext2)

Actual value (AI2)

Digital input

Start/Stop (DI1 manual, DI5 auto)

(Start; contact closed, Stop; contact open)

Control location selection (DI2)

Constant speed (D13)

Run enable (D14)

Analog output

Frequency (AO)

Relay output

Fault (RO1)

Running (R02)

For use with different closed loop control systems

- pressure control
- flow control
- level control

ACS 400 macro: Pre-magnetize (7)

Analog input
Frequency (AI1)

Analog output
frequency (AO)

Digital input

Start / Stop (DI1: contact closed / open)
Direction (DI2)
Constant speed (D13)
Constanl: speed (D14)
Pre-magnetize (DI5)

Relay output

Fault (RO1)
Running (R02)

With this macro the motor flux build up time can be eliminated
- **Motor starts very quickly**

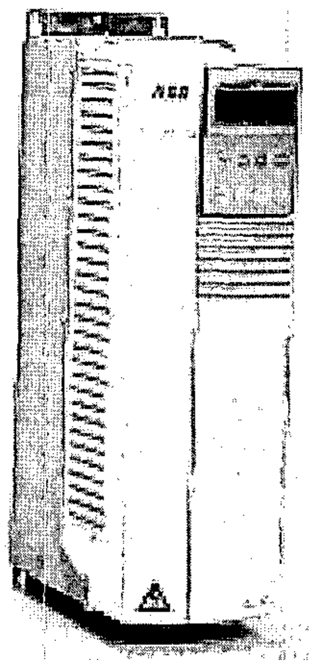
ACS 400 Features'

- **Summary of Features**
  - » 2 Analog Inputs
  - » 1 Analog Output
  - » 5 Digital Inputs
  - » 2 Relay Outputs
  - » Serial Communication RS485 as standard for Modbus
  - » Power Loss Ride Throu'gh
  - » Flying Start
  - » Pre-Magnetizing Macro plus 7 other macros
  - » 7 Preset Speeds
  - » DC Hold
  - » DDCS + fieldbuses

Tab 5
ACH 400/ACH 500 Comparison
ACH 400 PPT Presentation

ACH 400 Adjustable Speed AC Drives

from 3 HP to 400 HP for variable torque; applications

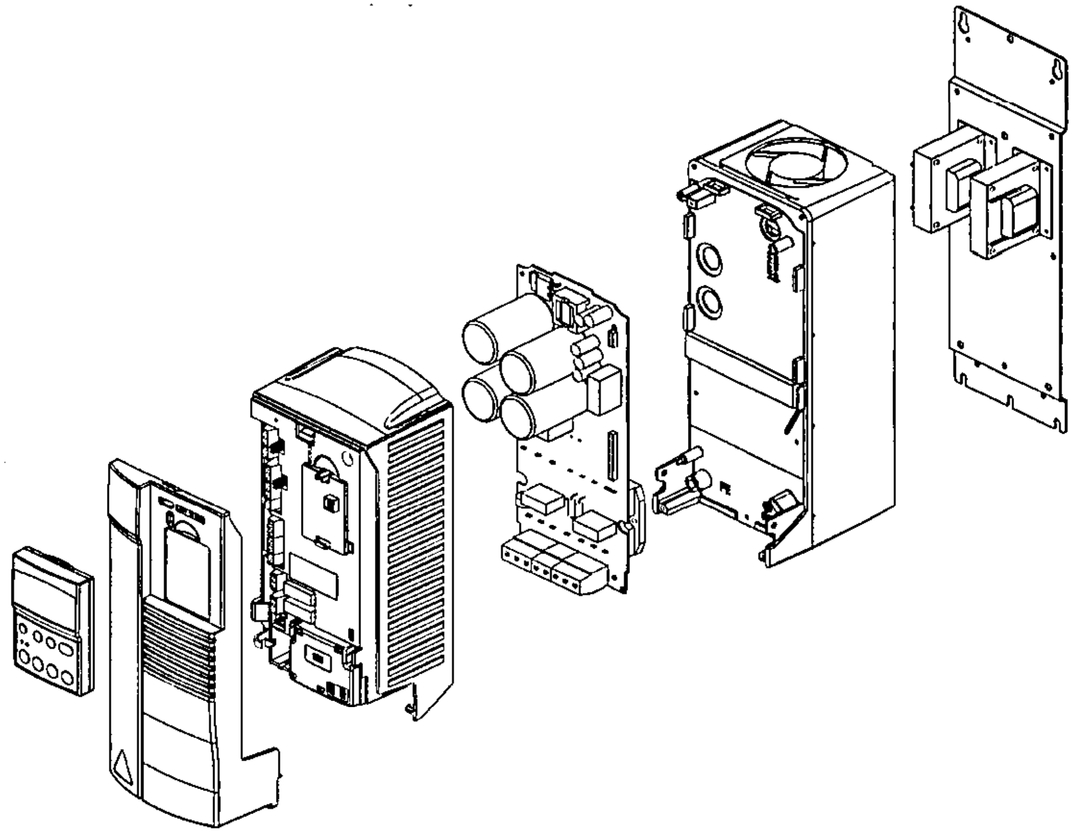


Input voltage:	**3 phase, 200...240 V, +/- 10%**
	3 phase, 380...480 V, +/- 10%
Input frequency:	**from 48 to 63 Hz**
Output voltage:	**From 0 to V_N**
Output frequency:	**from 0 to 250 Hz**

ABB

ACH 400

- **Easily Integrated**
  - No Need for Conversion Logic (source or sinking input)
  - Galvanically Isolated I/O
  - Standard, 3-Wire and Alternative Control Connections
  - Bookshelf design
- **Standards**
  - UL, cUL, CSA, CE
  - Production certified to IS09001 and IS014001



ACH 400 Type Code

AC H 4 0 1 - 0005 - 3 - 2

AC drive

Product type
S = Standard product
H = HVAC

ACS400 Product Famiiy

Input Bridge
0 = 6-pulse rectifier

Enclosure Type
1 = Wall mounted
2 = Floor standing

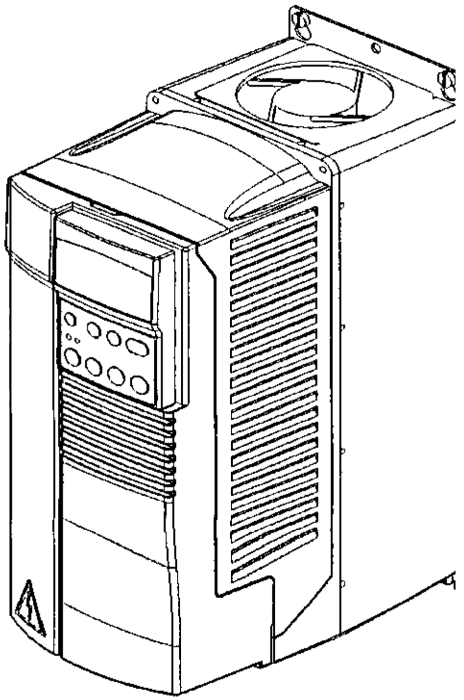
Rated Output Power in kVA
See ACS400 rating tables

Voltage Rating
1 = 200...240Vac
3 = 380...480Vac

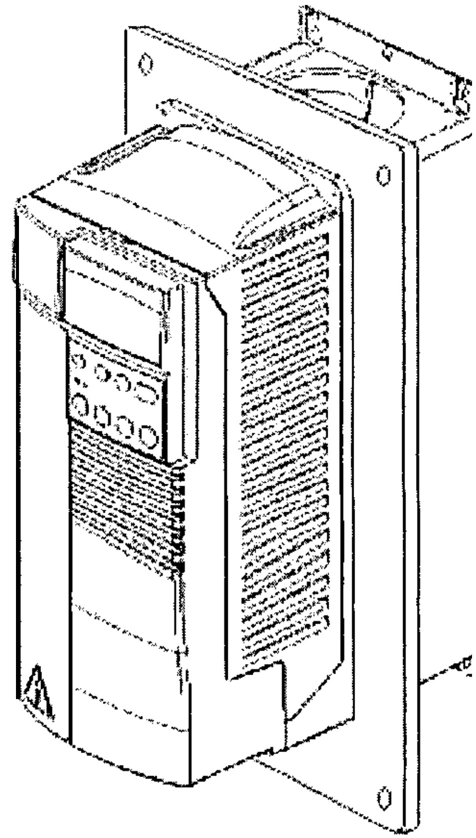
Enclosure Class
2 = IP21 (NEMA1)
5 = IP54 (NEMA12)

ACH 400 Mounting

Wall mounting



Flange, mounting (option)

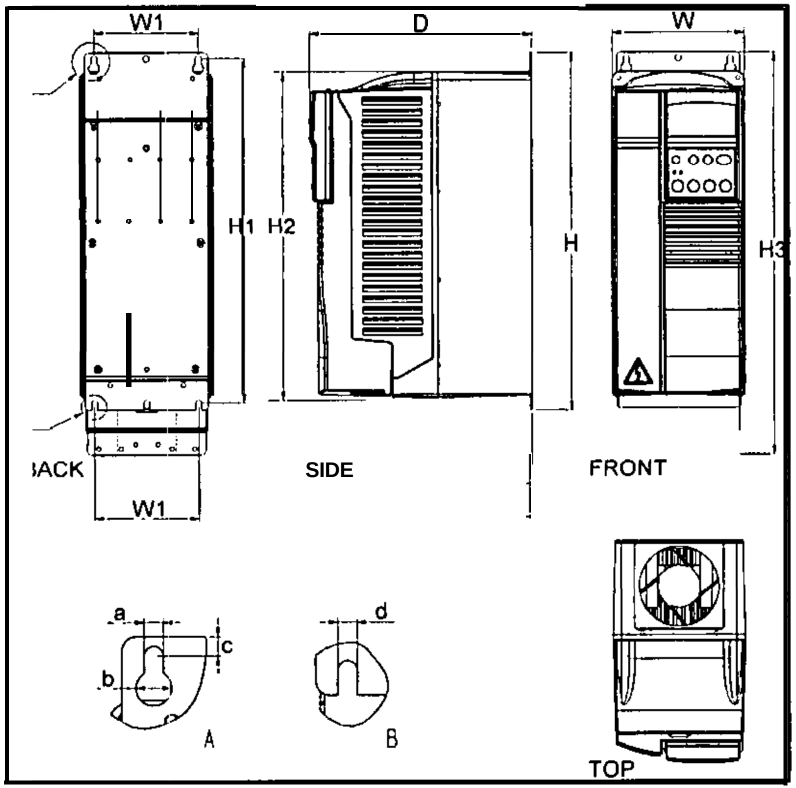


Mounting clearance

- 1.97 in on each side
- 7.87 in above and below

ACH 400 Dimensions

For NEIMA 1 enclosure



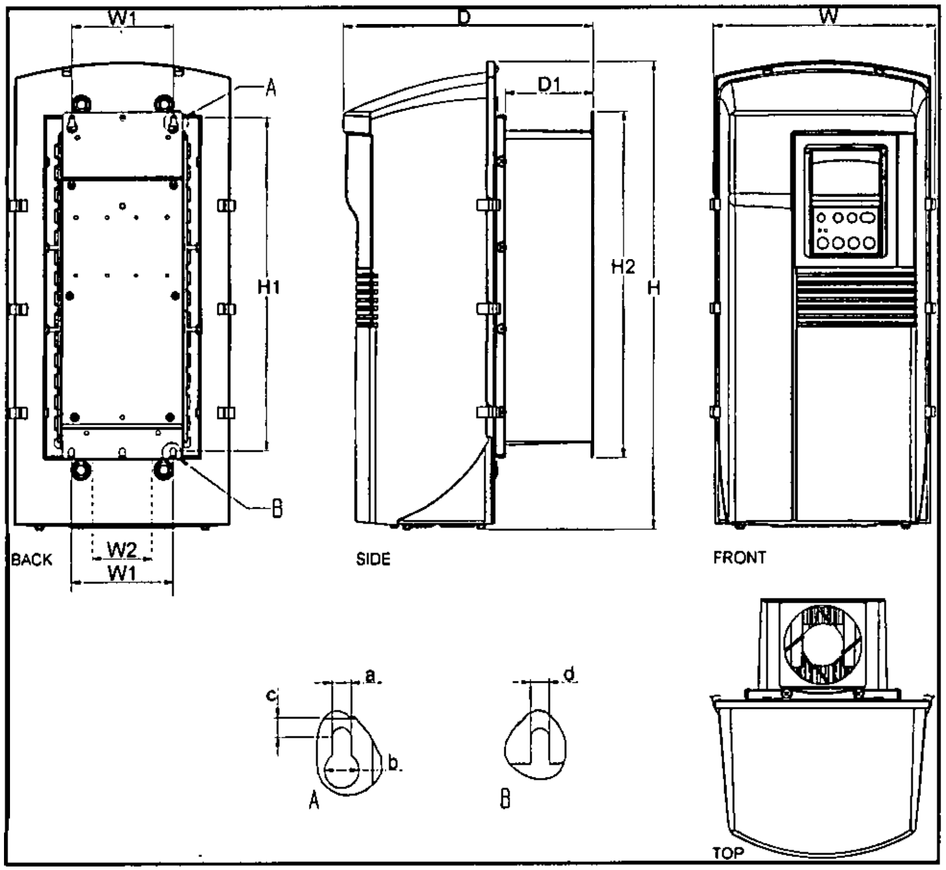
Dimension 'eference (mm)	Frame R I	Frame R2	Frame R3	Frame R4
Width W	4.92	4.92	7.99	7.99
Height H	12.99	16.93	21.46	25.04
Depth D	8.23	8.7	9.72	11.02
HI	12.52	16.42	20.79	24.37
H2	11.81	'15.75	19.69	23.62
WI	3.86	3.86	6.3	6.3
a(=d)	0.217	0.217	0.256	0.256
b	0.394	0.394	0.512	0.512
c	0.217	0.217	0.512	0.256
Weight (lbs)	12.76	19.8	40.7	59.4

High Power/Volume ratio

-> EFFICIENCY

ACH 400 Dimensions

For NEMA 12 enclosure



Width W	8.46	8.46	10.12	1[redacted]2
Height H	17.72	21.65	25.58	2[redacted]
Depth D	9.49	9.96	10.98	12[redacted]
H1	12.52	16.42	20.79	24[redacted]7
H2	12.99	16.93	21.46	24[redacted]4
a(=d)	0.217	0.217	0.256	0.2[redacted]6
b	0.394	0.394	0.512	0.5[redacted]2
c	0.217	0.217	0.256	0.[redacted]6
weight lbs	12.76	19.8	40.7	6[redacted]

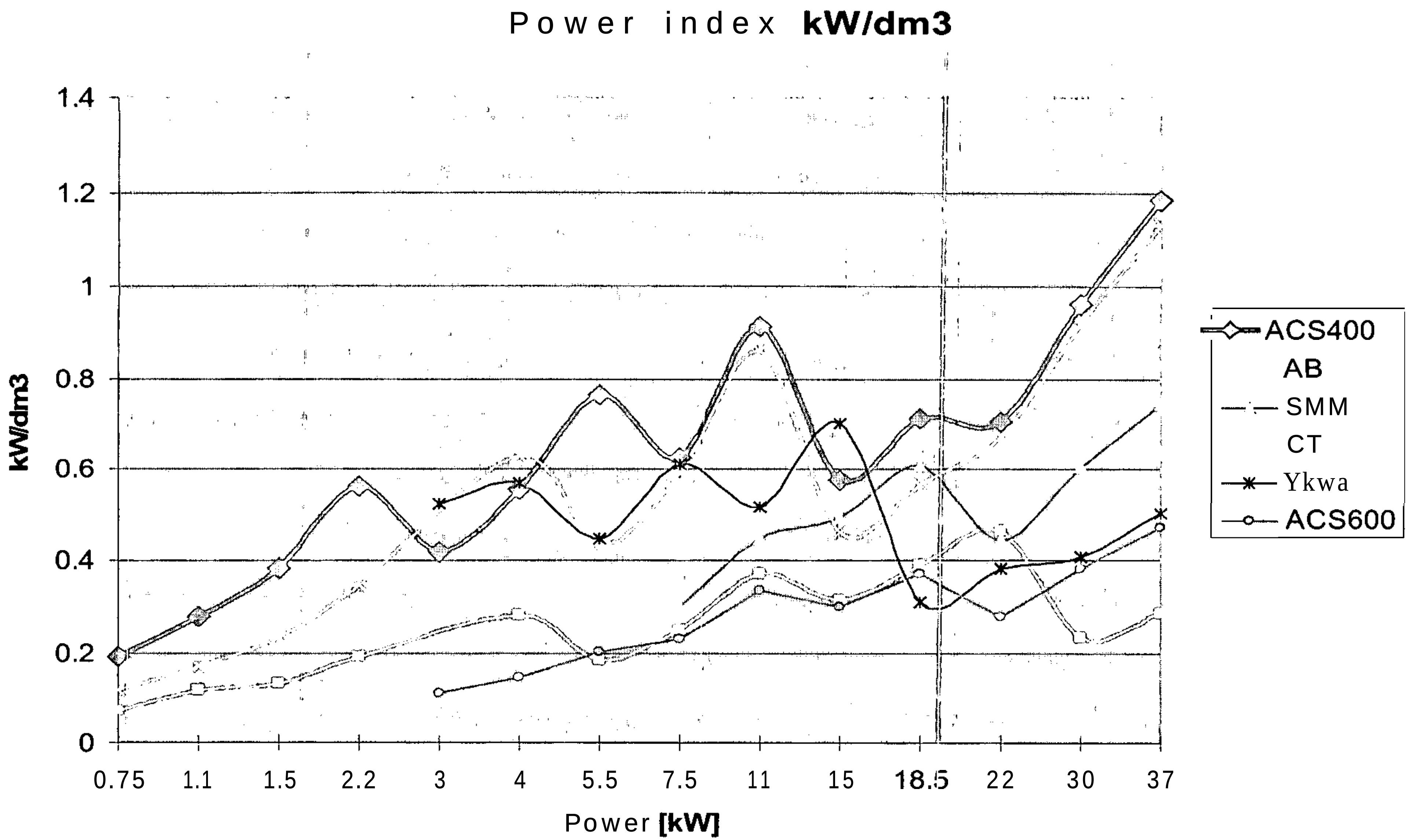
NEMA 12 requires

- Extra internal fan
- Factory installed (no kits)

NEMA 12 without derating!

ABB

Power/Volume Ratio



ACH 400 Current ratings

Standard ratings, ambient temperature 40 °C Variable Torque applications

Rated motor power P_n (HP)	Rated output I_2 (A)	Current I, Maximum (1 minute) I_{max} (A)
3	6.6	7.3
5	8.8	9.7
7.5	11.6	12.8
10	15.3	16.8
15	23	25.3
20	30	33
25	38	41.8
30	44	48.4
40	59	64.9
50	72	79.2

ACH 400 Types

Standard ratings, ambient temperature 40 °C Variable Torque Applications

Rated motor power P_n (HP)	Type designation	Rated input current	Fuse (A)	CU terminal size (mm2)
3	ACS 401-0004-3-X	6.2	10	2.5
5	ACS 401-0005-3-X	8.3	10	2.5
7.5	ACS 401-0006-3-X	11.1	16	6
10	ACS 401-0009-3-X	14.8	16	6
15	ACS 401-0011-3-X	21.5	25	10
20	ACS 401-0016-3-X	28.8	35	10
25	ACS 401-0020-3-X	35	50	16
30	ACS 401-0025-3-X	41.2	50	16
40	ACS 401-0030-3-X	55.7	63	25
50	ACS 401-0041-3-X	68.1	80	25

ACH 400 Protective functions

Inverter protection

Protective-function	Trip limit
Overcurrent	3,5 • I_N instantaneously
Over voltage	1,35 * rated voltage, 1,3 * U480
Under-voltage	0,65 • selected rated voltage
Over temperature	95 °C heatsink
Output short circuit	
Output ground fault	
Input phase loss	
Serial communication error	
Loss of analog input signal	

Motorprotection

Protective function	Programmable
Motor stall	Parameter protected (current, frequency and time)
Current regulation	0,5…1,5*I_N adjustable
Motor overload	I2T model (UL approved), parameter
Over current	Parameter

Application protection

Protective function	Programmable
Serial communication error	
I/O terminal short circuit	
Under load	Parameter

Relay outputs can be programmed to* indicate *fault conditions

ACH 400 her-visions

Code	Description
AL1	Panel upload/download failed
AL2	Panel operation canceled because drive is running
AL3	Panel ooeration canceled because drive is in Remote mode
AL5	Panel is not the source of start/stop/dir/ref commands
AL6	Operation disabled due to: parameter lock, panel lock, use of factory macro, parameter value is inconsistent
AL7	Operation disabled due to use of factory macro
AL10	Overcurrent alarm. Overcurrent controller controls output frequency
AL1 1	Overvoltage alarm. Overvoltage controller controls output frequency
AL12	Under-voltage alarm. Under-voltage controller controls output frequency
AL13	Direction lock ON. Direcrion request differs from locked direction
AL14	MODBUS loss alarm. Drive continues operation
AL15	MODBUS exceotion messaae was aenerated
AL16	Analog input 1 loss alarm. Drive continues operation
AL17	Analoa inout 2 loss alarm. Drive continues ooeration
AL16	Panel loss alarm. Drive continues operation
AL19	Overtemperature alarm. Drive is about to trip due to overtemperature
AL20	Motor overtemperature alarm (setting 2 = WARNING). Drive is about to trip due to motor overtemperature (setting 1 = FAULT)
AL21	Motor underload alarm (setting 2 = WARNING). Drive is about to trip due to underload (setting 1 = FAULT)
AL22	Stall alarm. Drive continues operation, but stall indication is ON
AL23	DDCS link loss alarm. Drive continues operation
AL24	Application dependent alarm. Drive continues operation
AL25	OFF button pressed in HVAC panel

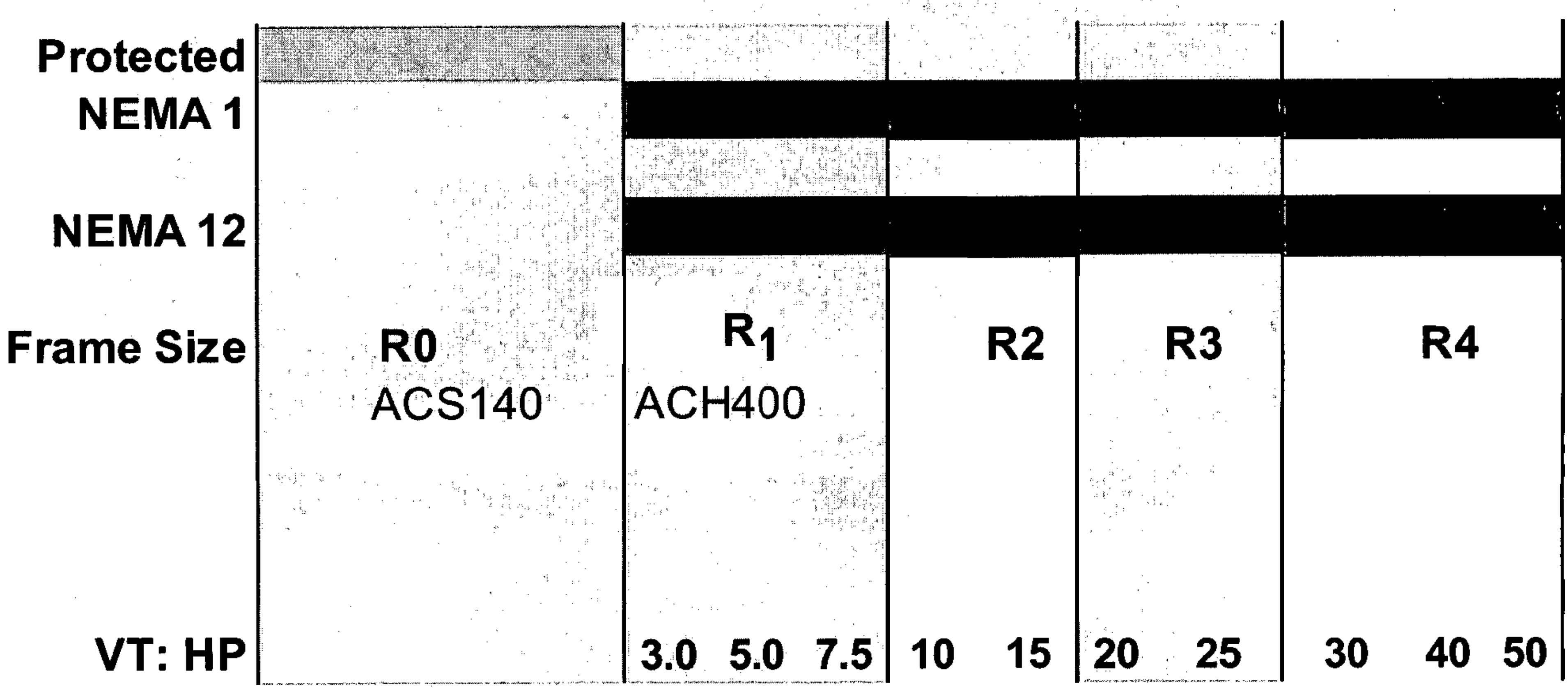
ACH 400 Faults

FL1	**Overcurrent.** Overcurrent trip detected
FL2	**Overvoltage** (1) Overvoltage trip detected (2) Start command detected when the DC voltage is above overvoltage controller limit
FL3	**Inverter overtemperature.** Inverter temperature too high. Trip level depends on the type
FL4	Fault current. Fault current trip detected
FL5	Overload. Integral of current squared is too high
FL6	**Undervoltage** (1) DC voltage drops below threshold when start is ON (2) Start command detected when the DC voltage is below undervoltage controller limit
FL7	Analog input 1 loss. Analog input 1 drops below limit
FL6	Analog input 2 loss. Analog input 2 drops below limit
FL9	Motor overtemperature. Motor model integral is too high
FL1 0	Panel loss. Panel loss detection ON when panel controls start/stop/dir or reference
FL11	Parameter error. Inconsistent parameter values
FL12	Stall. Stall protection trips
FL13	MODBUS loss. MODBUS loss detection ON when controlled over MODBUS
FL14	External fault. Digital input configured to external fault input is low
FL15	Ground fault. Ground fault trip detected
FL16	UC ripple. DC capasitor voltage ripple too high(bad capasitors)
FL17	Underload. Underload detection trips
FL16	Application dependent fault. Fault detection ON when application controlled
FL19	Comm loss. DDCS protocol. Loss detection ON when controlled over DDCS link or link in communication module, in DDCS link
FL20-26	*Hardware error, contact factory*

Fault codes 20-26 (contact factory)

nr.	perm.	source	params	fault word bits		legend
params 0128 .. 0130	yes/no	HW/SW	yes/no	param 0305	param 0306	
20	yes	SW	no		bit 11	Bad **analog** input. Invalid pulse count when transforming reference or around
						[illegible] FPROM
					bit 8	(1) Bad FPROM detected (FPROM didn't store data written)
					bit 9	(2) New FPROM detected during boot
22	yes	SW	no		bit 12	Type code error. Type code input out of valid slots
23	yes	SW	no		bit 13	Sporadic fault interrupt. Collected fault interrupt detected, but no accompanying fault interrupt (overcurrent, overvoltage, fault current, earth fault)
24	yes	SW	no		bit 14	Assert. SW assert expires. SW assumes certain internal state
25	yes	SW	no		bit 15	Modulator. Modulator stalled
26	yes	SW	no		bit 10	Unsuccessful Flash prom download

400V Unit Overview



VT: Variable torque applications

ACH 400 Options

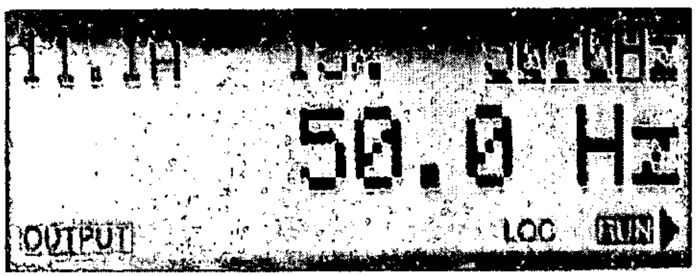
- Control Panels : ACS1OO-PAN /I
  ACS-PAN B
- EMI/ RFI Filters (Input)
- DDCS module
- Fieldbus adapters (from ACS600 family):
  Profibus(NPBA-02),
  Modbus (NMBA-OI),
  Modbus + (NMBP-01),
  Landis & Staefa FLN
  Metasys N2 Bus

ACH 400 Output display

Absolute output current

output current relative to I_{max}

Frequency setpoint



Output frequency

Drive running Direction

output display indicator

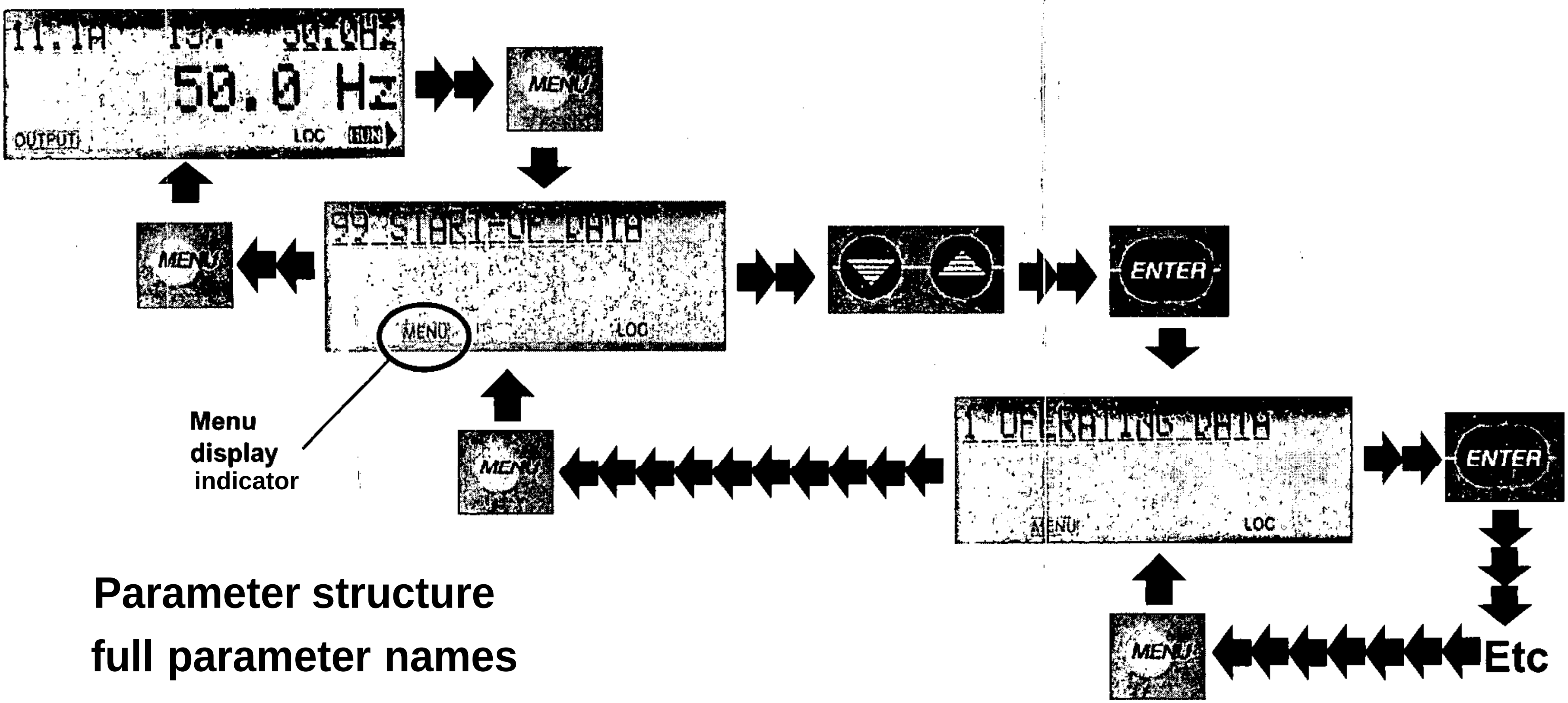
Hand/Off/Auto

Frequency setpoint can be increased or decreased by pressing

Alterations are confirmed by pressing

New menu level is selected by pressing

ACH 400 Parameter Navigation

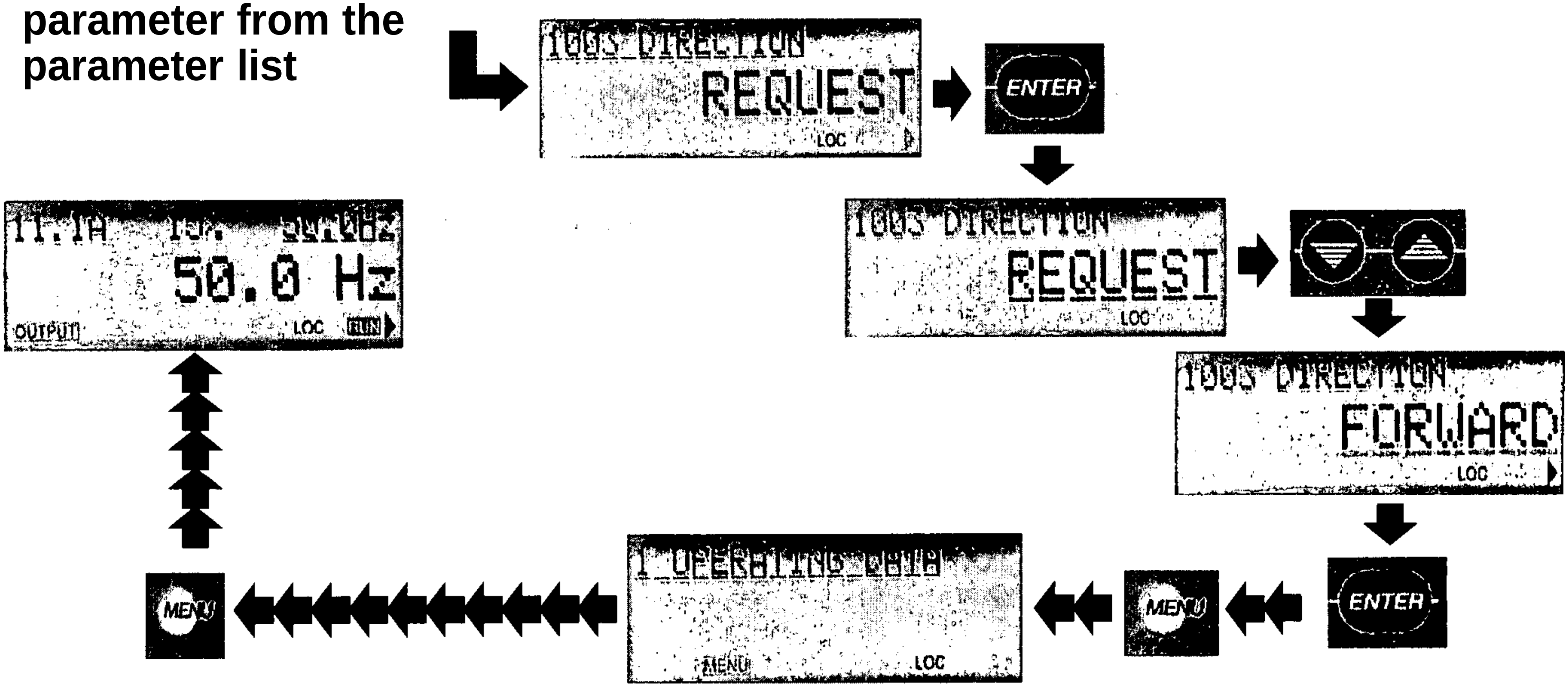


Parameter structure

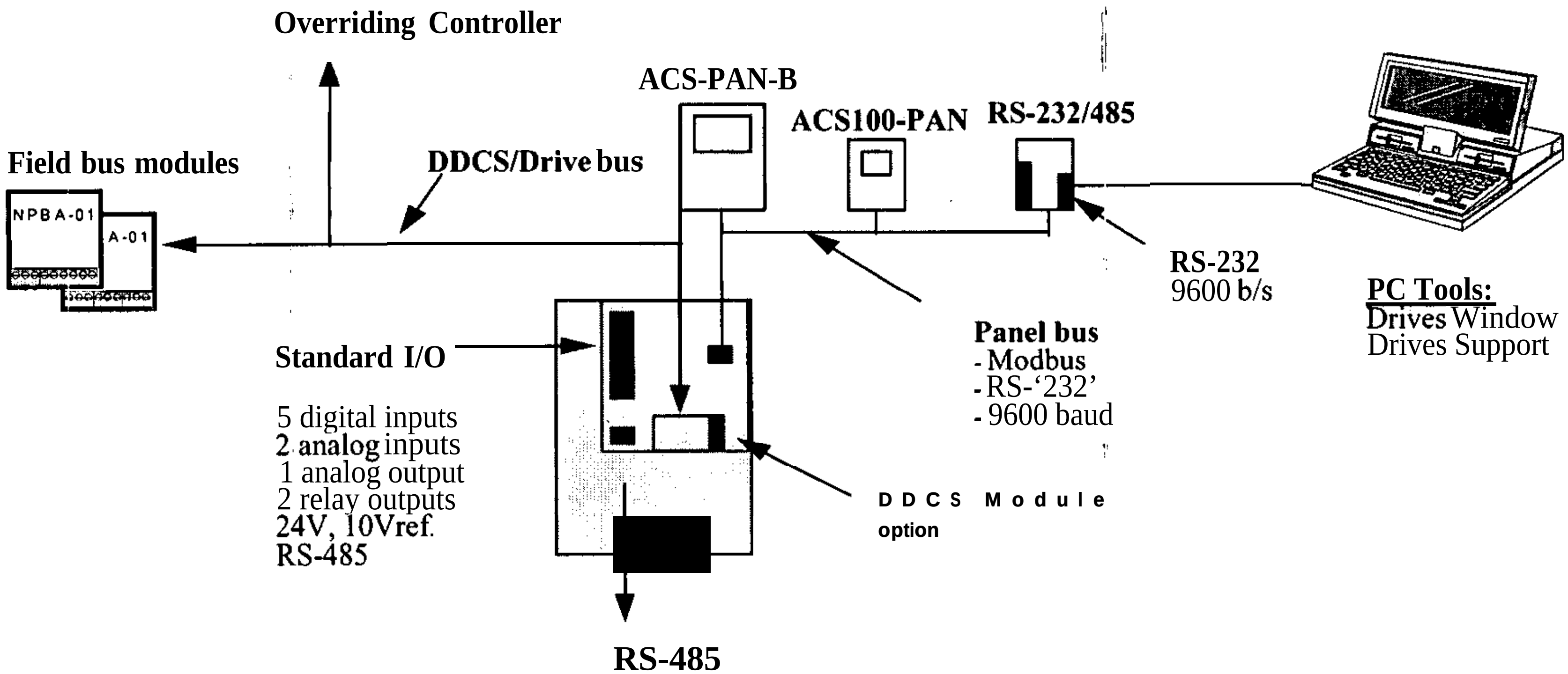
full parameter names

ACH 400 Parameter setting

After finding the required parameter from the parameter list



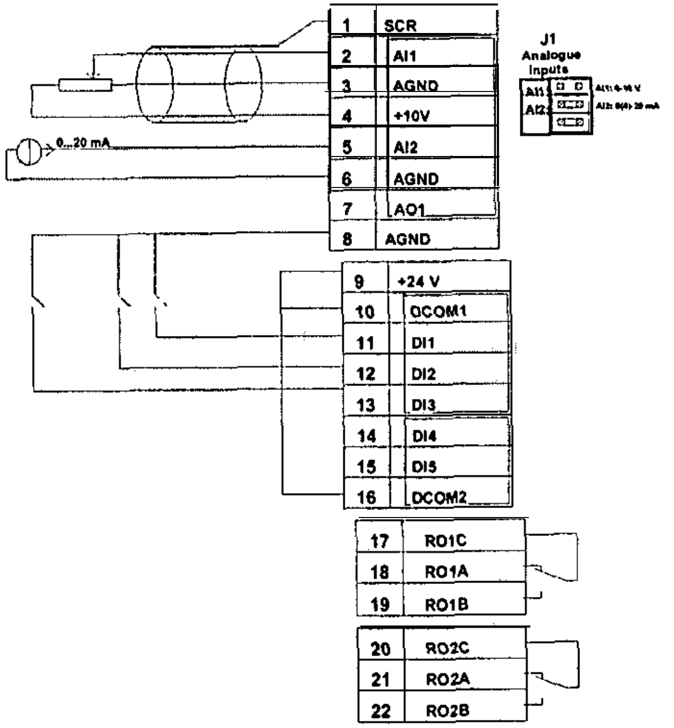
ACH 400 Drive control methods



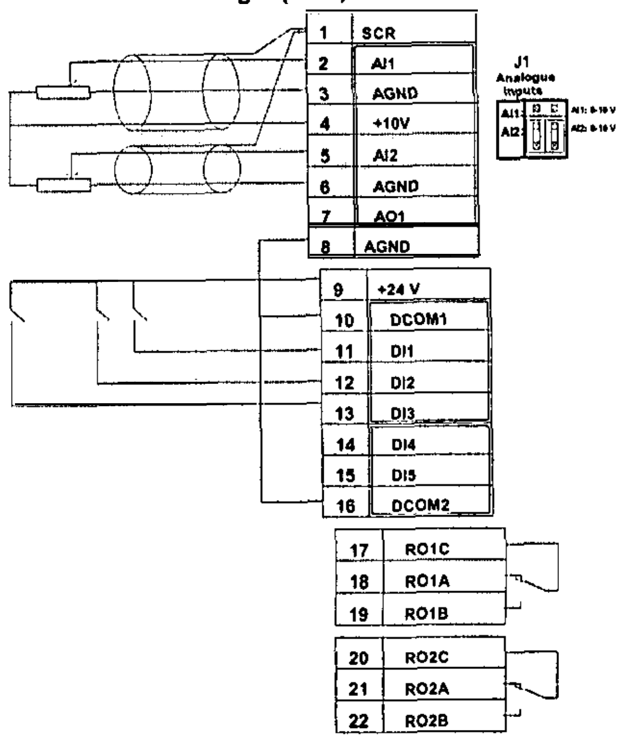
ACH 400 Control methods

- No Need For Conversion Logic

SINK Logic (NPN)



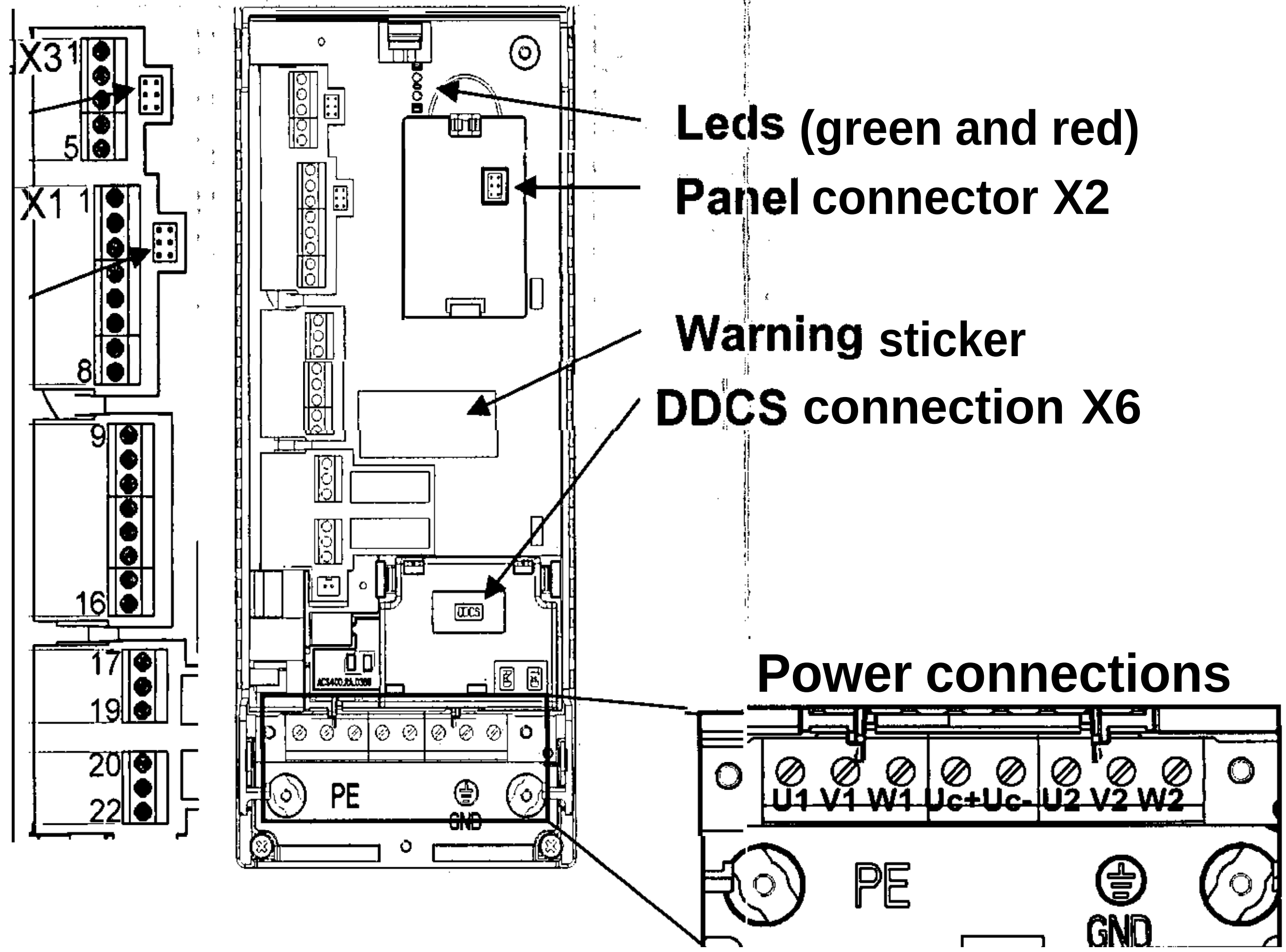
SOURCE logic (PNP)



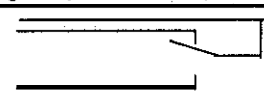
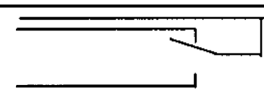
The ACH 400 Can Handle Both Without Any Additional Logic

ACH 400 Terminal Interface

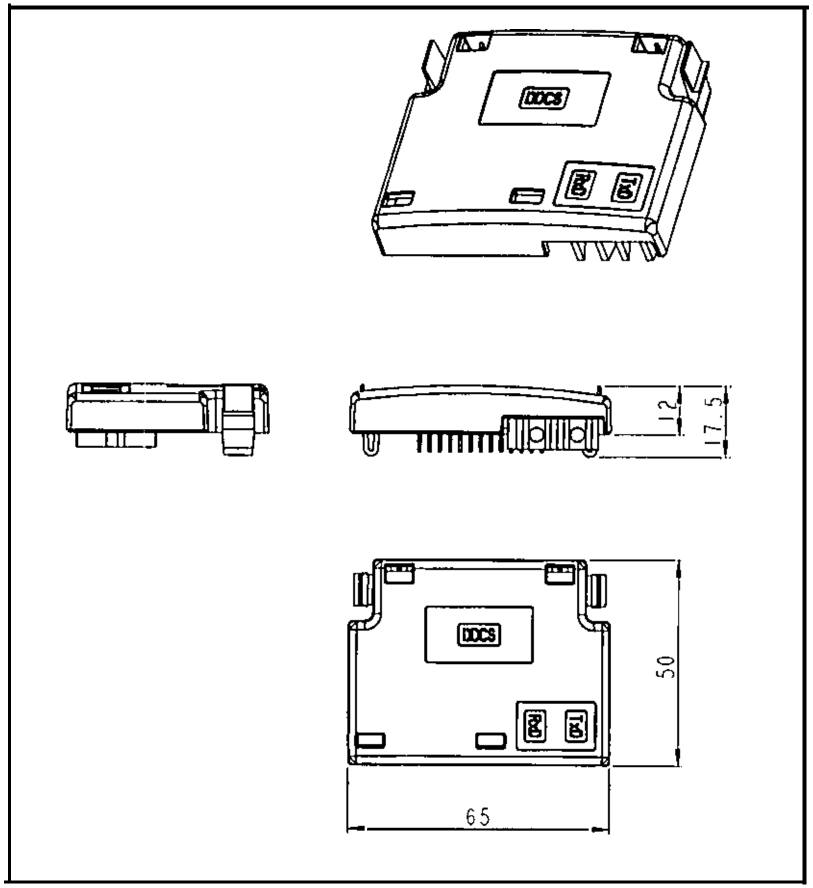
- RS485 connector X3
- V/I jumper S2
- I/O connection X1
- V/I jumper S1



ACH 400 I/O Configuration,

X1	Identification	Description	
1	SCR	Terminal for signal cable shield (connected internally to chassis	
2	AI1	Analog input channel 1, programmable Default: 0-10 V (Ri=200kohm)(s1:1:U) <==> 0 - from output frequency, 0-20 mA (Ri =500 ohm) (s1:1:I) <==> 0 - from output frequency resolution 0.1 %, accuracy +1 %	
3	AGND	Analog input circuit common. (Connected internally to chassis ground through 1 Mohm)	
4	10V	10V/10 mA reference voltage output for analog input potentiometer, accuracy +2 %	
5	AI2	Analog input channel 2, programmable Default:0-20 mA (Ri =500 ohm) (s1:2:U) <==> 0 - from output frequency 0-10 V (Ri=200kohm)(s1:2:U) <==> 0 - from output	
6	AGND	Analog input circuit common. (Connected internally to chassis groung through 1 Mohm)	
7	AO	Analog output, programmable. Default:0-20 mA / output frequency (load <500 ohm)	
8	AGND (Ground)	Common for DI return signals	
9	24V_OUT	24 V/250 mA auxiliary voltage output (reference to AGND). Short circuit protected	
10	DCOM1	DCOM1 digital input common 1 (for DI1, DI2 and DI3)To activate digital input, there must be +12 V (or -12 V) between that input and DCOM1. 24 V supply may be provided by the ACS400 (X1:9) or from external 12-24 V source.	
Digital input configuration		**Factory (0)**	**Factory (1)**
11	DI1	Start/StopActivate to start. Motor will ramp up to frequency reference. Deactivate to stop. Motor will coast to stop.	Start If DI2 is activated, momentary activation of DI1 starts the ACH400.
12	DI2	ReverseActivate to reverse rotation direction.	Stop Momentary deactivation always stops the ACH400.
13	DI3	JogActivate to set output frequency to constant 5Hz.	ReverseActivate to reverse rotation direction.
14	DI4	Has to be deactivated.	Has to be activated.
15	DI5	Acceleration/deceleration selection	Acceleration/deceleration selection
16	DCOM2	DCOM2 digital input common 2 (for DI4, DI5)	
2E+05	RO1		Relay output 1 programmable (default: fault => 17 connected to 18) 12-250 V AC /30 V DC, 10 mA - 2 A
2E+05	R02		Relay output 2 programmable (default: running => 20 corrected to 22) 12-250 V AC /30 V DC, 10 mA - 2 A

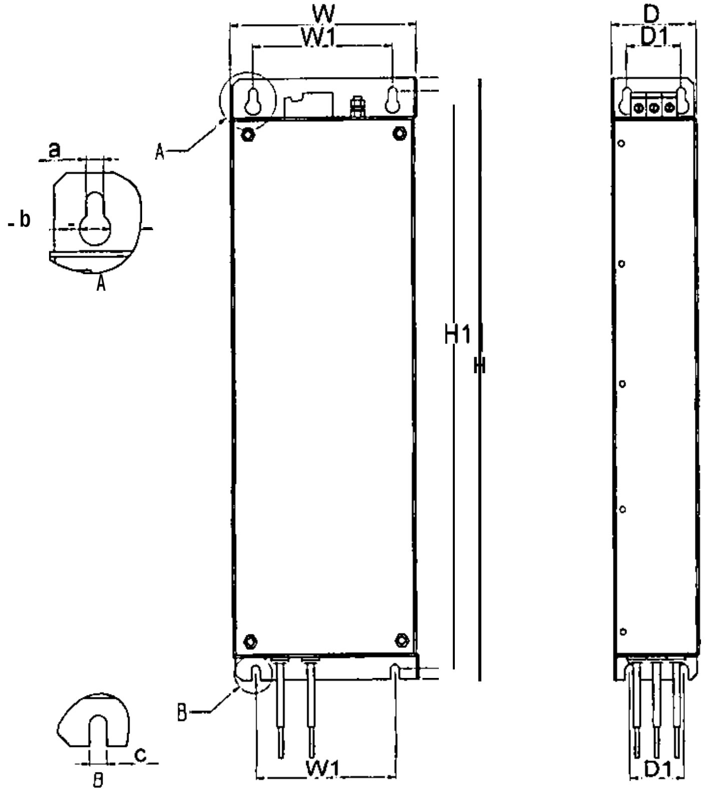
DDCS Module

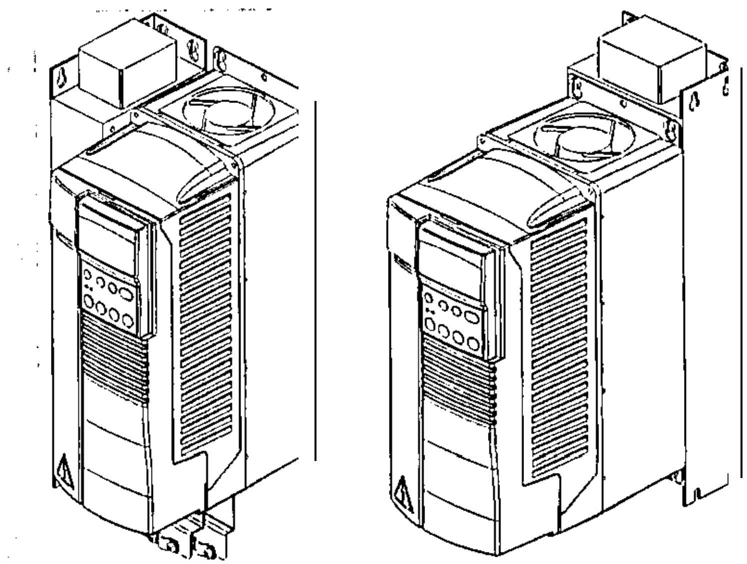


Converts messages from the internal databus into DDCS-protocol messages that are sent and transmitted using fiber optical cables. The! fiber optic cables are then connected to fieldbus modules.

ABB

ACH400-IF EMI/RFI Filter





EMC according to EN 61800-3

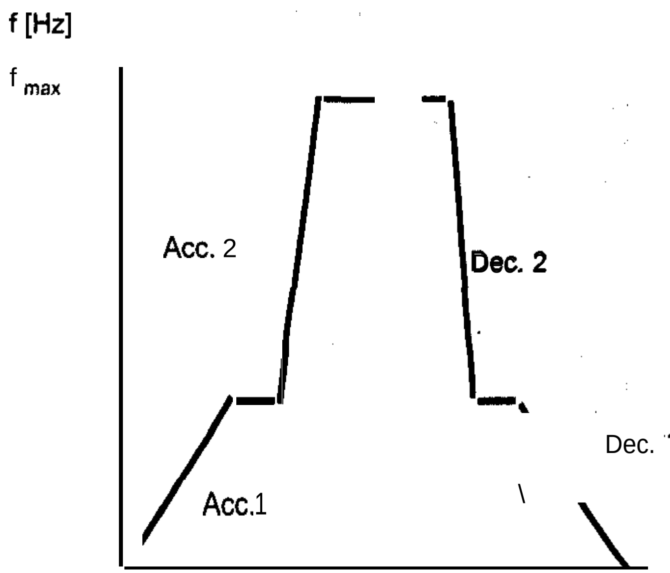
- **2nd (industrial) environment as standard**
- **1st (EN 50081-2 residential power) requires filter**
- NEMA 12 **enclosure**

ACH 400 Programmable features

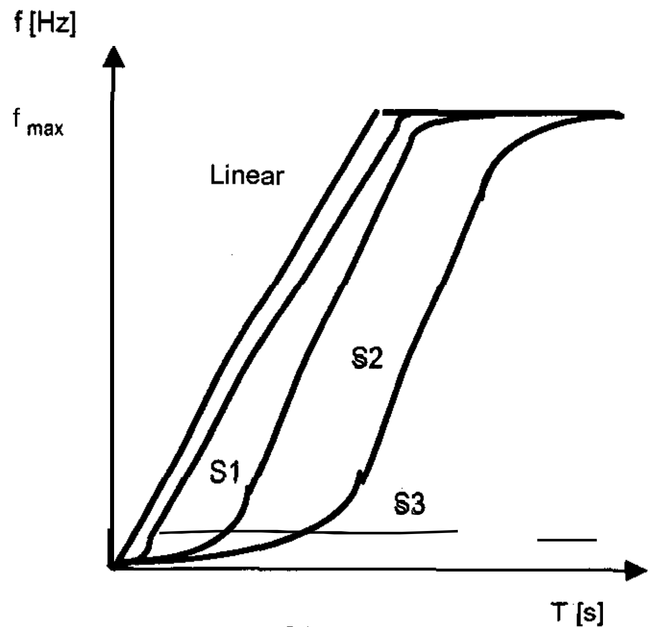
- Output current and frequency limit
- Versatile start and stop modes
- 2 programmable Acc/Dec ramps
- Programmable V/f ratio
- IR compensation
- Power loss ride through
- DC hold
- Sleep function
- 7 preset speeds
- 2 jump frequencies
- Parameter upload/download

Acceleration / Deceleration

- two different acc / dec ramp settings can be selected by digital input



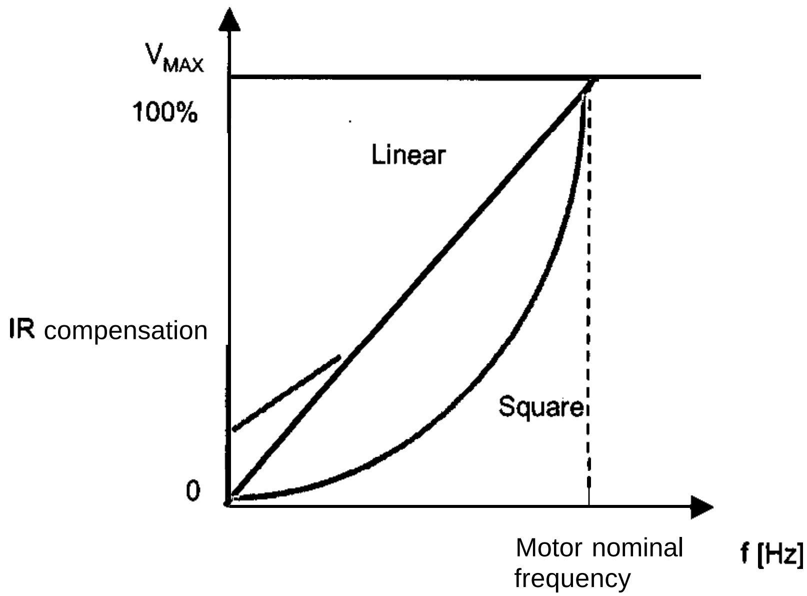
Parameter 2201 ramp pair selection
parameters 2202-2205 Acc / Dec parameters



Ramp times S1 < 1 s
Ramp times S2 < 1,5 s
Ramp times S3 < 15 s

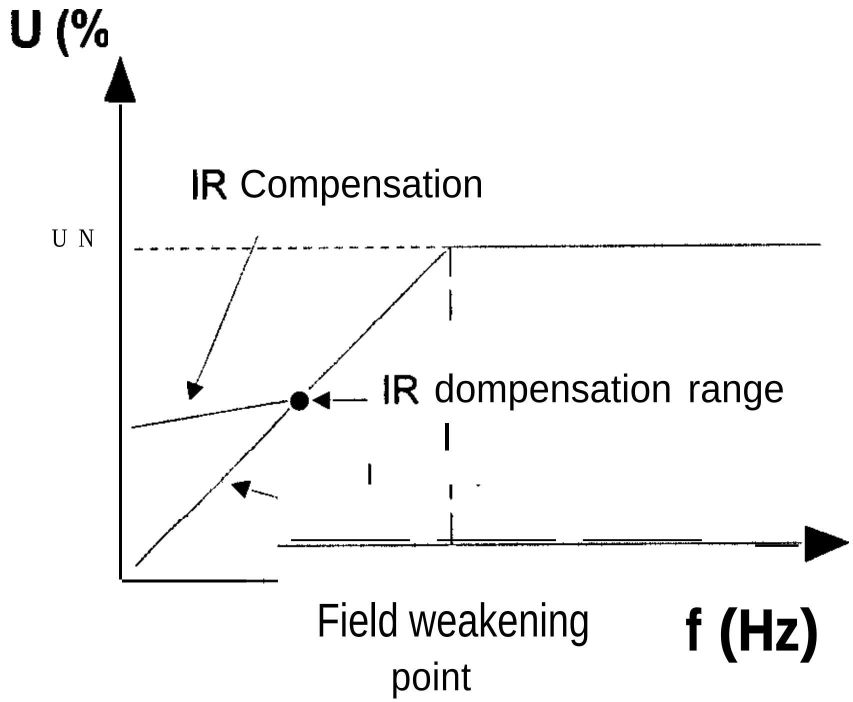
V/F Ratio

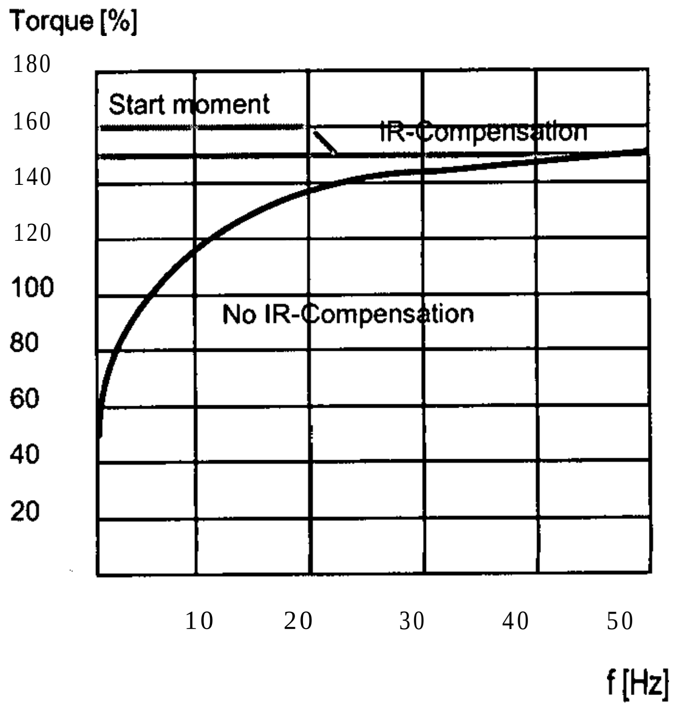
- **Selectable**
  - **Linear**
  - **Square**



Parameter 2606

IR-compensation

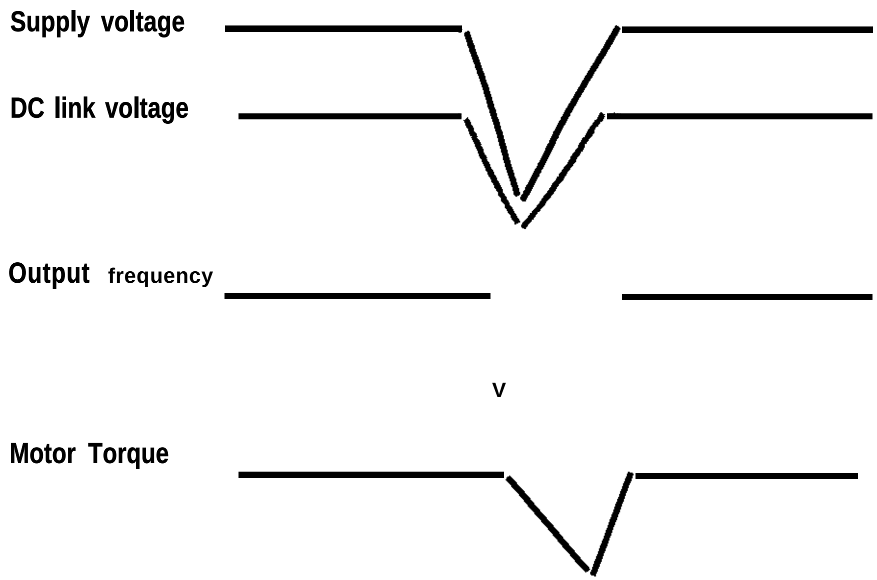




Adjustable

- compensation range 0 - f_{set}
- **compensation voltage**

Power loss ride through



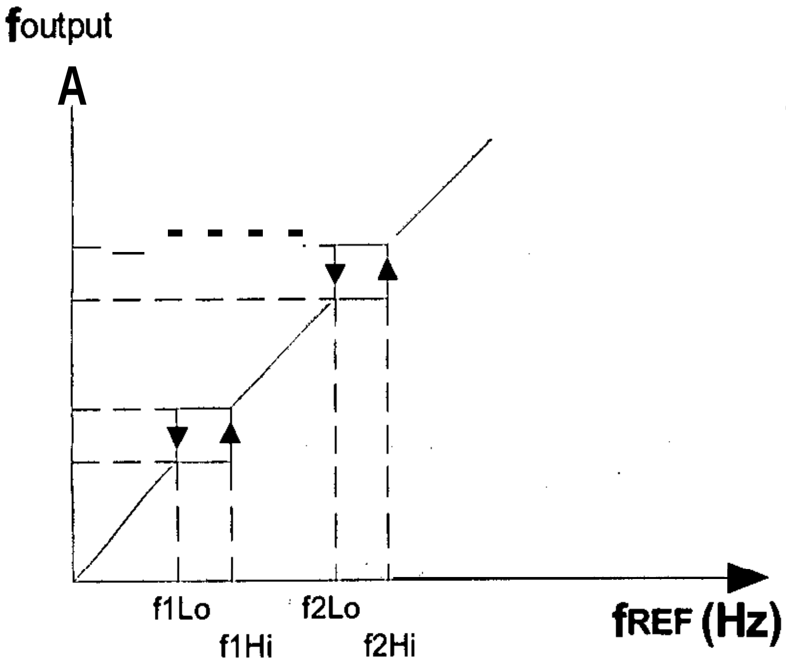
Parameter 2006
=0 disable
=1 enable 500 ms
- 2 enable without time limit

(Depends on the kinetic energy)

Drive behavior during power failure:

- **Power is recovered from the kinetic energy of the load**

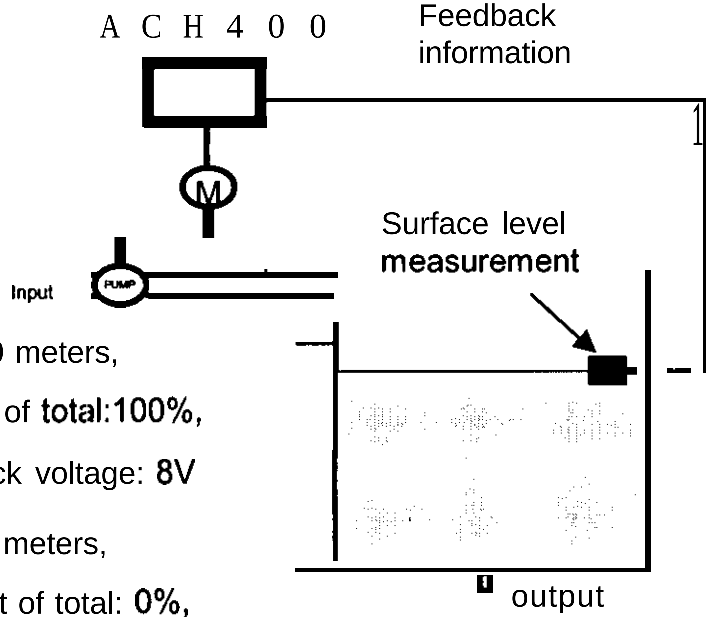
Critical frequency



- To avoid resonance problems in certain speed ranges
- Two adjustable jump speeds
- Individual settings for
  - skip frequency low limit
  - skip frequency high limit

PID-regulator P- control

- Level control is normally P only
- Averaging level : Low gain
- Tight level: High gain



High: 10 meters,

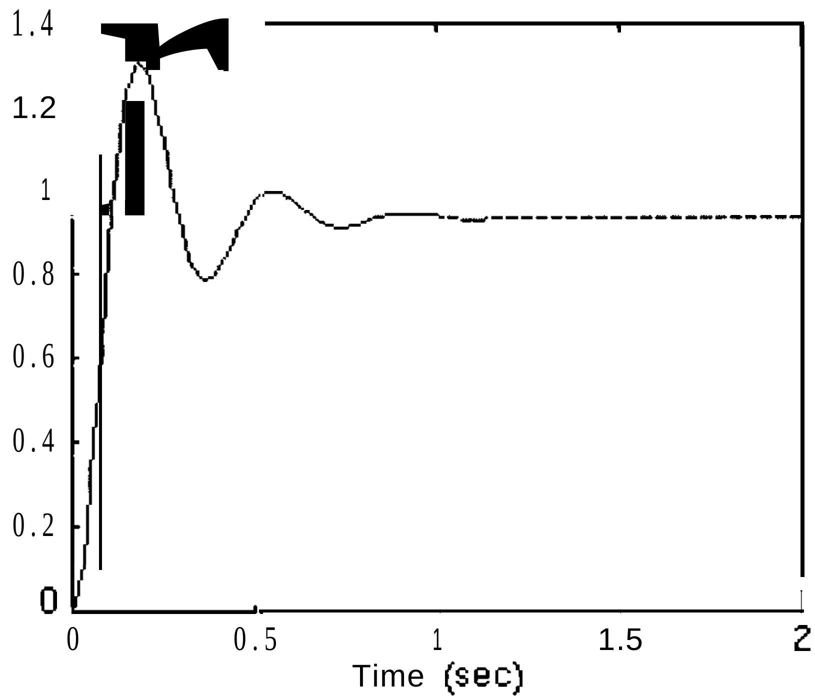
Percent of total:100%,

Feedback voltage: 8V

Low: 0 meters,

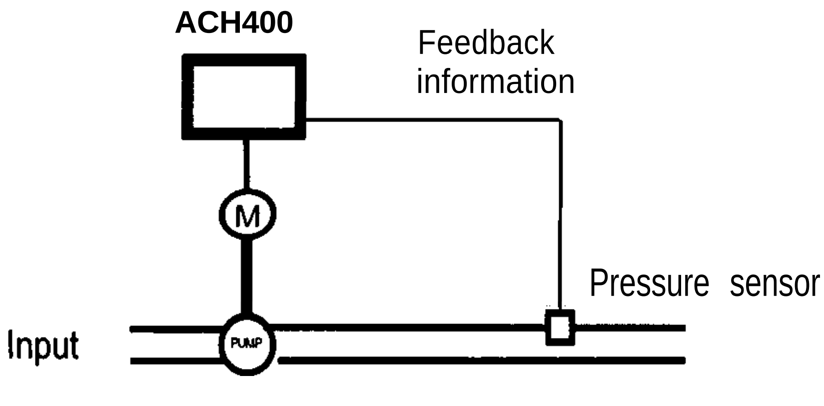
Percent of total: 0%,

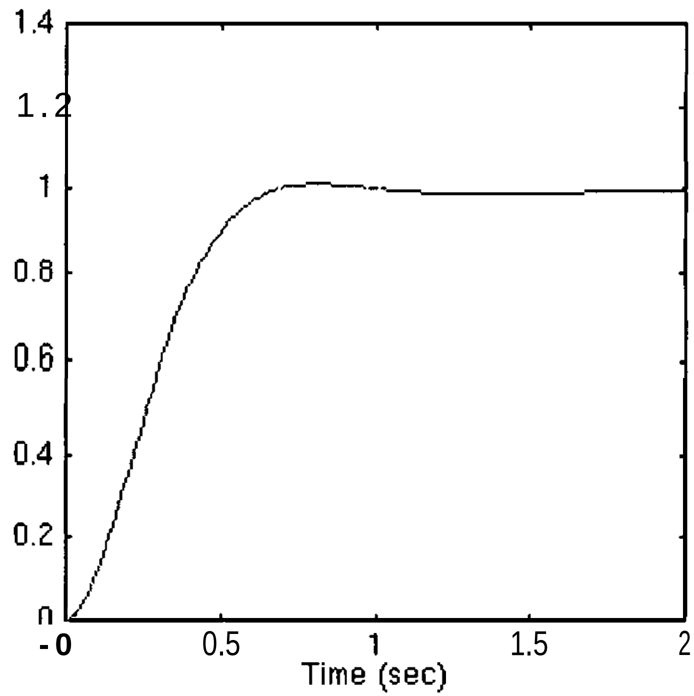
Feedback voltage: 4V



PID-regulator PI - Control

- Flow and pressure controls are normal PI
- For flow control low gain, fast integral time (T_i)
- For pressure control depends of the system

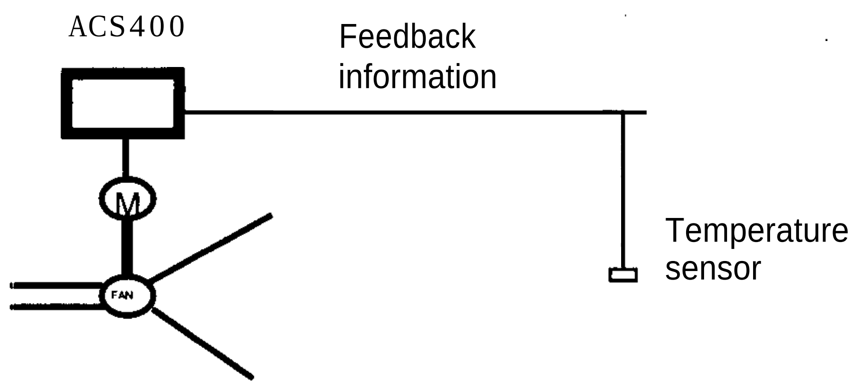




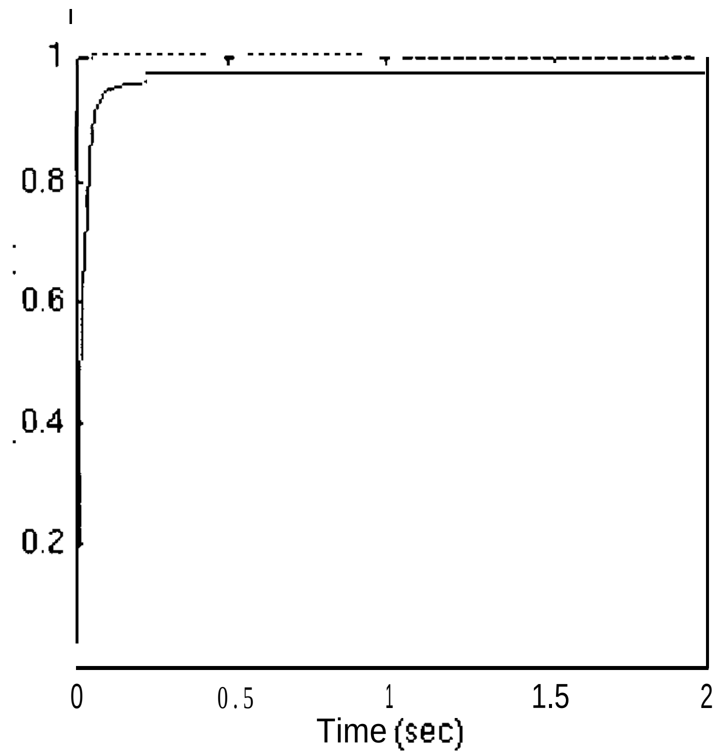
Integration time parameter 4002

PID-regulator PID - Control

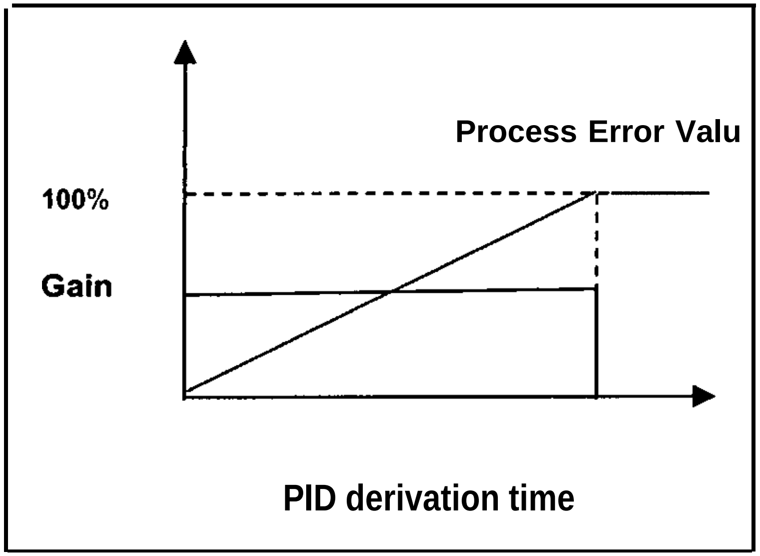
- **Temperature control is normally PID**
- **Gain 20-60; T_i = 2-5 min, Td = T_i/4**



Derivation time parameter 4003



PID-regulator Derivation time

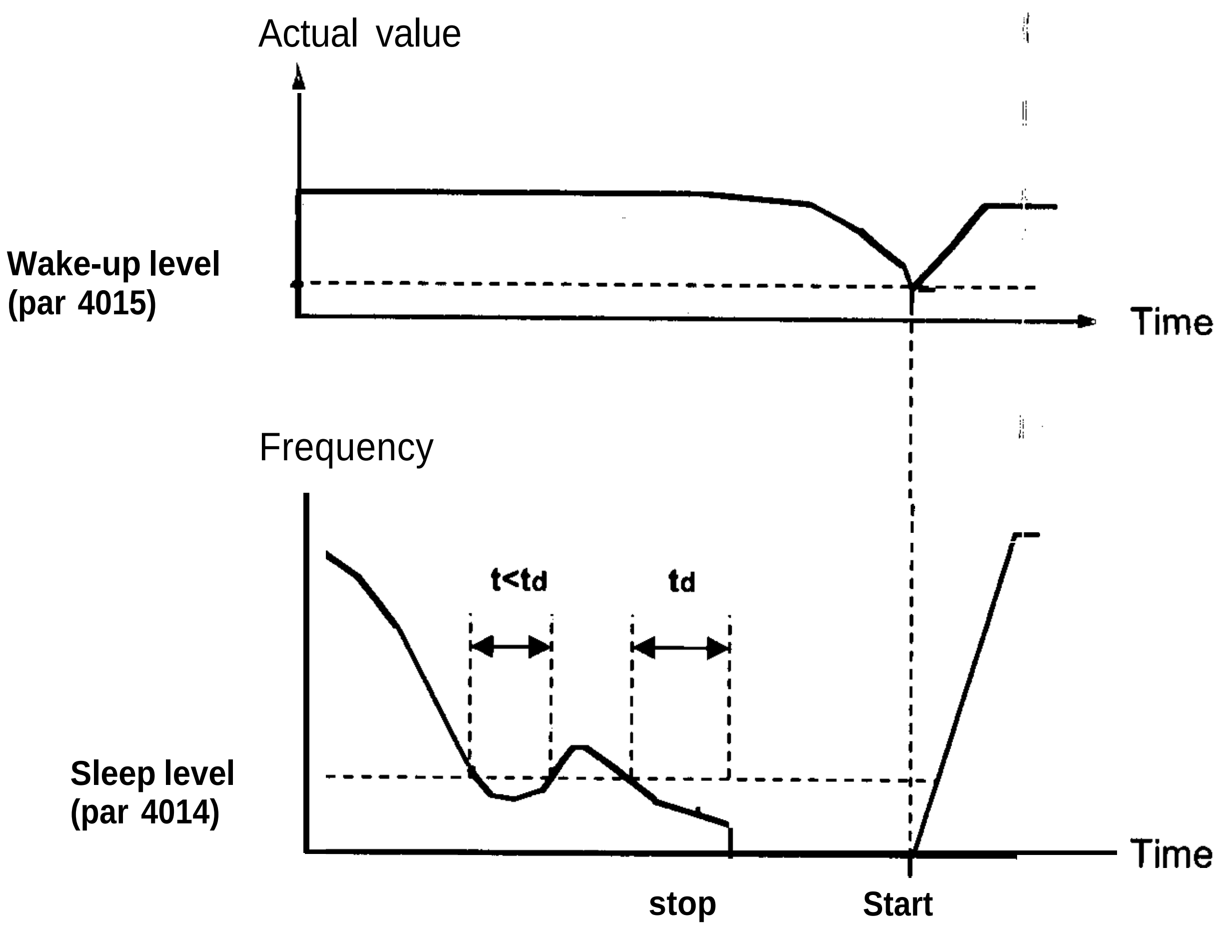


PID controller derivation time.

- **If the process error value changes linearly, D adds a constant value into the PID controller output.**
- **The derivative is filtered with a 1-pole filter.**
- **The time constant of the filter is defined by parameter (4004).**

PID-regulator Sleep function

- Sleep and wake-up available as a standard (Parameter 4015)



ACH 400 Application macros

- HVAC Hand - Auto
- HVAC - PID
- Floating Point
- Pump - Fan Control (2nd Qu.)

Designed to make the adaptation to customers application as easy as possible

ACH 400 macro: Hand-auto

Analog input

Hand (AI1)

Auto (AI2)

Digital input

Start/Stop (DI1 hand, DI5 auto)

Control location selection (DI3)

Analog output

Frequency (AO)

Relay output

Fault (RO1)

Running (R02)

> **Offers two external control locations**
> - **Typically in HVAC applications**

ACH 400 macro: PID-control

Analog input

Analog reference (All, Extl or Ext2)

Actual value (AI2)

Digital input

Start/Stop (DI1 manual, DI5 auto)

(Start; contact closed, Stop; contact open)

Control location selection (D12)

Constant speed (D13)

Run enable (D14)

Analog output

Frequency (AO)

Relay output

Fault (RO1)

Running (R02)

For use with different closed loop control systems

- pressure control
- flow control
- level control

ACH 400 Features

- **Summary of Features**
  - » 2 Analog Inputs
  - » 1 Analog Output
  - » 5 Digital'Inputs
  - » 2 Relay Outputs
  - » Serial Communication RS485 as standard for Modbus
  - » Power Loss Ride Through
  - » Flying Start
  - » Pre-Magnetizing Macro plus 7 other macros
  - » 7 Preset Speeds
  - » DC Hold
  - » DDCS + fieldbuses

ACH 400 / ACH 500 Comparison - Power

ACH 400	ACH 500
3-400 HP @ 480 VAC	3-400 HP @ 480 VAC
3-100 HP @ 200 - 240 VAC	2-40 HP @ 208 - 240 VAC
480 VAC + 10% rated	500 VAC + 10% rated
No input line fuses	Input line fuses standard
(2) DC line reactors 3-50 HP	(1) DC line reactor 2-400 HP
(1) Input 3 phase line reactor 60-400 HP	
Removable (remote mountable) keypad	Fixed keypad

ACH 400 / ACH 500 Comparison - I/O

ACH 400	ACH 500
(5) Digital inputs	(6) Digital inputs
(2) Analog inputs	(2) **Analog** inputs (pot)
(2) Relay outputs	(3) Relay outputs
(1) Analog output	(2) **Analog** outputs
H-O-A Keypad	H-O-A Switch
Up / down arrows	Hand speed pot

ABB Drives

ACH 400 The standard has just been raised

Information - Operating data section

- % Power output is now displayed in kW
- Run time - operating hours is now re-settable
- kWh counter - kWh counter is now re-settable
- Digital input and relay output status - now in op data section
- Analog input values - now in op data section
- Analog output value - now in op data section
- Process variables can be displayed in user units

ACH 400 The standard has just ‘been raised

Programmability

All applicable operating data can be tied to supervisory functions / relay and/or analog outputs

- **(7) preset speeds**
- **Relay outputs can be tied to more functions and now include programmable relay “on” and “off’ time delays**
- **DC brake upon start command ((premagnetization)**
- **Supervision capabilities have been expanded to all information in the operating data section and now include hysteresis adjustment capability**

ABB Drives

ACH 400 The standard has just been raised

Programmability - continued

- (29) Standard process variable units plus (2) custom units
- "On board" PID controller verses PI controller
- Standard "sleep" & "wake-up" programmability in PID macro
- Panel (keypad) upload / down load capability
- "Bumpless" transfer from "Auto" to "Hand" reference

ACH 400 The standard has just been raised

Serial Communications

- "Flash" loaded protocols available
- All analog values and digital input statuses are monitored / transmitted over the serial link
- The analog output value can be controlled over the serial link
- The relay outputs can be controlled over the serial link
- Underload (broken belt) indication over the serial link
- Active PID feedback is monitored over the serial link

ABB Drives

ACH 400 The standard has just been raised

Serial Communications - continued

- Loss of analog input indication over the serial link
- Drive fault information available over the serial link
- Fault reset capability over the serial link

ACH 400 The standard has just been raised

Electronic bypass features

- Micro processor based
- Keypad control with LED status indication
- "Auto" bypass - standard
- Input single phase protection - standard
- Voltage independent run contact receipt

ABB Drives

ACH 400 The standard has just been raised

Electronic bypass features - continued

- Selectable class 20 or class 30 electronic motor overload protection
- Regulated power supply with voltage tolerance off 35% - No contactor coil burn-out
- Fast acting semi-conductor fuses in the inverter circuit
- Two contactors - less connections, more reliable

ACH 400 The standard has iust 'been raised

Spec Stoppers

- New H-O-A keypad with "upload / download" capability
- Bumpless transfer feature of keypad
- DC injection brake at start (premagnetization)
- Loss of load (broken belt) feature
- (2) DC line reactors

ABB Drives

ACH 400 The standard has just been raised

Spec Stoppers

- Programmable time delays on relay outputs
- “Sleep” & “wake-up” functions
- Process variables user units
- Resettable ETM & kWh meters

ABB Drives

ACH 400 The standard has iust been raised

Spec stoppers - serial communications

ABB pioneered serial communications for the HVAC world

- **Drive relay output control over the serial link**
- **Drive analog output control over the serial link**
- **Drive digital input monitoring over the serial link**
- **Drive analog input monitoring over the serial link**

ACH 400 The standard has just been raised

Spec stoppers - serial communications - continued

- **Broken belt indication over the serial link**
- **Loss of reference indication over the serial link**
- **"Active" PID feedback over the serial link**
- **Fault queue & fault reset over the serial link**

1

GROUP	CODE	NAME	RANGE	RESOL	Default FACTORY0 / FACTORY1 / HVAC	Dep.: M=Ind. macro / H=HVAC macro / US=US defaults	B=Short Menu Par	S=Edit only in stop	E=Store to E2P	Is=Immed. save	U=Upload possible	DESCRIPTION
START-UP DATA	9901	**LANGUAGE**	0=ENGLISH, 1=ENGLISH (AM), 2=GERMAN, 3=ITALIAN, 4=SPANISH, 5=PORTUGUESE, 6=DUTCH, 7=FRENCH, 8=DANISH, 9=FINNISH, 10=SWEDISH, 11=RUSSIAN, 12=(reserved)	1	0 / US: 1	US	B		E	Is		Language selection
-99-	9902	**APPLIC MACRO**	0=FACTORY, 1=ABB STANDARD, 2=3-WIRE, 3=ALTERNATE, 4=MOTOR POT, 5=HAND/AUTO, 6=PID CONTROL, 7=PREMAGN, 8=PFC CONTROL, 9=RESERVED, 10=HVAC, 11=HVAC FL PNT, 12=HVAC PID, 13=HVAC PFC	1	0 / HVAC: 10		B	S	E	Is	U	Application macro selection. If hidden parameter 7505 g_bHvac =0, then the range is 0-8 and the default is 0; otherwise the range is 10-13 and the default is 10
	9904	**(MOTOR CTRL MODE)**	(0=DTC, 1=SCALAR)	(1)	(0)							Motor control mode. Note: this doesn't exist in ACS 400, this is only a place holder for ACS 400 interface kit parameter
	9905	**MOTOR** NOM **VOLT**	For 200 V units: 200,208,220,230,240 For 400 V units: 380,400,415,440,460,480V	-	230V / US: 230V 400V / US: 460V	US	B	S	E	Is		Nominal motor voltage from rating plate
	9906	**MOTOR** NOM **CURR**	0.5-1.5 *In	0.1 A	1.0*In		B	S	E	Is		Nominal motor current from rating plate
	9907	**MOTOR** NOM **FREQ**	0-250 Hz	1 Hz	50Hz / US: 60Hz	US	B	S	E	Is		Nominal motor frequency from rating plate
	9908	**MOTOR** NOM **SPEED**	0-3600 rpm	1 rpm	1440rpm / US: 1750rpm	US	B	S	E	Is		Nominal motor speed from rating plate
	9909	**MOTOR** NOM **POWER**	0.1-100.0kW / 0.1-134.1Hp	0.1kW / 0.1Hp	*		B	S	E	Is		Nominal motor power from rating plate. Default value depends on the inverter type. Unit is kW or Hp depending on the parameter 7503 g_bUsUnits value
	9910	**MOTOR COS PHI**	0.50-0.99	0.01	0.83		B	S	E	Is		Nominal motor cos phi from rating plate

GROUP	CODE	NAME	RANGE	RESOL	Default FACTORY0 / FACTORY1 / HVAC	Dep.: M=Ind. macro / H=HVAC macro / US=US defaults	B=Short Menu Par	S=Edit only in stop	E=Store to E2P	Is=Immed. save	U=Upload possible	DESCRIPTION
OPERATING DATA -01-	0102	**SPEED**	0-9999 rpm	1 rpm								Calculated speed in rpm
	0103	**OUTPUT FREQ**	0-250 Hz	0.1 Hz								Output frequency
	0104	**CURRENT**	-	0.1 A								Output current
	0105	**TORQUE**	-100 ... 100%	0.1 %								Output torque
	0106	**POWER**	-	0.1 kW								Motor power
	0107	**DC BUS VOLTAGE**	0-999.9 V	0.1 V								Intermediate circuit voltage (VDC)
	0109	**OUTPUT VOLTAGE**	0-480 V	0.1 V								Calculated motor voltage
	0110	**ACS400 TEMP**	0-150°C / 32-302°F	0.1°C / 0.1°F								Temperature of heatsink. Unit is °C or °F depending on the parameter 7503 g_bUsUnits value
	0111	**EXTERNAL REF 1**	0- 250 Hz	0.1 Hz								External reference 1
	0112	**EXTERNAL REF 2**	0-100 %	0.1 %								External reference 2
	0113	**CTRL LOCATION**	0=LOCAL, 1=EXT1, 2=EXT2	1								Active control location
	0114	**RUN TIME (R)**	0 - 9999 h	1 h					E			Elapsed time meter (resettable). To reset, write 0 (from serial link) or recall the default value =0 and write it (with panel)
	0115	**kWh COUNTER (R)**	0-9999 kWh	1 kWh					E			kWh meter (resettable). To reset, write 0 (from serial link) or recall the default value =0 and write it (with panel)
	0116	**APPL BLK OUTPUT**	0-100 %	0.1 %								Application block (PID Control) output signal
	0117	**DI1-DI4 STATUS**	0000-1111 binary, or 0-15 decimal	1								Status of digital inputs 1-4
	0118	**AI1**	0-100 %	0.1 %								Value of analog input 1
	0119	**AI2**	0-100 %	0.1 %								Value of analog input 2
	0121	**DI5 & RELAYS**	0000-0111 binary, or 0-7 decimal	1								Status of digital input 5 and relay outputs
	0122	**AO**	0-20 mA	0.1 mA								Value of analog output
	0124	**ACTUAL VALUE 1**	0-100 %	0.1 %								Feedback signal 1 for PID Controller
	0125	**ACTUAL VALUE 2**	0-100 %	0.1 %								Feedback signal 2 for PID Controller
	0126	**CONTROL DEV**	-100 ... 100%	0.1 %								Deviation of PID Controller
	0127	**PID ACT VALUE**	-100 ... 100%	0.1 %								Feedback signal for PID Controller

GROU	CODE				Default FACTORY0 / FACTORY1 / HVAC	Dep.: M=Ind. macro / H=HVAC macro / US=U defaults	B=Short Menu Par	S=Edit only in stop	E=Store to E2P	Is=Immed. save	U=Upload possible	DESCRIPTION
	0128	LAST FAULT	0-26	1			B		E			Last recorded fault
	0129	PREVIOUS FAULT	0-26	1					E			Previous recorded fault
	0130	OLDEST FAULT	0-26	1					E			Oldest recorded fault
	0131	SER LINK DATA 1	0-255	1								Free data location that can be written from serial link
	~~0132~~	SER LINK DATA 2	~~0-255~~	~~1~~								~~(as 0131)~~
	0133	SER LINK DATA 3	0-255	1								(as 0131)
	0134	PROCESS VAR 1	-	-								Process variable 1, as selected by parameters in group 34
	0135	PROCESS VAR 2	-	-								Process variable 2 (as 0134)
	0136	RUN TIME	0.00-99.99 kh	0.01 kh					E			Elapsed time meter
	0137	MWh COUNTER	0-9999 MWh	1 MWh					E			MWh meter

GROUP	CODE	NAME	RANGE	RESOL	Default FACTORY0 / FACTORY1 / HVAC	Dep.: M=Ind. macro / H=HVAC macro / US=US defaults	B=Short Menu Par	S=Edit only in stop	E=Store to E2P	Is=Immed. save	U=Upload possible	DESCRIPTION
COMMAND INPUTS	1001	EXT1 COMMANDS	0=NOT SEL, 1=DI1, 2=DI1,2, 3=DI1P,2P, 4=DI1P,2P,3, 5=DI1P,2P,3P, 6=DI5, 7=DI5,4, 8=KEYPAD, 9=DI1F,2R, 10=COMM	1	2 / 4 / HVAC: 1	M H		S	E	k	U	Start/Stop and Direction sources for EXT1. Write protected If FACTORY macro is selected
-10-	1002	EXT2 COMMANDS	(as 1001)	1	0	M H		S	E	Is	U	Start/Stop and Direction sources for EXT2
	1003	DIRECTION	1=FORWARD, 2=REVERSE, 3=REQUEST	1	3 / HVAC: 1	M	B	S	E	Is	U	Rotation direction lock
REFERENCE SELECT	1101	KEYPAD REF SEL	1=REF1(Hz), 2=REF2(%)	1	1				E	Is	U	Selection of active keypad reference
-11-	1102	EXT1/EXT2 SEL	1..5=DI1-DI5, 6=EXT1, 7=EXT2, 8=COMM	1	6	M H		S	E	Is	U	External control location selection source
	1103	EXT REF1 SELECT	O=KEYPAD. 1=AI1, 2=AI2, 3=AI1/JOYST, 4=AI2/JOYST, 5=DI3U,4D(R), 6=DI3U,4D, 7=DI4U,5D, 8=COMM 9=COMM+AI1, 10=COMM*AI1	1	1	M H		S	E	Is	U	External reference 1 source
	1104	EXT REF1 MIN	O-250 Hz	1 Hz	0 Hz				E	Is	U	External reference 1 minimum value
	1105	EXT REF1 MAX	O-250 Hz	1 Hz	50Hz / US: 60Hz	M H US	B		E	Is	U	External reference 1 maximum value
	1106	EXT REF2 SELECT	(as 1103)	1	0	M		S	E	Is	U	External reference 2 input
	1107	EXT REF2 MIN	O-100 %	1%	0%				E	Is	U	External reference 2 minimum value
	1108	EXT REF2 MAX	O-500 %	1%	100%				E	Is	U	External reference 2 maximum value
CONSTANT SPEEDS	1201	CONST SPEED SEL	0=NOT SEL, 1..5=DI1..DI5, 6=DI1,2, 7=DI3,4, 8=DI4,5, 9=DI1,2,3, 10=DI3,4,5	1	3 / 0 / HVAC: 10	M H		S	E	Is	U	Constant speed selection. Write protected if FACTORY macro is selected
-12-	1202	CONST SPEED 1	O-250 Hz	0.1 Hz	5 Hz		B		E	k	U	Constant speed 1
	1203	CONST SPEED 2	O-250 Hz	0.1 Hz	10 Hz		B		E	k	U	Constant speed 2
	1204	CONST SPEED 3	0250 Hz	0.1 Hz	15 Hz		B		E	k	U	Constant speed 3
	1205	CONST SPEED 4	O-250 Hz	0.1 Hz	20 Hz				E	k	U	Constant speed 4
	1206	CONST SPEED 5	0250 Hz	0.1 Hz	25 Hz				E	k	U	Constant speed 5
	1207	CONST SPEED 6	O-250 Hz	0.1 Hz	40 Hz				E	k	U	Constant speed 6

GROUP	CODE	NAME	RANGE	RESOL	Default FACTORY0 / FACTORY1 / HVAC	Dep.: M=Ind. macro / H=HVAC macro / US=US defaults	B=Short Menu Par	S=Edit only in stop	E=Store to E2P	Is=Immed. save	U=Upload possible	DESCRIPTION
	1208	CONST SPEED 7	0-250 Hz	0.1 Hz	50 Hz				E	Is	U	Constant speed 7

ABB Industry **AC Components**	ACS 400 Parameter list	**ACS400-SW-0315** **File: 400par29.XLS**

Dept	Prepared	Date	Approved	Rev Valid from SW version (label)
EGC	JMEH	2000-03-24		3.00 1.1.2.4

GROUP	CODE	NAME	RANGE	RESOL	Default FACTORY0 / FACTORY1 / HVAC	H=HVAC macro / US=US defaults	B=Short Menu Par	S=Edit only in stop	E=Store to E2P	Is=Immed. save	U=Upload possible	DESCRIPTION
ANALOGUE INPUTS **-13-**	1301	MINIMUM AIl	0.100%	1 %	0 %		B		E	Is	U	Minimun value of AI1. Value correspond to minimun reference
	1302	MAXIMUM AIl	O-100 %	1 %	100 %				E	Is	U	Maximun value of AI1. Value correspond to maximun reference
	1303	FILTER AIl	0-10 s	0.1 s	0.1 s				E	Is	U	Filter time constant for AI1
	1304	MINIMUM **AI2**	. °	1 %	0 %				E	Is	U	Minimun value of AI2. Value correspond to *minimun reference*
	1305	MAXIMUM AI2	O-100 %	1 %	100 %				E	Is	U	Maximun value of AI2. Value correspond to maximun reference
	1306	FILTER AI2	0-10 s	0.1 s	0.1 s				E	Is	U	Filter time constant for AI2
RELAY OUTPUTS **-14-**	1401	RELAY OUTPUT 1	O=NOT SEL. 1=READY, 2=RUN, =FAULT(-1), 4=FAULT, 5=ALARM 6=REVERSED, 7=*SUPRV1* OVER, 8=*SUPRV1* UNDER, 9=SUPRV 2 OVER. 10=SUPRV 2 UNDER, 11=AT SET POINT, 12=FAULT(RST), 13=FLT/ALARM, 14=EXT CONTROL, 15=REF 2 SEL. 16=CONST FREQ, 17=REF LOSS, 18=OVERCURRENT, 19=OVERVOLTAGE, 20=ACS400 TEMP. 21=ACS OVERLOAD, 22=UNDERVOLTAGE, 23=AI1 LOSS, 24=AI2 LOSS, 25=MOT OVR TMP, 26=STALL, 27=UNDERLOAD 28=PID SLEEP, 29=PFC, 30=AUTOCHANGE, 31=STARTED	1	3	M H		S	E	Is	U	Relay output 1 content. For those settings that refer to faults or alarms (e.g. OVER CURR. . ..), the relay activates on both alarm and fault
	1402	**RELAY** OUTPUT 2	(as 1401)	1	2	M H		S	E		U	Relay output 2 content
	1403	**RO** 1 ON DELAY	0-3600s	0.1; 1 s	0 s				E		U	Relay 1 on delay

ABB Industry AC Components	ACS 400 Parameter list		ACS400-SW-0315 File: 400par29.XLS
Dept	Prepared	Date	Approved	Rev Valid from SW version (label)
EGC	JMEH	2000-03-24		3.00 1.1.2.4

GROUP	CODE	NAME	RANGE	RESOL	Default FACTORY0 / FACTORY1 / HVAC	Dep.: M=Ind. macro / H=HVAC macro / US=US defaults	B=Short Menu Par	S=Edit only in stop	E=Store to E2P	Is=Immed. save	U=Upload possible	DESCRIPTION
	1404	RO 1 OFF DELAY	0-36005	0.1; 1 s	0 s				E	Is	U	Relay 1 off delay
	1405	RO 2 ON DELAY	0-3600s	0.1; 1 s	0 s				E	Is	U	Relay 2 off delay
	1406	RO 2 OFF DELAY	0-3600s	0.1; 1 s	0 s				E	Is	U	Relav 2 off delav

GROUP	CODE	NAME	RANGE	RESOL	Default FACTORY0 / FACTORY1 / HVAC	Dep.: M=Ind. macro / H=HVAC macro / US=US defaults	B=Short Menu Par	S=Edit only in stop	E=Store to E2P	Is=Immed. save	U=Upload possible	DESCRIPTION
ANALOGUE OUTPUT	1501	**AO CONTENT**	102-137	1	103				E	Is	U	Analog output content (number of parameter)
-15-	1502	**AO CONTENT MIN**		*	0.0 Hz				E	Is	U	Analog output content minimum. Limits and default value depend on AO content selection 1501
	1503	**AO CONTENT MAX**		*	50.0Hz / US: 60.0Hz	M H US	B		E	Is	U	Analog output content maximum. Limits and default value depend on AO content selection 1501
	1504	**MINIMUM AO**	0.0-20.0 mA	0.1 mA	0 mA				E	Is	U	Analog output signal minimum
	1505	**MAXIMUM AO**	0.0-20.0 mA	0.1 mA	20.0 mA				E	Is	U	Analog output signal maximum
	1506	**FILTER AO**	0-10 s	0.1 s	0.1 s				E	Is	U	Filter time constant for AO
SYSTEM CONTROLS	1601	**RUN ENABLE**	0=NOT SEL, 1..5=DI1..5, 6=COMM	1	0 / HVAC 2	M		S	E	Is	U	Run enable input
-16-	1602	**PARAMETER LOCK**	0=LOCKED, 1=OPEN, 2=NOT SAVED	1	1				E			Parameter lock. Parameter lock affects only parameter accesses with panel
	1604	**FAULT RESET SEL**	0=KEYPAD, 1..5=DI1..5, 6=START/STOP, 7=COMM	1	6 / HVAC 0	M		S	E	Is	U	Fault reset input. Note: KEYPAD can always reset
	1605	**LOCAL LOCK**	0=OPEN, 1=LOCKED	1	0				E	Is		Local lock. When LOCKED, panel can't move to local mode (however, the OFF button in HVAC panel is obeyed).
	1607	**PARAM. SAVE**	0=DONE, 1=SAVE..	1	0							Parameter save function. Selection 1 (SAVE..) saves all altered parameters to permanent memory; after this, value 0 (DONE) is restored.
	1608	**DISPLAY ALARMS**	0=NO, 1=YES	1	0				E	Is	U	When 1=YES, all alarms are displayed normally in the panel and green LED. When 0=NO, all alarms with alarm code number 10 or above except alarm 30. are suppressed, both in display and in green LED. Alarm 30 is always visible

GROUP	CODE	NAME	RANGE	RESOL	Default FACTORY0 / FACTORY1 / HVAC	Dep.: M=Ind. macro / H=HVAC macro / US=US defaults	B=Short Menu Par	S=Edit only in stop	E=Store to E2P	Is=Immed. save	U=Upload possible	DESCRIPTION
LIMITS	2003	MAX CURRENT	(depends on drive type and low noise setting)	0.1 A	1.5*In		B		E	k	U	Maximum output current
-20-	2005	**OVERVOLT** CTRL	0=DISABLE, I=ENABLE	1	1				E	k	U	DC overvoltage controller enable
	2006	UNDERVOLT CTRL	0=DISABLE, 1=ENABLE(TIME), Z-ENABLE	1	1				E	k	U	DC undervoltage controller enable. ENABLE(TIME) is enable with 500 ms limit for operation
	2007	MINIMUM FREQ	O-250 Hz	1 Hz	0 Hz				E	Is	U	Operating range minimum frequency
	2008	MAXIMUM FREP	O-250 Hz	1 Hz	;0Hz / US: 60Hz	M H US	B	S	E	Is	U	Operating range maximum frequency
START/STOP	2101	START FUNCTION	1=RAMP, 2=FLYING, 3=TORQUE BOOST, 4=FLY + BOOST	1	1 / HVAC: 1			S	E	Is	U	Conditions during motor acceleration
-21-	2102	STOP FUNCTION	1=COAST, 2=RAMP	1	1		B		E	k	U	Conditions during motor stop
	2103	**TORQ BOOST CURR**	(depends on drive type and low noise setting)	0.1 A	1.2*In			S	E	k	U	Maximun torque boost current
	2104	STOP DC INJ TIME	O-250 s	0.1 s	0 s				E	k	U	DC injection time at stopping
	2105	PREMAGNSEL	O=NOT SEL, 1..5=DI1..5, 6=CONST	1	0	M		S	E	k	U	Source for premagn command
	2106	PREMAGN MAX TIME	0.0-130.0 s	0.1 s	2 s				E	k	U	Max premagnetizing time
	2107	START **INHIBIT**	0=OFF, I=ON	1	1 / HVAC: 0				E	k	U	Start inhibit control. Start inhibit means: when fault reset or mode change (moving from Local mode to Remote mode: or switching between EXT1 and EXT2 modes; or ENABLE input raises) takes place: if there Is pending start command, that command is ignored.

GROUP	CODE	NAME	RANGE	RESOL	Default FACTORY0 / FACTORY1 / HVAC	Dep.: M=Ind. macro / H=HVAC macro / US=US defaults	B=Short Menu Par	S=Edit only in stop	E=Store to E2P	Is=Immed. save	U=Upload possible	DESCRIPTION
ACCEL/DECEL	2201	ACC/DEC 1/2 SEL	0=NOT SEL, 1..5=DI1..5	1	5 / HVAC: 0	M		S	E	Is	U	Source for ramp pair selection signal
-22-	2202	ACCELER TIME 1	0.1-1800 s	0.1; 1 s	5s / HVAC: 30s		B		E	Is	U	Time from 0 to maximum frequency; ramp 1
	2203	DECELER TIME 1	0.1-1800 s	0.1; 1 s	5s / HVAC: 30s		B		E	Is	U	Time from maximum frequency to 0; ramp 1
	2204	ACCELER TIME 2	0.1-1800 s	0.1; 1 s	60 s		B		E	Is	U	Time from 0 to maximum frequency; ramp 2
	2205	DECELER TIME 2	0.1-1800 s	0.1; 1 s	60 s		B		E	Is	U	Time from maximum frequency to 0; ramp 2
	2206	RAMP SHAPE	0=LINEAR, 1=FAST S CURVE, 2=MEDIUM S CRV, 3=SLOW S CURVE	1	0				E	Is	U	Ramp shape
CRITICAL FREQ	2501	CRIT FREQ SEL	0=OFF, 1=ON	1	0				E	Is	U	Critical frequencies jump over logic
-25-	2502	CRIT FREQ 1 LO	0-250 Hz	1 Hz	0 Hz				E	Is	U	Critical frequency 1 start
	2503	CRIT FREQ 1 HI	0-250 Hz	1 Hz	0 Hz				E	Is	U	Critical frequency 1 end
	2504	CRIT FREQ 2 LO	0-250 Hz	1 Hz	0 Hz				E	Is	U	Critical frequency 2 start
	2505	CRIT FREQ 2 HI	0-250 Hz	1 Hz	0 Hz				E	Is	U	Critical frequency 2 end
MOTOR CONTROL	2603	IR COMPENSATION	For 200 V units: 0-30 V For 400 V units: 0-60 V	1 V	10V / HVAC: 0V				E	Is	U	IR compensation voltage
-26-	2604	IR COMP RANGE	0-250 Hz	1 Hz	50 Hz				E	Is	U	IR compensation range
	2605	LOW NOISE	0=OFF, 1=ON(1) (2=ON(2))	1	0			S	E	Is	U	Motor noise option. ON(1) = 8 kHz switch. freq, ON(2) = 16 kHz switch freq. NOTE: Value 2 can be written only in Test Mode
	2606	U/f RATIO	1=LINEAR, 2=SQUARE	1	1 / HVAC: 2		B	S	E	Is	U	U/f below field weakening point
	2607	SLIP COMP RATIO	0-250 %	1 %	0 %			S	E	Is	U	Slip compensation strength

ABB Industry AC Components	ACS 400 Parameter list	ACS400-SW-0315 File: 400par29.XLS

Dept	Prepared	Date	Approved	Rev Valid from SW version (label)
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GROUP	CODE	NAME	RANGE	RESOL	Default FACTORY0 / FACTORY1 / HVAC	Dep.: M=Ind. macro / H=HVAC macro / US=US defaults	B=Short Menu Par	S=Edit only in stop	E=Store to E2P	Is=Immed. save	U=Upload possible	DESCRIPTION
FAULT FUNCTIONS	3001	**AI<MIN FUNCTION**	0=NOT SEL, 1=FAULT, 2=CONST SP 7, 3=LAST SPEED	1	1 / HVAC: 0	H			E	Is	U	Operation in case of AI<Minimum fault
-30-	3002	**PANEL LOSS**	1=FAULT, 2=CONST SP 7, 3=LAST SPEED	1	1				E	Is	U	Operation in case of keypad loss fault
	3003	**EXTERNAL FAULT**	0=NOT SEL, 1..5=DI1..5	1	0				E	Is	U	External fault input
	3004	**MOT THERM PROT**	0=NOT SEL, 1=FAULT, 2=WARNING	1	1 / HVAC: 0				E	Is	U	Motor overtemperature function
	3005	**MOT THERM TIME**	256-9999 s	1 s	500 s				E	Is	U	Time for 63% temperature rise
	3006	**MOT LOAD CURVE**	50-150 %	1 %	100 %				E	Is	U	Motor current maximum limit
	3007	**ZERO SPEED LOAD**	25-150 %	1 %	70 %				E	Is	U	Motor load curve point at zero speed
	3008	**BREAK POINT**	1-250 Hz	1 Hz	35Hz / HVAC: 15Hz				E	Is	U	Break point of motor load curve
	3009	STALL FUNCTION	0=NOT SEL. 1=FAULT, 2=WARNING	1	0				E	Is	U	Stall function
	3010	**STALL CURRENT**	(depends on drive type and low noise setting)	0.1 A	1.2*In				E	Is	U	Current limit for stall protection
	3011	**STALL FREQ HI**	0.5-50 Hz	0.1 Hz	20 Hz				E	Is	U	Frequency limit for stall protection logic
	3012	**STALL TIME**	10-400 s	1 s	20 s				E	Is	U	Time for stall protection logic
	3013	**UNDERLOAD FUNC**	0=NOT SEL, 1=FAULT, 2=WARNING	1	0				E	Is	U	Underload function
	3014	**UNDERLOAD TIME**	10-400 s	1 s	20 s				E	Is	U	Time limit for underload protection
	3015	**UNDERLOAD CURVE**	1-5	1	1				E	Is	U	Underload curve
	(3016)	**(MOTOR PHASE LOSS)**	(0=NOT SEL, 1=FAULT)	(1)	(1)							Motor phase loss supervision. Note: this doesn't exist in ACS 400, this is only a place holder for ACS 400 interface kit parameter
	3017	**EARTH FAULT**	@WARNING) 1=FAULT, 2=NO	1	1				E	Is	U	Earth fault detection. Note: Setting 0=WARNING doesn't exist in ACS 400, this k only a place holder for ACS 400 interface kit parameter setting
	3022	AI 1 FLT LIMIT	0-100%	1%	0%				E	Is	U	Analog input 1 fault limit

GROUP	CODE	NAME	RANGE	RESOL	Default FACTORY0 / FACTORY1 / HVAC	Dep.: M=Ind. macro / H=HVAC macro / US=US defaults	B=Short Menu Par	S=Edit only in stop	E=Store to E2P	Is=Immed. save	U=Upload possible	DESCRIPTION
	3023	AI 2 FLT LIMIT	0-100%	1%	0%				E	Is	U	Analog input 2 fault limit

GROUP	CODE	NAME	RANGE	RESOL	Default FACTORY0 / FACTORY1 / HVAC	Dep.: M=Ind. macro / H=HVAC macro / US=US defaults	B=Short Menu Par	S=Edit only in stop	E=Store to E2P	Is=Immed. save	U=Upload possible	DESCRIPTION
AUTOMATIC RESET	3101	NR OF TRIALS	0-5	1	/ HVAC: 2				E	Is	U	Number of faults limit for Autoreset logic
-31-	3102	TRIAL TIME	1 .0-180.0 s	0.1 s	30s				E	Is	U	Time limit for Autoreset logic
	3103	DELAY TIME	0.0-3.0 s	0.1 s	0s				E	Is	U	Time delay between reset attempts
	3104	AR OVERCURRENT	0=DISABLE, 1=ENABLE	1	0				E	Is	U	Enable automatic fault reset for overcurrent faults
	3105	AR OVERVOLTAGE	0=DISABLE, 1=ENABLE	1	0				E	Is	U	Enable automatic fault reset for overvoltage faults
	3106	AR UNDERVOLTAGE	0=DISABLE, 1=ENABLE	1	/ HVAC: 1				E	Is	U	Enable automatic fault reset for undervoltage faults
	3107	AR AI<MIN	0=DISABLE, 1=ENABLE	1	/ HVAC: 1				E	Is	U	Enable automatic fault reset for AI < MINIMUM AI faults
SUPERVISION	3201	SUPERV 1 PARAM	102-137	1	103				E	Is	U	1. Sup-wised parameter number
-32-	3202	SUPERV 1 LIM LO		-	0				E	Is	U	1. Supervision low limit. Display for this parameter depends on selected supervised parameter.
	3203	SUPERV 1 LIM HI		-	0				E	Is	U	1. Supervision high limit. Display for this parameter depends on selected supervised parameter.
	3204	SUPERV 2 PARAM	102-137	1	103				E	Is	U	2. Supervised parameter number
	3205	SUPERV 2 LIM LO		-	0				E	Is	U	2. Supervision low limit Display for this parameter depends on selected supervised parameter.
	3206	SUPERV 2 LIM HI		-	0				E	Is	U	2. Supervision high limit. Display for this parameter depends on selected supervised parameter
INFORMATION	3301	SW VERSION	0.0.0.0-f.f.f.f				B					SW version
-33-	3302	TEST DATE	yy.ww						E	k		Test date; year/week. Write protected, however can be written in test mode

GROUP	CODE	NAME	RANGE	RESOL	Default FACTORY0 / FACTORY1 / HVAC	Dep.: M=Ind. macro / H=HVAC macro / US=US defaults	B=Short Menu Par	S=Edit only in stop	E=Store to E2P	Is=Immed. save	U=Upload possible	DESCRIPTION
PROCESS VARIABLES -34-	3401	DISPLAY SEL	1=STANDARD, 2=PROCESS VAR	1	1				E	Is	U	Selection of panel displayed variables
	3402	P VAR 1 SEL	102-137	1	104				E	Is	U	Selection of process variable 1
	3403	P VAR 1 MULTIP	1-9999	1	1				E	Is	U	Process variable 1 multiplier
	3404	P VAR 1 DIVISOR	1-9999	1	1				E	Is	U	Process variable 1 divider
	~~3405~~	P VAR 1 SCALING	~~0-3~~	~~1~~	~~1~~				~~E~~	~~Is~~	~~U~~	~~Decimal point location of process variable 1,~~ when displayed
	3406	P VAR 1 UNIT	0=NO SEL, 1=A, 2=V, 3=Hz, 4=%, 5=s, 6=h, 7=rpm, 8=kh, 9=°C, 10=lb ft, 11=mA, 12=mV, 13=kW, 14=W, 15=kWh, 16=°F, 17=hp, 18=MWh, 19=m/s, 20=m3/h, 21=dm3/s, 22=bar, 23=kPa, 24=GPM, 25=PSI, 26=CFM, 27=ft, 28=MGD, 29=inHg, 30=FPM, 31=Cst	1	1				E	Is	U	Process variable 1 unit
	3407	P VAR 2 SEL	102-137	1	103				E	Is	U	Selection of process variable 2
	3408	P VAR 2 MULTIP	1-9999	1	1				E	Is	U	Process variable 2 multiplier
	3409	P VAR 2 DIVISOR	1-9999	1	1				E	Is	U	Process variable 2 divider
	3410	P VAR 2 SCALING	0-3	1	1				E	Is	U	Decimal point location of process variable 2. when displayed
	3411	P “AR 2 UNIT	(as 3406)	1	3				E	Is	U	Process variable 2 unit. See 3406

ABB Industry AC Components	ACS 400 Parameter list	ACS400-SW-0315 File: 400par29.XLS

Dept	Prepared	Date	Approved	Rev Valid from SW version (label)
EGC	JM/EH	2000-03-24		3.00 1.1.2.4

GROUP	CODE	NAME	RANGE	RESOL	Default FACTORY0 / FACTORY1 / HVAC	Dep.: M=Ind. macro / H=HVAC macro / US=US defaults	B=Short Menu Par	S=Edit only in stop	E=Store to E2P	Is=Immed. save	U=Upload possible	DESCRIPTION
PID CONTROL	4001	**PID GAIN**	**0.1-100**	0.1	1.0 / VAC: 2.5	M			E	Is	U	PID Controller gain selection
-40-	4002	PID **INTEG** TIME	0.1-320 s	0.1 s	60s / IVAC: 3s	M			E	Is	U	PID Controller I-time selection
	4003	PID DERN TIME	0-10 s	0.1 s	0 s				E	Is	U	PID Controller D-time selection
	4004	PID **DERIV** FILTER	O-10 s	0.1 s	1 s				E	Is	U	Time constant for the filter of D-term
	4005	**ERROR** VALUE **INV**	O=NO.1=YES	1	0				E	Is	U	PID Controller error value inversion
	4006	ACTUAL VAL SEL	1=ACT1, 2=ACT1-ACT2, 3=ACT1+ACT2, 4=ACT1*ACT2, 5=ACT1/ACT2, 6=MIN(A1,A2), 7=MAX(A1,A2), 8=sqrt(A1-A2), 9=sqA1+sqA2	1	1			S	E	Is	U	PID Controller actual signal selection
	4007	**ACT1** INPUT SEL	1=AI1, 2=AI2	1	/ HVAC: 1			S	E	Is	U	Actual 1 signal input selection
	4006	ACT2 INPUT SEL	1=AI1, 2=AI2	1	2			S	E	Is	U	Actual 2 signal input selection
	4009	**ACT1 MINIMUM**	0.1000%	1 %	0 %				E	Is	U	Minimum scaling factor of the Actual 1
	4010	**ACM MAXIMUM**	O-1000%	1 %	100 %				E	Is	U	Maximum scaling factor of the Actual 1
	4011	ACT2 MINIMUM	o-1000%	1 %	0 %				E	Is	U	Minimum scaling factor of the Actual 2
	4012	**ACT2 MAXIMUM**	o-1000%	1 %	100 %				E	Is	U	Maximum scaling factor of the Actual 2
	4013	PID SLEEP DELAY	0.0-3600 s	).1; 1 s	60 s				E	Is	U	Time delay for the sleep function
	4014	PID SLEEP LEVEL	0.0-120 Hz	0.1 Hz	0 Hz				E	Is	U	Level for activation of sleep function
	4015	**WAKE-UP LEVEL**	**0.0-100 %**	0.1%	0 %				E	Is	U	Level for deactivation of sleep function
	4016	**PID PARAM SET**	1..5=DI1..5, 6=SET 1. 7=SET 2	1	6				E	Is	U	PID parameter set selection
	4017	WAKE-UP DELAY	0-60s	0.015	0.50s				E	Is	U	Wake-up delay
	4016	**SLEEP SELECTION**	0=INTERNAL, 1..5=DI1..5	1	0			S	E	Is	U	Sleep source selection
	4019	SET POINT **SEL**	1=INTERNAL, 2=EXTERNAL	1	2				E	Is	U	Set point selection. 1=INTERNAL: PID set point is parameter 4020 INTERNAL SETPNT. 2=EXTERNAL: PID set point is external reference as selected through parameters in group 11

GROUP	CODE	NAME	RANGE	RESOL	Default FACTORY0 / FACTORY1 / HVAC	Dep.: M=Ind. macro / H=HVAC macro / US=US defaults	B=Short Menu Par	S=Edit only in stop	E=Store to E2P	Is=Immed. save	U=Upload possible	DESCRIPTION
	4020	**INTERNAL SETPNT**	0.0 00.0%	0.1%	40%				E	Is	U	Internal set point. See parameter 4019 SET POINT SEL

GROUP	CODE	NAME	RANGE	RESOL	Default FACTORY0 / FACTORY1 / HVAC	Dep.: M=Ind. macro / H=HVAC macro / US=US defaults	B=Short Menu Par	S=Edit only in stop	E=Store to E2P	Is=Immed. save	U=Upload possible	DESCRIPTION
PID CONTROL (2) -41-	4101	PID GAIN	0.1-100	0.1	1.0				E	Is	U	PID Controller gain selection. Param set 2
	4102	PID INTEG TIME	0.1-320 s	0.1 s	60 s				E	Is	U	PID Controller I-time selection. Param set 2
	4103	PID DERIV TIME	0-10 s	0.1 s	0 s				E	Is	U	PID Controller D-time selection. Param set 2
	4104	PID DERIV FILTER	0-10 s	0.1 s	1 s				E	Is	U	Time constant for the filter of D-term. Param set 2
	4105	ERROR VALUE INV	(as 4005)	1	0				E	Is	U	PID Controller error value inversion. Param set 2
	4106	ACTUAL VAL SEL	(as 4006)	1	1			S	E	Is	U	PID Controller actual signal selection. Param set 2
	4107	ACT1 INPUT SEL	(as 4007)	1	2			S	E	Is	U	Actual 1 signal input selection. Param set 2
	4108	ACT2 INPUT SEL	(as 4008)	1	2			S	E	Is	U	Actual 2 signal input selection. Param set 2
	4109	ACT1 MINIMUM	0-1000%	1 %	0 %				E	Is	U	Minimum scaling factor of the Actual 1. Param set 2
	4110	ACT1 MAXIMUM	0-1000%	1 %	100 %				E	Is	U	Maximum scaling factor of the Actual 1. Param set 2
	4111	ACT2 MINIMUM	0-1000%	1 %	0 %				E	Is	U	Minimum scaling factor of the Actual 2. Param set 2
	4112	ACT2 MAXIMUM	0-1000%	1 %	100 %				E	Is	U	Maximum scaling factor of the Actual 2. Param set 2
	4119	SET POINT SEL	(as 4019)	1	2				E	Is	U	Set point selection, param. set 2.
	4120	INTERNAL SETPNT	0.0 - 100.0%	0.1%	40.0%				E	Is	U	Internal set point, param. set 2

GROUP	CODE	NAME	RANGE	RESOL	Default FACTORY0 / FACTORY1 / HVAC	Dep.: M=Ind. macro / H=HVAC macro / US=US defaults	B=Short Menu Par	S=Edit only in stop	E=Store to E2P	Is=Immed. save	U=Upload possible	DESCRIPTION
COMMUNICATION -50-	5001	DDCS BIT RATE	1=1 Mbits/s, 2=2 Mbits/s, 4=4 Mbits/s, 8=8 Mbits/s	-	1			S	E	Is	U	DDCS link communication speed
	5002	DDCS NODE NR	1-254	1	1			S	E	Is		DDCS link node number
	5003	COMM FAULT TIME	0.1-60s	0.1s	1s				E	Is	U	Communication time out (Std MODBUS or DDCS links)
	5004	COMM FAULT FUNC	0=NOT SEL, 1=FAULT, 2=CONST SP 7, 3=LAST SPEED	1	0				E	Is	U	Communication fault function (Std MODBUS or DDCS links)
	5005	PROTOCOL SEL	0=NOT SEL, 1=DDCS, 2=STD MODBUS, 3=STD MDB+DDCS, (4=OEM APPLIC, 5=OEM APP+DDCS)	1	0			S	E	Is	U	Protocol SW selection. If hidden parameter 7506 g_bFlashApplic =0, then the range is 0-3; otherwise the range is 0-5
	5006	COMM COMMANDS	0=NOT SEL, 1=STD MODBUS, 2=DDCS, (3=OEM APPLIC)	1	0			S	E	Is	U	The commands source protocol selection. If hidden parameter 7506 g_bFlashApplic =0, then the range is 0-2; otherwise the range is 0-3
	5007	DDCS BUS MODE	1=FIELDBUS, 2=IO EXTENSION	1	1			S	E	Is	U	Sets the operation mode of the DDCS link. Value 2 can be used when PFC macro is selected.
	5008	DDCS LINK CTRL	0-15	1	8			S	E	Is	U	Controls the DDCS link light intensity
	5009	DDCS HW CONFIG	0=STAR, 1=RING	1	1			S	E	Is	U	DDCS link HW configuration
EXT COMM MODULE (DDCS LINK)	5101	FIELDBUSPAR1	-	-	-				E	Is		Parameter 1 of comm. module in DDCS link. Contains identification of the fieldbus module. If viewed with panel, containts identifying number. If viewed through DDCS link, containts identifying text string.
-51-	5102 - 5115	FIELDBUSPAR2 - FIELDBUSPAR15	-	-	-				E	Is		Parameters 2 - 15 of comm. module in DDCS link

GROUP	CODE	NAME	RANGE	RESOL	Default FACTORY0 / FACTORY1 / HVAC	Dep.: M=Ind. macro / H=HVAC macro / US=US defaults	B=Short Menu Par	S=Edit only in stop	E=Store to E2P	Is=Immed. save	U=Upload possible	DESCRIPTION
STANDARD MODBUS	5201	STATION ID	1-247	1	1				E	Is		Station ID
-52-	5202	COM SPEED	3=300 bits/s, 6=600 bits/s, 12=1200 bits/s, 24=2400 bits/s, 48=4800 bits/s, 96=9600 bits/s, 192=19200 bits/s	-	96				E	Is	U	Communication speed
(COMM PORT 1)	5203	PARITY	0=NONE, 1=EVEN, 2=ODD	1	0				E	Is	U	Parity
	5206	BAD MESSAGES	0-FFFF	1					E			Counter for messages not accepted
	5207	GOOD MESSAGES	0-FFFF	1					E			Counter for messages accepted
	5208	BUFFER OVERRUNS	0-FFFF	1					E			Counter for message chars exceeding buffer size
	5209	FRAME ERRORS	0-FFFF	1					E			Counter for characters with frame error
	5210	PARITY ERRORS	0-FFFF	1					E			Counter for characters with parity error
	5211	CRC ERRORS	0-FFFF	1					E			Counter for messages with CRC error
	5212	BUSY ERRORS	0-FFFF	1					E			Counter for chars received while serving another query
	5213	SER FAULT MEM 1	0-255	1					E			Serial fault memory 1
	5214	SER FAULT MEM 2	0-255	1					E			Serial fault memory 2
	5215	SER FAULT MEM 3	0-255	1					E			Serial fault memory 3
OEM APPLICATION (FLASH)	5301	OEM APP PAR1	-	-	-				E	Is		Parameter 1 of application in FLASH PROM. If hidden parameter 7506 g_bFlashApplic =0, then this group and all the parameters within it are hidden; otherwise they are visible
-53-	5302 - 5315	OEM APP PAR2 - OEM APP PAR15	-	-	-				E	Is		(as parameter 5301)

GROUP	CODE	NAME	RANGE	RESOL	Default FACTORY0 / FACTORY1 / HVAC	Dep.: M=Ind. macro / H=HVAC macro / US=US defaults	B=Short Menu Par	S=Edit only in stop	E=Store to E2P	Is=Immed. save	U=Upload possible	DESCRIPTION
PFC CONTROL	8103	REFERENCE STEP 1	0.0-100%	0.1%	0%				E	Is	U	Reference step 1. Process reference increase when 1st auxiliary motor is started
-81-	8104	REFERENCE STEP 2	0.0-100%	0.1%	0%				E	Is	U	Reference step 2. Process reference increase when 2nd auxiliary motor is started
	8105	REFERENCE STEP 3	0.0-100%	0.1%	0%				E	Is	U	Reference step 3. Process reference increase when 3rd auxiliary motor is started
	8109	START FREQ 1	0.0-250Hz	0.1Hz	50Hz / US: 60Hz	US			E	Is	U	Start frequency 1. Frequency limit to start 1st auxiliary motor
	8110	START FREQ 2	0.0-250Hz	0.1Hz	50Hz / US: 60Hz	US			E	Is	U	Start frequency 2. Frequency limit to start 2nd auxiliary motor
	8111	START FREQ 3	0.0-250Hz	0.1Hz	50Hz / US: 60Hz	US			E	Is	U	Start frequency 3. Frequency limit to start 3rd auxiliary motor
	8112	LOW FREQ 1	0.0-250Hz	0.1Hz	25Hz				E	Is	U	Low frequency 1. Frequency limit to stop 1st auxiliary motor
	8113	LOW FREQ 2	0.0-250Hz	0.1Hz	25Hz				E	Is	U	Low frequency 2. Frequency limit to stop 2nd auxiliary motor
	8114	LOW FREQ 3	0.0-250Hz	0.1Hz	25Hz				E	Is	U	Low frequency 3. Frequency limit to stop 3rd auxiliary motor
	8115	AUX MOT START D	0.0-3600s	0.1s; 1s	5s				E	Is	U	Start delay for auxiliary motors
	8116	AUX MOT STOP D.	0.0-3600s	0.1s; 1s	3s				E	Is	U	Stop delay for auxiliary motors
	8117	NR OF AUX MOT	0-3	1	1			S	E	Is	U	Number of auxiliary motors
	8118	AUTOCHNG INTERV	0.0h=NOT SEL, 0.1-336h	0.1h	0.0h				E	Is	U	Time interval for autochange function
	8119	AUTOCHNG LEVEL	0.0-100.0 %	0.1 %	50%				E	Is	U	PFC output level for autochange function
	8120	INTERLOCKS	0=NOT SEL, 1..5=DI1..DI5, 6=EXTERNAL IO	1	4 / HVAC: 0			S	E	Is	U	Interlocks. The group of inputs used for interlock signals starts at the setting. The number of inputs in the group is parameter 8117 NR OF AUX MOT. When 6 is selected, all interlock signals come from NDIO module.

ABB Industry AC Components	ACS 400 Parameter list	ACS400-SW-0315 File: 400par29.XLS

Dept	Prepared	Date	Approved	Rev	Valid from SW version (label)
EGC	JMEH	2000-03-24		3.00	1.1.2.4

GROUP	CODE	NAME	RANGE	RESOL	Default FACTORY0 / FACTORY1 / HVAC	Dep.: M=Ind. macro / H=HVAC macro / US=US defaults	B=Short Menu Par	S=Edit only in stop	E=Store to E2P	Is=Immed. save	U=Upload possible	DESCRIPTION
	8121	REGBYPASSCTRL	0=NO, 1=YES	1	0				E	Is	U	PID controller by-pass. - If setting is 1=YES, the set point as selected through parameter 4019/4119 SET POINT SEL is directly used as PFC reference
	8122	PFC START DELAY	0-10s	0.01s	0.5s				E	Is	U	PFC start delay. Start delay for the speed regulated motor

Work Procedure for accessing hidden Parameters

1. Install ACS-PAN-B operator panel
2. Depress MENU and use UP ARROW until Group 33 INFORMATION is visible on the display
3. Depress ENTER to access parameter 3301 (software version). Software version 1.0.3.E or higher is necessary for HVAC Macros
4. Depress ENTER and RESET simultaneously for 3 seconds. The display will "blink"
5. Depress MENU. An exclamation point should be present on the middle right of the operator display. This indicates that you now have access to the hidden parameter group. Groups 61 through 75 are normally hidden. Use ***extreme caution in changing any of these hidden parameters. These change the performance characteristics of the drive and fault settings.***
6. To change the drive from ACS400 to ACH400 use the DOWN ARROW key and scroll to Group 75.
7. Scroll to Hidden Parameter 7505.
8. Depress ENTER. The default value (0) should be underlined indicating the value can be changed.
9. Depress the UP ARROW key and change the value to (I). This modifies the drive firmware to ACH400 operating characteristics and Macros.
10. Hidden Parameter 7503 can also be changed from default (0) to (1) for US units of measure.
11. To change the drive back to an ACS 400 simply use the above procedure, but change parameter 7505 from 1 to 0.
12. To exit the hidden parameter mode power the drive off/on.

ABB Industry AC Components		ACS 400 Parameter list (hidden params)			ACS400-SW-0422 File: 400phd29.xls
Dept	Prepared	Date	Approved	Rev	Valid from SW version (label)
EGC	JM/EH	2000-03-24		3.00	1.1.2.4

GROUP	CODE	NAME	RANGE	Default	S=Edit only in stop	E=Store to E2P	Is=Immed. save	DESCRIPTION
DISPLAYED VALUES -00-	0001	g_wFOut	0-250Hz	-				ACS-100-PAN displayed output frequency; 10 = 1Hz
	0002	g_wIActFilt	0-2*In	-				ACS-100-PAN displayed output current; 10 = 1A
OPERATING DATA -01-	0138	g_wMotorTemp	0-100%	-				Calculated motor temperature; 10 = 1%. Operation with 3004 MOT THERM PROT values: if 0=NOT SEL, then calculated motor temperature is initialised. If 1=FAULT, then 97.5% is alarm level, 100% is fault trip level, and 95% is reset level. If 2=WARNING, then 95% is alarm level
	0139	g_wSWTemp	0-100%	-				Overload detection status variable; 10 = 1%. Fault trip level is given by parameters 6501, 6511, 6512 based on parameter 2605 LOW NOISE value. The respective alarm level is 97.5% of the trip level
STANDARD MODBUS -52-	5216	g_wRecErrORER	0-FFFF	-		E		Counter for chars received before reading previous char. The previous char will be lost, ie. overrun situation.

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Profile, Fault and Alarm words	0301	g_wProfileCmd	0-FFFF	-				Profibus profile command WORD: bit0=OFF1, bit1=OFF2, bit2=OFF3, bit3=RUN, bit4=(reserved), bit5=Ramp hold, bit6=Ramp i/, 0, bit7=Flt reset, bit8..10=(reserved), bit11=EXT2/EXT1, bit12..15=(reserved)
-03-	0302	g_wProfileStatus	0-FFFF	-				Profibus profile status WORD: bit0=RDYON, bit1=RDYRUN, bit2=RDYREF, bit3=FAULTED, bit4=OFF_2_STA, bit5=OFF_3_STA, bit6=SwcOnInhib, bit7=WARNING, bit8=AT_SETPOINT, bit9=REMOTE, bit10=ABOVE_LIMIT, bit11=EXT_CNTL_LOC, bit12=NO_INTERLOCKS
lote: Group 03 is always visible from serial communication :hannels (OOCS. std Modbus)	0305	g_wFaultWord1	0-FFFF					FaultWord1; bit0=OC, bit1=OV, bit2=OT, bit3=FC, bit4=OL, bit5=UV, bit6=AI1L, bit7=AI2L, bit8=MT, bit9=PL, bit10=PAR, bit11=UCR, bit12=STALL, bit13=MBL, bit14=EXT, bit15=EARTH
	0306	g_wFaultWord2	0-FFFF					FaultWord2; bit0=UL, bit1 =App, bit0=BEE, bit2=DDCS, bit6=Dwnload, bit7=BFL, bit8=NFL, bit9=FLC, bit10=FLP, bit11=BAI, bit12=size, bit13=SINT, bit14=ass, bit15=mod
	0308	g_wAlarmWord1	0-FFFF	•		E		Alarm Word I; bit0=OC, bit1=OV, bit2=UV, bit3=DIR, bit4=MBL, bit5=MBE, bit6=AI1L, bit7=AI2L, bit8=PL, bit9=OT, bit10=MT, bit11=UL bit12=STALL, bit13=DDCS, bit14=App, bit15=OFF
	0309	g_wAlarm Word2	0-FFFF	•		E		Alarm Word2 ; bit0=OL, bit1=AR, bit2=Sleep
OOCS link control	6003	g_bDdcsDIn	O-FF					Digital input data received from NDIO modules: bit 0 = Input 1 of NDIO module at address 5; bit 1 = input 2 of NDIO module at address 5; bit 2 = Input 1 of NDIO module at address 6; bit 3 = Input 2 of NDIO module at address 6
-60-	6004	g_bDdcsDOut	O-FF					Digital output data to NDIO modules: bit 0 = output 1 of NDIO module at address 5: bit 1 = outout 2 of NDIO module at address 5: bit 2 = outout 1 of NDIO module at address 6; bit 3 = output 2 of NDIO module at address 6

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Trend configuration -61-	*6101*	*g_wTimeLevel*	*1-65535*	*2*		*E*	*Is*	*Trend time level (1=2 ms, 2=4 ms,...)*
	6102	*g_wTrendVar_1*	*1-FFFE*	*		*E*	*Is*	*Channel 1 variable (g_wCurrent as default)*
	6103	*g_wTrendVar_2*	*1-FFFE*	*		*E*	*Is*	*Channel 2 variable (g_wVolMeas as default)*
	6104	*g_wTrigVar*	*1-FFFE*	*		*E*	*Is*	*Trig variable (g_wCurrent as default)*
	6105	*g_wTrigLevel*	*0-65535*	*2000*		*E*	*Is*	*Trig level*
	6106	*g_bPostTrigCnt*	*0-49*	*25*		*E*	*Is*	*Post trig count*
	6107	*g_bTrigType*	*0-255*	*3*		*E*	*Is*	*Trig type; bit 0=fault, bit 1=over level, bit 2=under level, bit 3=equal, bit 4=not equal*
	6108	*g_bVarTypes*	*0-255*	*63*		*E*	*Is*	*Trig type; bit 0=var1 rwm, bit 1=var1 word, bit 2=var2 rwm, bit 3=var2 word, bit 4=trig rwm, bit 5=trig word,bit 6=trig bit*
	6109	*g_bTrendPtr*	*0-255*	*0*				*Trend pointer*
	6110	*g_bTrendStatus*	*0-255*	*16*				*Trend status; bit0=RUN, 1=TRIGGED, 2=STOP,3=CNF_ERROR,4=CNF*

GROUP	CODE	NAME	[redacted]GE	Default	S=Edit only in stop	E=Store to E2P	Is=Immed. save	DESCRIPTION
Flying start	[redacted]	g_wRestartDelayPar	[redacted]	0		E	Is	Restart delay, in ms. If =0, then type dependent value is used internally
-62-	6202	[redacted]g_bFSCurrLim	[redacted]	0		E	Is	Fly start test current, as percentage of the greater of inverter nominal current, and motor nominal current. Value =0: internal value dep. on drive type is used
	6203	g_[redacted]rateStepMin	1-255	8		E	Is	voltage ramp steepness when finding ny start test current
	6204	g_[redacted]rtFilt	1-65535	120		E	Is	Average current filtering time constant, in 0.1 ms
	6205	g_wFlyPipeDwn	1-65535	20		E	Is	The amount of current drop below test current for flv start loaic to accept that avera e current falls. 10=1%
	6206	g_bFlyStabilTimer	1-255	20		E	Is	Time interval that fly start logic allows for average current to stabilise at
	6207	g_bVoltBalance	1-255	2		E	Is	Therate at whichflystart test voltageisrisen normalvoltageatgiven fre uenc , is 512ms/ _bVoltBalance
	6208	g_bFlyStartRampOver	0-100	5		E	Is	Fly start begins searching motor speed with frequency = FMAX + g_bFlyStartRampOver; 1 = 1Hz
	6209	g_bFlyStartRampPar	1-255	8		E	Is	Fly start output frequency sweep speed; 1 = 5Hz/s, 2 = 10Hz/s, ...
	6211	g_bFSCurrLim20	0-100	0		E	Is	Fly start outputs two voltage ramps when serching for a good output voltage. Between the two ramps the output voltage is held at 0, until current drops to g_bFSCurrLim20 percentage of the initial current target. 1 =1%. Value =0: Internal value dep. on drive type is used
	6212	g_wFlyStartRampEnd	I-65535	500		E	Is	Fly start output frequency sweep ending frequency. 100 = 1Hz
	6213	g_bAveCurrTestVal	O-255	0		E	Is	Offset for average current in fly start logic. Value =0: internal value dep. on drive type is used
	6214	g_bFSVolMin	o-255	0		E	Is	Minimum applied voltage during fly start ramp (offset lo output voltage). Value =0: internal value dep. on drive type is used
	6215	g_bStartBstP	O-255	0		E	Is	Start boost current controller P. Value =0: internal value dep. on drive type is used
	6216	g_bStartBstD	O-255	0		E	Is	Start boost current controller D part time constant; 10==1 ms. Value =0: Internal value dep. on drive type is used
	6217	g_wStartBstDF	lo-65535	0		E	Is	Start boost current controller D part filter time constant; 10==1 ms. Value =0: internal value dep. on drive type is used
	6218	g_bStartBstI	O-255	0		E	Is	Start boost current controller I part time constant; 10==1 ms. Value =0: infernal value dep. on drive type is used

ABB Industry c components	ACS 400 Parameter list (hidden params)	ACS400-SW-0422 File: 400phd29.xls

ept	Prepared	Date	Approved	Rev	Valid from SW version (label)
3C	JMEH	2000-03-24		3.00	1.1.2.4

GROUP	CODE	NAME	RANGE	Default	S=Edit only in stop	E=Store to E2P	Is=Immed. save	DESCRIPTION
Status variables -63-	6301	g_wPOnTime	0-65535	-		E		Power on time 1 = 10 h
	6305	g_wFPanelRef1	0-250 Hz	-		E		Panel Reference 1; 10 = 1Hz
	6306	g_wFPanelRef2	0-500 %	-		E		Panel Reference 2; 10 = 1%
	6307	g_bSystTestCntr	0-255	0		E	Is	System test 1 counter; Writing possible only when test mode is on.
	6308	g_bToolWatchDog	0-255	0				Tool mode watchdog counter
	6309	g_bFaultMask	0-255	0		E	Is	Fault mask; bit0=Overload, bit1=Panel loss, bit2=UC ripple, bit3=Bad AIn, bit4=HW temp
	6310	g_dwFlashEraseCnt	0-65535	-		E		Flash erase counter, high WORD part
	6311	(see 6310)	0-65535	-		E		Flash erase counter, low WORD part
DC brake configuration -64-	6401	g_bVoltBrakeMax	0-60	30		E	Is	DC brake max voltage; 1=1 V
	6402	g_bRefBrakeLevel	0-150	100		E	Is	DC brake max current, % of nominal peak current; 1=1%
	6403	g_bRefBrakeMin	0-100	30		E	Is	DC brake rise time; 0-> par 6401 at 40 * par 6401 / par 6403 ms
	6404	g_bIBrRef07	0-150	70		E	Is	DC brake current controller lower set point during bang-bang phase
	6405	g_bIBrRef02	0-150	55		E	Is	DC brake current controller lower set point after initial voltage ramp
	6406	g_bBrMaxCnt	0-255	0		E	Is	Max time in each of the DC brake current controller initial phases (1 = 4ms; setting 0 means 1024)
	6407	g_bSlipCompTimeConst	o-256	20		E	Is	Filtering time constant for slip compensation slip estimate; 1 = 50ms
Temperature control -65-	6501	g_wSWTempTripLimit	1000-4000	0		E	Is	Module sw temp trip limit at 4kHz; 10 = 1%. Value 0: SW uses type etc. dependent value internally
	6502	g_wSWTempTimeConst	0-18000	0		E	Is	Module temp model time constant; 10 = 1s. Value 0: SW uses type etc. dependent value Internally
	6504	g_bHWTempFltOn	0-1					HW temp trip indicator; 1 = temperature is over trip limit
	6508	g_bTempOvCurrSpan	0-100	10		E	Is	Used IMAX reduction due to temperature: temperature span; 1 = 1 degC
	6509	g_bTempOvCurrLimit	0-150	100		E	Is	Used IMAX reduction due to temperature: IMAX span, for normal drive. 1=1%
	6510	g_bTempOvCurrLimitHvac	0-150	100		E	Is	Used IMAX reduction due to temperature: IMAX span, for HVAC drive. 1=1%
	6 5 1 1	g_wSWTempTripLimitLowNoise	1000-4000	0		E	Is	Module sw temp trip limit at 8kHz; 10 = 1%. Value 0: SW uses type etc. dependent value internally
	6512	g_wSWTempTripLimitLowNoise16	1000-4000	0		E	Is	Module sw temp trip limit at 16kHz; 10 = 1%. Value 0: SW uses type etc. dependent value internally

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I/O Forcing -66-	6601	g_bDInForceMask	0-255	0				Digital inputs forcing mask, bit 0=DI1,...
	6602	g_bDInForceData	0-255	0				Digital inputs forcing data, bit 0=DI1,...
	6603	g_bDOutForceMask	0-255	0				Digital output forcing data; bit0=DOUT1, bit1=DOUT2, bit3=I filter control, bit4=Fan control, bit5=RDY LED, bit6=FLT LED, bit7=CHG relay
	6604	g_bDOutForceData	0-255	0				Digital output forcing data; bit0=DOUT1, bit1=DOUT2, bit3=I filter control, bit4=Fan control, bit5=RDY LED, bit6=FLT LED, bit7=CHG relay
	6605	g_bAForceMask	0-255	0				Analog I/O forcing mask; bit 0=force AI1, bit 1=force AI2, bit 2=force AO
	6606	g_wAIn1ForceData	0-1000	0				Analog input 1 forcing data; 1000=100%
	6607	g_wAIn2ForceData	0-1000	0				Analog input 2 forcing data; 1000=100%
	6608	g_bAOutForceData	0-200	0				Analog output forcing data; 200=20.0mA
	6609	g_bChargeCntr	0-255	125		E	Is	Charge relay activation delay = value of this parameter * 4 ms. The delay is calculated from the moment when DC voltage exceeds the limit STARTENLOW.
A/D converter raw outputs -67-	6701	g_wADC0	0-1023	-				ADC channel 0 (ICP; 1023=5V)
	6702	g_wADC1	0-1023	-				ADC channel 1 (ICA; 1023=5V)
	6703	g_wADC2	0-1023	-				ADC channel 2 (UCM; 1023=5V)
	6704	g_wADC3	0-1023	-				ADC channel 3 (ICN; 1023=5V)
	6705	g_wADC4	0-1023	-				ADC channel 4 (TEMP; 1023=5V)

GROUP	CODE	NAME	RANGE	Default	S=Edit only in stc	E=Store to E2P	Is=Immed. save	DESCRIPTION
Overvolt controller -69-	6901	g_bUgainD1	0-255	45		E	Is	D type control gain
	6902	g_bUgainP1	0-255	25		E	Is	P type control gain
	6903	g_bUOLimD	0-250	0		E	Is	Voltage limit for D part; 1 = 1%. Value =0: internal value dep. on drive type is used
	6904	g_bUOhystValue	0-100	6		E	Is	Hysteresis for OV control; 1 = 1%
	6905	g_bAveCurLimLo	0-255	5		E	Is	Average current limit; scale 1000 = In
	6906	g_bAveCurLimHi	0-255	20		E	Is	Average current limit for D part; used as negated; scale 1000 = In
	6908	g_bOUAveKick	0-255	100		E	Is	Parametrizes extra frequency kick for overvoltage controller. Kick depends on average current.
	6909	g_bUcOvNoFldWk	0-255	0		E	Is	Overvoltage controller voltage reference output strength (100=1), when not in field weakening. Value =0: internal value dep. on drive type is used
	6910	g_bUcOvFldWk	0-255	0		E	Is	Overvoltage controller voltage reference output strength (100=1), when in field weakening. Value =0: internal value dep. on drive type is used
Undervoltage controller -70-	7001	g_bUgainD2	0-255	0		E	Is	D type control gain. Value =0: internal value dep. on drive type is used
	7002	g_bUgainP2	0-255	0		E	Is	P type control gain. Value =0: internal value dep. on drive type is used
	7003	g_bUlimDLo	0-250	0		E	Is	100 % level for D part. 1=1%. Value =0: internal value dep. on drive type is used
	7004	g_bUlimDHi	0-250	0		E	Is	0 % level for D part. 1=1%. Value =0: internal value dep. on drive type is used
	7005	g_bUUhystValue	0-100	3		E	Is	Hysteresis for UV controller. 1=1%
	7006	g_bUUAveKick	0-255	100		E	Is	Parametrizes extra frequency kick for undervoltage controller. Kick depends on average current.
	7007	g_bUcUvNoFldWk	0-255	100		E	Is	Undervoltage controller voltage reference output strength (100=1), when not in field weakening
	7008	g_bUcUvFldWk	0-255	110		E	Is	Undervoltage controller voltage reference output strength (100=1), when

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Overcurrent controller -71-	7101	g_wIgainP	0-32767	10		E	Is	Control gain ' frequency reduction
	7102	g_wIUlowF	0-32767	4000		E	Is	Max voltage for voltage reduction
	7103	g_wFLowLimit	0-5000	800		E	Is	Max frequency for voltage reduction; 100 = 1Hz
	7104	g_wIgainD	0-32767	20		E	Is	D type control gain
	7105	g_bCurFastLim	0-150	5		E	Is	Current limit for P part (% over Imax; fast signal); 1=1%
	7106	g_bCurFastLimHi	0-150	20		E	Is	Current limit for D part (% over Imax; fast signal); 1=1%
	7107	g_bTqBoostCurAdd	0-255	50		E	Is	Current limit for D part (% over Imax; fast signal); 10=1%
	7108	g_bCurrGainLoFr0	0-255	0		E	Is	Current masurement tuning parameter; 10=1%. Value =0: internal value dep. on drive type is used
	7109	g_bCurrGainLoFr1	0-255	0		E	Is	Current masurement tuning parameter; 10=1%. Value =0: internal value dep. on drive type is used
	7110	g_bCurrGainHiFr0	0-255	0		E	Is	Current masurement tuning parameter; 10=1%. Value =0: internal value dep. on drive type is used
	7111	g_bCurrGainHiFr1	0-255	0		E	Is	Current masurement tuning parameter; 10=1%. Value =0: internal value dep. on drive type is used
	7112	g_bCurrGainFldWk0	0-255	100		E	Is	Current masurement tuning parameter; 10=1%
	7113	g_bCurrGainFldWk1	0-255	100		E	Is	Current masurement tuning parameter; 10=1%
	7114	g_bCurrFrCoeff0	0-255	0		E	Is	Current masurement tuning parameter; 10=1%. Value =0: internal value dep. on drive type is used
	7115	g_bCurrFrCoeff1	0-255	0		E	Is	Current masurement tuning parameter; 10=1%. Value =0: internal value dep. on drive type is used
	7116	g_wCurrFr1	0-65535	0		E	Is	Current masurement tuning parameter; 100=1Hz. Value =0: internal value dep. on drive type is used
	7117	g_wCurrFr2	0-65535	0		E	Is	Current masurement tuning parameter; 100=1Hz. Value =0: internal value dep. on drive type is used
	7118	g_bCurrCosphiCoeff0	0-255	0		E	Is	Current masurement tuning parameter; 10=1%. Value =0: internal value dep. on drive type is used
	7119	g_bCurrCosphiCoeff90	0-255	0		E	Is	Current masurement tuning parameter; 10=1%. Value =0: internal value dep. on drive type is used

ABB Industry AC Components	ACS 400 Parameter list (hidden params)	ACS400-SW-0422 File: 400phd29.xls

Dept	Prepared	Date	Approved	Rev	Valid from SW version (label)
EGC	JM/EH	2000-03-24		3.00	1.1.2.4

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Voltage stabilizer -72-	7201	g_bFUKD	O-255	0		E	Is	D type gain; 10=1. Value -0: internal value dep. on drive type is used
	7202	g_bTfu	O-255	15		E	Is	Filter coeff (* 0.1 ms)
	7203	g_bUcFldWk	O-255	200		E	Is	Coefficient for fwk area; 10=1
	7204	g_wUDCRippleMax	0-20000	0		E	Is	UDC voltage ripple detection, max limit. 10 = IV. Value =0: internal value dep. on drive type is used
	7205	g_wUDCRippleMin	0-20000	0		E	Is	UDC voltage ripple detection, min limit. 10 = IV. Value =0: internal value dep. on drive type is used
Current stabilizer -73-	7301	g_bFTKD	0-255	20		E	Is	D type gain; 10=1
	7302	g_bTft	0-255	80		E	Is	Filter coeff (* 0.1 ms)
	7303	g_bCurLoLim	0-255	0		E	Is	Lower current limit (used for D calc.); 10=1
	7304	g_bCurHiLim	0-255	120		E	Is	Higher current limit (used for D calc.); 10=1
	7305	g_nFIStabUCoeff	-32767-32767	0		E	Is	Voltage channel gain (signed value)
	7306	g_wAveLossCurr4	0-65535	15		E	Is	Average current measurement offset at 4kHz carrier
	7307	g_wAveLossCurr8	0-65535	18		E	Is	Average current measurement offset at 8kHz carrier
	7308	g_wAveLossCurr16	0-65535	18		E	Is	Average current measurement offset at 16kHz carrier
	7309	g_wAveLossCurr4X	0-65535	30		E	Is	X-value used when offsetting average current measurement 4kHz carrier
	7310	g_wAveLossCurr8X	0-65535	40		E	Is	X-value used when offsetting average current measurement 8kHz carrier
	7311	g_wAveLossCurr16X	0-65535	40		E	Is	X-value used when offsetting average current measurement 16kHz carrier
	7312	g_wAnglMaxHi	O-65535	1536		E	Is	Parameter of current angle estimation
	7313	g_wAnglMaxLo	o-65535	597		E	Is	Parameter of current angle estimation
	7314	g_wAnglMinLo	c-65535	256		E	Is	Parameter of current angle estimation
	7315	g_wAnglMaxFrHi	0.65535	1000		E	Is	Parameter of current angle estimation
	7316	g_wAnglMaxFrLo	0-65535	500		E	Is	Parameter of current angle estimation

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Modulator	*7401*	*g_wBackCntDsp*	*0-9999*	*-*				*Back program counter. Increments by 1 every time back program is executed, cleared to 0 every time incremented above 9999*
-74-	*7402*	*g_bPhiIScheme*	*0-1*	*1*		*E*	*Is*	*0 =use fixed angle; 1 = use estimated angle*
	7403	*g_wAnglCurSet*	*0-3072*	*768*		*E*	*Is*	*fixed angle; 768=90 deg*
	7404	*g_wTimeCurrAngle*	*4-9999*	*200*		*E*	*Is*	*time contant for filtering (angle); 1=1 ms*
	7405	*g_wCurAngleFilt*	*-*	*-*				*estimated angle; 768=90 deg*
	7406	*g_wTimeCurrFilter*	*2-9999*	*12*		*E*	*Is*	*fast filtering time const for current; 1=1 ms*
	7407	*g_wMinPulse*	*2-255*	*2*		*E*	*Is*	*min pulse time; 18=1us*
	7408	*g_wCommDelay*	*2-255*	*23*		*E*	*Is*	*commutation delay time; 18=1us*
	7410	*g_wContrMask*	*0-FFFF*	*0*		*E*	*Is*	*Controllers disable; bit 0=U stab, bit 1=I stab, bit 2=I max, bit 3=U max, bit 4=U min controller; 1F all disabled*

ABB Industry AC Components	ACS 400 Parameter list (hidden params)			ACS400-SW-0422 File: 400phd29.xls
Dept	Prepared	Date	Approved	Rev	Valid from SW version (label)
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HW versioning *-75-*	*7501*	*g_bSizeCode*	*0-20*					*Type code of unit (0=type code error)*
	7502	*g_bDontSaveSignals*	*0-1*	*0*		*E*	*Is*	*If 1, signals that change often are NOT stored to Flash PROM (i.e. com,boot,start,time counters)*
	7503	*g_bUsUnits*	*0-1*	*0*	*S*	*E*	*Is*	*0 = normal units are displayed: 1 = US units (F, hp instead of C, kW) are displayed*
	7504	*g_bOemDefaults*	*0-1*	*0*	*S*	*E*	*Is*	*0 = no OEM defaults: 1 = OEM defaults from FPROM sector 2 are used*
	7505	*g_bHvac*	*0-1*	*0*	*S*	*E*	*Is*	*0 = normal drive; 1 = HVAC drive*
	7506	*g_bFlashApplic*	*0-1*	*0*	*S*	*E*	*Is*	*Permission to run Flash application. 0 = no FLASH application; 1 = FLASH application (if any) is permitted to run. Note: Also Flash sectors 3-8 contents is examined before trying to run the application.*
	7507	*g_wSerNrHi*	*0-65535*	*0*		*E*	*Is*	*ACS400 unit running id number, HIGH WORD. The fieldbus comm. module uses the contents of parameters 7507 and 7508 to identify the drive*
	7508	*g_wSerNrLo*	*0-65535*	*0*		*E*	*Is*	*ACS400 unit running id number, LOW WORD*
	7509	*g_wPanTxtVersion*	-	-				*Panel text file version (downloaded from panel)*
	7510	*g_wFlashApplicID*	-	-				*Flash application ID number (read from header area in Flash application)*
	7511	*g_bFlashMajorVer*	-	-				*Flash application major version number (read from header area in Flash application)*
	7512 - 7517	*array g_bFldBTextString*	*0-65535*	*0*		*E*	*Is*	*Fieldbus comm. module name text string placeholder parameters*
	7518	*g_bUsDefaults*	*0-1*	*0*	*S*	*E*	*Is*	*0=Normal default values are used: 1=US defaults are used (60Hz instead of 50Hz etc.)*
	7519	*g_bResetParams*	*0-1*	*0*	*S*			*Reset (initialize) all parameters. To reset all parameters, do the following: (l) stop drive: (2) turn hidden parameters on; (3) turn test mode on; (4) write 7519 = 1. The value of 7519 is also reset to 0 during the operation. The result of resetting all parameters is the same as if there was inserted a new processor of different version on the card.*
	7520	*g_bPhase2of200V*	*0-1*	*0*	*S*	*E*	*Is*	*Obsolete (this was earlier used for Phase II of 200V units). Note: the value has no effect*

GROUP	CODE	NAME	RANGE	Default	S=Edit only in stop	E=Store to E2P	Is=Immed. save	DESCRIPTION

Notes

1 .Hidden parameters can be released from keypad by following procedure:

ACSIOO-PAN 1.1 Go parameter 3301 set mode — 1.2 Push arrow buttons and ENTER button simultaneously until display blinks

ACS-PAN 1.1 Go parameter 3301 — 1.2 Push ENTER and RESET buttons until display blinks

2. Hidden parameters can released from modbus device by following procedure:

2.1 Write mdb reg 12 OxOABB — 2.2 Read mdb reg 13 (value)

2.3 Write mdb reg 13 value^0xA100 — 2.4 Write mdb reg 12 0xAC51

3. Test mode (I/O forcing possible) can be set on from keypad by following prosedure (after hidden parameters have been released first):

ACS100-PAN 3.1 Go parameter 3301 set mode — 3.2 Push arrow buttons simultaneously: display blinks

ACS-PAN 3.1 Go parameter 3301 — 3.2 Push arrow buttons simultaneously: display blinks

4. Test mode (I/O forcing possible) can be set on from modbus device by following procedure:

4.1 Write mdb reg 12 0x0ABB — 4.2 Read mdb reg 13 (value)

4.3 Write mdb reg 13 value^0xA100 — 4.4 Write mdb reg 12 0xFOOB

Student Information

ACS 400 AC Drive
Lab Exercise #1

For use in the DSS Operation & Maintenance Schools

Introduction

In this lab exercise, you will become acquainted with the functions of the ACS 400.

Objectives

After performing this lab, the student will:

1) Become familiar with the basic features of the ACS 400 (programming, macros, hardware, etc.)
2) Become familiar with the specific steps required in programming the drive and how modifications are made

Materials Required

1 ACS 400 Training Demo with overlays
1 ACS 400 Programming Manual

Procedure

1) Verify that the demo unit has power (i.e. green LED is illuminated and the display is activated).

2) Ensure that "Factory Macro (1)" is set into memory. (For more information, refer to the User Manual, Application Macro Section). During the remainder of this lab exercise, you will change parameters that are commonly reprogrammed in a **standard** application.

3) Verify that the "Start-Up Data" in memory is appropriate for the demo that you are using. (Note: Unless indicated by the instructor, do not reprogram these parameters to exactly match the manual.)

4) Select the "Operating Data" section. Initiate a START command. Scroll through the operating display and verify that the values are appropriate per the Factory Macro (1) Parameter Settings in the manual.

5) Review Group 10 through Group 26 list of parameters. Set, indicate and verify the parameters necessary to perform the following functions:

External Start/Stop using DI 1 & DI 2 (3-wire)

____

Allow Reverse operation using DI 3

____

Use Analog Input (AI1) as speed reference

____

Note: Change the Macro to "Application Macro 3 Wire" and perform the following steps.

Preset Speed 1 of 18 Hz

____

Preset Speed 2 of 28 Hz

____

Preset Speed 3 of 58 Hz

____

6) Set, indicate and verify the parameters necessary to perform the following functions:

Minimum output frequency of 10 Hz

____

Maximum output frequency of 80 Hz

____

Ramp - Start and Stop function

____

1 Second Accel time and a 7 second decel time

____

Critical frequency range between 20 and 40 hz

____

Note: Reset the "Critical Frequency" parameter to ***"OFF."*** *(This will allow you to observe operations in the next steps.) Use* ***the "REMOTE"*** *controls to perform the following steps.*

7) Set the "V/Hz Ratio" parameter to "Squared." With your hand on the flywheel, START the drive and slowly rotate the REF pot to 75%. Describe the effects on motor torque.

____

____

Set the "V/Hz Ratio" parameter to "Linear." START the drive and repeat the above step. Describe the difference in motor torque.

____

____

8) Set the "IR Compensation" parameter Voltage to 2 V). With your hand on the flywheel, START the drive and rotate the REF pot to 25%. Notice the effect on torque at zero speed (try turning the flywheel).

____

STOP the drive. Set the "IR Comp Voltage” to maximum (about 30 V). Repeat the above step. Describe the effects compared to minimum IR Comp.

Note: Reset the "IR Compensation " to "0 Volts

9) Review Groups 30 through 34. Set the “Underload Function” parameter to “WARNING” and the “Underload Time” at **“10s.”** Set the “Underload Curve” to **“30%.”** Return the display to “Operating Data.” Initiate a START command and set a reference of 30 Hz. Describe what happens

What does the display panel state?

10) Program the drive for a “Low Noise” switching frequency. START the drive and note the audible nbise. Reprogram the drive back to “default” switching frequency and compare operation. What are the results?

Summary Questions

1) What is the “Critical Frequency” programming **function?**

What is the benefit? ______________________________________

____

2) How would the drive be programmed to provide an automatic restart function after a power outage? List the parameters and values that would be used.

____

____

3) What is an advantage and disadvantage of a high IR Compensation value?

Adv. ____

Dis. ____

Notes

ACS 400 Lab Exercise #1

Automation Services
16250 West Glendale Drive
New Berlin, WI 53151

Student Information

ACS 400 AC Drive Lab Exercise #2

For use in the DSS Operation &Maintenance Schools

Introduction

In this lab exercise, you will develop an I / O configuration to meet the customer's specifications. In addition, you will reprogram the drive to enable appropriate system operation.

Objectives

After performing this lab, the student will:

1) Become familiar with the procedure for developing an I / 0 structure that meets the customer's requirements.
2) Be able to reprogram the drive to meet specific operating requirements.

Materials Required

1 ACS 400 Training Demo with overlays
1 ACS 400 Programming Manual

Procedure

1) Using the "3 Wire" Macro, set up your demo to accomplish the following customer requirements:

    Remote Start and Stop Pushbuttons (Use DI1 and DI2)
    Accel rate of 10 seconds, Decel rate of 15 seconds
    Reverse capability
    Remote Reference (Use AI1 pot)
    Indication of drive: Run and Reverse Operation

2) Use the attached I / 0 Worksheet to develop a sketch of how the control circuit would be configured.

3) Record your parameter changes on the attached Parameter Settings Worksheet. Use the demo to verify your configuration.

I / O Worksheet

I	SCR	Reference Voltage
2	AI 1	10 vDC, 10 mA.
3	AGND	
4	+10 V	
5	AI 2	
6	AGND	
7	A01	Output 0 – 20 ma.
8	AGND	
9	+24V	Aux. Voltage Output +24VDC
10	DCOM 1	
11	DI I	
	DI 2	
13	DI 3	I
14	I DI 4	
	DI 5	
16	DCOM 2	
17	RO 1C	RELAY OUTUT #1
18	RO 1A	
19	RO 1B	
20	RO 2C	RELAY OUTPUT #2
21	RO 2A	
22	RO 2B	

Parameter Settings Worksheet

Group 99 Start-Up Data	Setting / Value
Group 01 Operating Data	**Setting / Value**
Groups 10 – 16 Parameters	**Setting / Value**
Groups 20 - 26 Parameters	**Setting / Value**
Groups 30 - 52 Parameters	**Setting / Value**

Summary Questions

1) What parameter changes would you make if a remote, 2-wire Start / Stop control was required?

2) What parameter changes would be needed if DI5 were used as a Jog pushbutton?

ABB

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New Berlin. WI 53151

Student Information

ACS 400 AC Drive
Lab Exercise #3

For use in DSS Operation & Maintenance Schools

Introduction

'm this lab exercise, you wiii deveiop an ii O configuration to meet the customer's specifications. ln addition, you will reprogram the drive to enable appropriate system operation.

Objectives

After performing this lab, the student will:

1) Become familiar with the procedure for developing an I / 0 structure that meets the customer's requirements.
2) Be able to reprogram the drive to meet specific operating requirements.

Materials Required

1 ACS 400 Training Demo with overlays
1 ACS 400 Programming Manual

Procedure

1) Use whatever macro is necessary in setting up your demo to accomplish the following customer requirements:
   Remote 3-wire Start / Stop control (Use DI1 and DI2)
   Accel rate of 8 seconds, Decel rate of 6 seconds
   Remote Manual Reference Pot (Use AI1 pot)
   1 preset speed of 170 RPM = _______ Hz (Use D14)
   Maximum Speed of 1475 RPM = _______ Hz
   Minimum Speed of 5 Hz
   Indication of drive: Run and Preset Speed

2) Use the attached I / 0 Worksheet to develop a sketch of how the control circuit would be configured.

3) Record your parameter changes on the attached Parameter Settings Worksheet. Use the demo to verify your configuration.

I IO Worksheet

1	SCR	Reference Voltage
2	AI 1	10 vDC, 10 mA.
3	AGND	
4	+10 V	
5	AI 2	
6	AGND	
7	AO 1	Output 0 – 20 ma.
8	AGND	
9	+24V	Aux. Voltage Output +24VDC
10	DCOM 1	
11	DI 1	
12	DI 2	
13	DI 3	
14	DI 4	
15	DI 5	
16	DCOM 2	
17	RO 1C	RELAY OUTUT #I
18	RO 1A	
19	RO 1B	
20	RO 2C	RELAY OUTPUT #2
21	RO 2A	
22	RO 2B	

Parameter Settings Worksheet

Group 99 Start-Up Data	Setting I Value
Group 01 Operating Data	**Setting I Value**
Groups-10 – 16 Parameters	**Setting / Value**
Groups 20 - 26 Parameters	**Setting I Value**
Groups 30 - 52 Parameters	**Setting / Value**

Summary Questions

1) If the customer wanted to display % Speed on the Local Panel, how would you program the drive to meet the requirements?

____

____

2) If the maximum speed was 1200 RPM, what would you program as a maximum frequency? __________ HZ

What parameter(s) would you program?

____

____

3) What programming change(s) would you make if the customer had an 11 amp, 254T frame, 7.5 HP, NEMA B motor.

____

____

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Student Information

ACS 400 AC Drive
Lab Exercise #4

For use in the Basic Product Training School

Introduction

In this lab exercise, you will develop an I / 0 configuration to meet the customer's specifications. In addition, you will reprogram the drive to enable appropriate system operation.

Objectives

After performing this lab, the student will:

1) Develop an I / 0 structure that meets the customer's requirements.,
2) Be able to reprogram the drive to meet specific operating requirements.

Materials Required

1 ACS 400 Training Demo with overlays
1 ACS 400 Programming Manual

Procedure

1) Use whatever macro is necessary in setting up your demo to accomplish the following customer requirements:
   - Local Start / Stop, 2-wire control (Use DI1)
   - Local Manual Reference Pot (Use AI1)
   - 1 preset speed of 375 RPM = _______ Hz (Use D14)
   - Remote Start / Stop, 2-wire control (Use D15)
   - Remote Manual Reference Pot (Use AI2)
   - Local Reverse Operation
   - Indication of drive: Run and Reverse Operation

2) Use the attached I / 0 Worksheet to develop a sketch of how the control circuit would be configured.

3) Record your parameter changes on the attached Parameter Settings Worksheet. Use the demo to verify your configuration.

I / O Worksheet

1	SCR	Reference Voltage 10 vDC, 10 mA.
2	AI 1	
3	AGND	
4	+10 V	
5	AI 2	
6	AGND	
7	AO 1	output 0 – 20 ma.
8	AGND	
9	+24V	Aux. Voltage Output +24VDC
10	DCOM 1	
11	DI 1	
12	DI 2	
13	DI 3	
14	DI 4	
15	DI 5	
16	DCOM 2	
17	RO 1C	RELAY OUTUT #1
18	RO 1A	
19	RO 1B	
20	RO 2C	RELAY OUTPUT #2
21	RO 2A	
22	RO 2B	

Parameter Settings Worksheet

Group 99 Start-Up Data	Setting / Value
Group 01 Operating Data	**Setting / Value**
Groups 10 – 16 Parameters	**Setting / Value**
Groups 20 - 26 Parameters	**Setting / Value**
Groups 30 - 52 Parameters	**Setting / Value**

Summary Questions

1) What changes in programming would be needed to allow a preset speed and no local (Hand) reversing? Explain.

2) Is there another macro that would meet the customer's requirements? If so, what changes would you make in programming?

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New Berlin, WI 53151

3

Student Information

ACS 400 AC Drive
Lab Exercise #5

For use in DSS Operation &Maintenance Schools

introduction

in this iab exercise, you wiii deveiop an ii O configuration to meet the customer's specifications. In addition, you will reprogram the drive to enable appropriate system operation.

Objectives

After performing this lab, the student will:

1) Develop an I / 0 structure that meets the customer's requirements.
2) Be able to reprogram the drive to meet specific operating requirements.

Materials Required

1 ACS 400 Training Demo with overlays
1 ACS 400 Programming Manual

Procedure

1) Use whatever macro is necessary in setting up your demo to accomplish the following customer requirements:
   - Local Start / Stop, 2-wire control with Manual Speed Pot
   - 1 preset speed of 775 RPM = _______ Hz
   - 1 preset speed of 350 RPM = _______ Hz
   - Jog Pushbutton
   - Jog Accel and Decel rate of 1 second
   - Jog Speed of 200 RPM = _______ Hz
   - Accel Rate of 2 seconds, Decel rate of 15 seconds
   - Min. Frequency of 2 Hz, Max. Frequency of 55 Hz
   - Indication of drive: Run, Preset Speed, % Speed

2) Use the attached I / 0 Worksheet to develop a sketch of how the control circuit would be configured.

3) Record your parameter changes on the attached Parameter Settings Worksheet. Use the demo to verify your configuration.

I IO Worksheet

1	SCR	Reference Voltage 10 vDC, 10 mA.
2	AI 1	
3	AGND	
4	+10 V	
5	AI 2	
6	AGND	
7	AO 1	Output 0 – 20 ma.
8	AGND	
9	+24V	Aux. Voltage Output +24VDC
10	DCOM 1	
11	DI 1	
12	DI 2	
13	DI 3	
14	DI 4	
15	DI 5	
16	DCOM 2	
17	RO 1C	RELAY OUTUT #1
18	RO 1A	
19	RO 1B	
20	RO 2C	RELAY OUTPUT #2
21	RO 2A	
22	RO 2B	

Parameter Settings Worksheet

Group 99 Start-Up Data	Setting / Value
Group 01 Operating Data	**Setting / Value**
Groups 10 – 16 Parameters	**Setting / Value**
Groups 20 - 26 Parameters	**Setting / Value**
Groups-30 - 52 Par&meters	**Setting I Value**

Summary Questions

1) What changes in programming would be needed to allow three preset speeds and no reversing? Explain.

____

____

2) Is there another macro that would meet the customer's requirements? If so, what changes would you make in programming?

____

____

3) What macro would be best in an application for a centrifugal pump or fan?

____

Why? ______________________________

____

ABB

Student Information

ACS 400 AC Drive
Lab Exercise - Process Control

For use in DSS Operation & Maintenance Schools

Introduction

In this lab exercise, you will develop an I / 0 configuration to meet the customer's specifications. In addition, you will reprogram the drive to enable appropriate system operation.

Objectives

After performing this lab, the student will:

1) Become familiar with the procedure for developing an I / 0 structure that meets the customer's requirements.
2) Be able to reprogram the drive to meet specific operating requirements in the process control environment.

Materials Required

1 ACS 400 Training Demo with overlays
1 ACS 400 User's Manual

Procedure

1) Using the appropriate macro, set up your demo to accomplish the customer requirements listed below. The system requirements are:
   - Customer needs capability of Hand/Auto operation
   - 4-20 ma process control signal is supplied as feedback
   - START / STOP control will be 2 wire
   - Manual speed pot (remote from the drive)
   - Minimum speed of 575 RPM = _______ HZ
   - Visual indicator of minimum speed
   - Motor speed feedback to central control, indicating RPM
   - Accel time = 45 seconds
   - Decel time = 30 seconds
   - Capability of drive starting while motor is free spinning
   - Control system will provide a Run / Enable signal
   - Drive must provide RUN indication via RO 2
   - Drive must provide ability for (2) critical freq lockouts (25 to 29 Hz and 41 to 47 Hz)

1 Preset Speed upon loss of Analog Input signal (30 Hz)
RO 1 will indicate PRESET SPEED is reached

2) Use the I / 0 Worksheet below to develop a sketch of how the control circuit would be configured.

I / O Worksheet

1	SCR	Reference Voltage 10 vDC, 10 mA.
2	AI 1	
3	AGND	
4	+10 V	
5	AI2	
6	AGND	
7	AO 1	Output 0 – 20 ma.
8	AGND	
9	+24V	Aux. Voltage Output +24VDC
10	DCOM 1	
11	DI 1	
12	DI 2	
13	D13	
14	DI 4	
15		
16	DCOM 2	

17	RO 1C	RELAY OUTUT #1
18	RO 1A	
19	RO 1B	
20	RO 2C	RELAY OUTPUT #2
21	RO 2A	
22	RO 2B	

3) Record your parameter changes on the Parameter Settings Worksheet below. Use the demo to verify your configuration.

Parameter Settings Worksheet

Group 99 Start-Up Data	Setting / Value
Group 01 Operating Data	**Setting / Value**
Groups 10 - 16 Parameters	**Setting / Value**
Groups 20 - 26 Parameters	**Setting I Value**
Groups 30 - 52 Parameters	**Setting I Value**

Summary Questions

1) Did you consider using the HAND/AUTO Macro? Why or why not?

2) Did you encounter any specific problem(s) with the one PRESET SPEED requested?

3) How does the Proportional Gain changes affect the drive operation?

4) What did you experience when various integral times were used?

Tab 8
ACH 400 Lab Exercises (five)

2/12/02

Dear Jose,

Welcome to ABB's Automation University-New Berlin, WI Training Center. We are pleased you will be with us for a few days attending one of our classes.

It is our intent that upon completion of your course, you will be delighted with the quality of training you received and also with the way you were treated while you were here. Please let us know if we are not successful in both areas.

As a token of our appreciation for your business, please select an item from the display case located in the hallway as a memento of your visit.

Simply return the attached coupon below to your instructor with the item number of your selection indicated by the end of the day on Wednesday. We'll take care of the rest. Your instructor will deliver the item of your choice on the last day of class.

We want your entire training experience to be pleasant and valuable. Please do not hesitate to let me know if I can be of assistance.

Sincerely,

Roy Cole

Roy Coleman, Operations Manager
ABB Automation University - US

Student Information

ACH 400 AC Drive
Lab Exercise – HVAC Pumping Application

For use in the Advanced HVAC Schools

introduction

In this lab exercise, you will become acquainted with the specialized functions of the ACH 400.

Objectives

After performing this lab, the student will:

1) -Become familiar with the basic features and flexibility of the ACH 400 (programming, hardware, etc.)
2) Become familiar with the specific steps required in programming the drive and how modifications are made.

Materials Required

1 ACH 400 Training Demo
1 ACH 400 Users Manual

Procedure

1) Power up the ACH 400 Demo Unit and verify that correct Motor Data is saved in memory in Group 99. (Per the demo unit Motor Nameplate)

2) Set-Up the drive to operate with the following customer requirements. Use whatever macro is necessary.

A customer has two pumps, one lead and one lag. You have supplied two ACH 400 drives, one for each pump. Alternation of pumps is not required. The customer would like to set up these pumps for pressure control. A two-wire pressure transmitter with a 4-20 ma output will be supplied as a feedback device.

The **lead** pump will handle the pressure requirements for most of the day. At peak demand times, both pumps are required. The engineer has determined that the lag pump will be required whenever the lead pump output frequency goes above 56 Hz for 5 minutes. The drop out point to switch **back** to one pump operation is 40 Hz also for 5 minutes.

Program your ACH 400 demo unit for this application. Use the I/O Worksheet to sketch how you would wire the lead VFD to the lag VFD.

Note: For demonstration purposes, use a 30-second delay for pulling in and dropping out the lag pump. Use the demo mounted O-10 VDC pot to simulate the pressure transmitter.

I IO Worksheet

1	SCR	Reference Voltage
2	AI 1	10 vDC, 10 mA.
3	AGND	
4	+10 V	
5	AI 2	
6	AGND	
7	AO 1	Output 0 – 20 ma.
8	AGND	
9	+24V	Aux. Voltage Output +24VDC
10	DCOM 1	
11	DI 1	
12	DI 2	
13	DI 3	
14	DI 4	
15	DI 5	
16	DCOM 2	
17	RO 1C	RELAY OUTUT #1
18	RO 1A	
19	RO 1B	
20	RO 2C	RELAY OUTPUT #2
21	RO 2A	
22	RO 2B	

Fill in the Parameter Table with changes to your demo.

Parameter Settings Worksheet

Group 99 Start-Up Data	Setting I Value
Group 01 Operating Data	**Setting I Value**
Groups 10 – 16 Parameters	**Setting / Value**
Groups 20 - 26 Parameters	**Setting I Value**
Groups 30 - 52 Parameters	**Setting / Value**

Summary Questions

1) What problems did you encounter when trying to set-up a wiring scheme?

2) Identify the similarities and differences between the ACH 500 (Pump Fan Macro) and the ACH 400 operation.

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Student Information

ACH 400 AC Drive
Lab Exercise – Dual Sensor Control

For use in the Advanced HVAC Schools

Introduction

In this lab exercise, you will become acquainted with the specialized functions of the ACH 400.

Objectives

After performing this lab, the student will:

1) Become familiar with the basic features and flexibility of the ACH 400 (programming, hardware, etc.)
2) Become familiar with the specific steps required in programming the drive and how modifications are made.

Materials Required

1 ACH 400 Training Demo
1 ACH 400 Users Manual

Procedure

1) Power up the ACH 400 Demo Unit **and** Verify that correct Motor Data is saved in memory in Group 99. (Per the demo unit Motor Nameplate)

2) Set-Up the drive to operate with the following customer requirements. Use whatever macro is necessary.

   A customer has one supply fan with an ACH 400 VFD supplying a dual zone system. One zone is along a southern exposure of a glass wall. The second zone is along a northern exposure of a glass wall. The customer will supply two (2) 2- 10 VDC signals as feedback for pressure. These transmitters are powered by others.
   Program your ACH 400 demo to control static pressure of the supply fan on this VAV system utilizing the dual transmitter feedback. Use the PID tuning instructions found in the ACH 400 manual to fine-tune the PID loop.

Program your ACH 400 demo unit for this application. Use the I/O Worksheet to sketch how you would **wire the** lead VFD and feedback signals.

Note: For demonstration purposes, use, use the demo mounted O-10 VDC pots to simulate the two (2) feedback signals..

I / O Worksheet

1	SCR	Reference Voltage 10 vDC, 10 mA.
2	AI 1	
3	AGND	
4	+10 V	
5	AI 2	
6	AGND	
7	AO 1	Output 0 – 20 ma.
8	AGND	
9	+24V	Aux. Voltage Output +24VDC
10	DCOM I	
II	DI I	
12	DI 2	
13	DI 3	
14	DI 4	
15	DI 5	
16	DCOM 2	
17	RO 1C	RELAY OUTUT #1
18	RO IA	
19	RO 1B	
20	RO 2C	RELAY OUTPUT #2
21	RO 2A	
22	RO 2B	

Fill in the Parameter Table with changes to your demo.

Parameter Settings Worksheet

Group 99 Start-Up Data	Setting / Value
Group 01 Operating Data	**Setting.1 Value**
Groups 10 – 16 Parameters	**Setting / Value**
Groups 20 - 26 Parameters	**Setting I Value**
Groups 30 - 52 Parameters	**Setting./ Value**

Summary Questions

1) What problems did you encounter when trying to set-up a wiring scheme?

____

____

2) Identify the similarities and differences between the ACH 500 (PI Macro) and the ACH 400 operation.

____

____

____

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New Berlin, WI 53151

ABB

Student Information

AC/f 400 AC Drive
Lab Exercise -- Serial Communications

For use in the Advanced HVAC Schools

Introduction

In this lab exercise, you will become acquainted with the specialized functions of the ACH 400.

Objectives

After performing this lab. the student will:

1) -Become familiar with the basic features and flexibility of the ACH 400 (programming, hardware, etc.)
2) Become familiar with the specific steps required in programming the drive and how modifications are made.

Materials Required

1 ACH 400 Training Demo
1 ACH 400 Users Manual

Procedure

1) Power up the ACH 400 Demo Unit and Verify that correct Motor Data is saved in memory in Group 99. (Per the demo unit Motor Nameplate)

2) Set-Up the drive to operate with the following customer requirements. Use whatever macro is necessary.

A customer has a Landis & Staefa System 600 building automation system. You have supplied an ACH 400 drive for a supply fan. The supply fan requires a run permissive from the damper end switch before the drive is allowed to run. The damper control is to be accomplished by a VFD - DO. The end switch will be wired back to the VFD.

This mechanical room also has a chilled water valve that is controlled by a 4-20 ma signal. The O-10 VDC chilled water feedback transmitter is in the same mechanical room.

The Landis & Staefa branch office would prefer that the chilled water valve be controlled by the VFD - AO, rather than having to supply a TEC controller in this room.

Program the designated VFD demo unit to accomplish the customer requirements. Use the Landis & Staefa CIS to demonstrate that the VFD is properly programmed. Use the I/O Worksheet to sketch how you would wire the lead VFD and feedback signals.

Note: For demonstration purposes, use, use the demo mounted O-10 VDC pots to simulate the feedback signal.

I / O Worksheet

1	SCR	Reference Voltage 10 vDC, 10 mA.
2	A11	
3	AGND	
4	+10 V	
5	AI2	
6	AGND	
7	AO I	Output 0 – 20 ma.
8	AGND	
9	+24V	Aux. Voltage Output +24VDC
10	DCOM I	
11	DI 1	
12	DI 2	
13	DI 3	
14		
15	DI 5	
16	DCOM 7	
17	RO 1C	RELAY OUTUT #I
18	RO IA	
19	RO 1B	
20	RO 2C	RELAY OUTPUT #2
21	RO 2A	
22	RO 2B	

Fill in the Parameter Table with changes to your demo.

Parameter Settings Worksheet

Group 99 Start-Up Data	**Setting / Value**
Group 01 Operating Data	**Setting / Value**
Groups 10 – 16 Parameters	**Setting / Value**
Groups 20 - 26 Parameters	**Setting / Value**
Groups 30 - 52 Parameters	**Setting / Value**

Summary Questions

1) What problems did you encounter when trying to set-up a wiring scheme?

2) Identify the similarities and differences between the ACH 500 (PI Macro) and the ACH 400 operation.

Drives & Power Products
16250 West Glendale Drive
New Berlin, WI 53151

Student Information

ACH 400 AC Drive
Lab Exercise – Rotating Motor Start

For use in the Advanced HVAC Schools

Introduction

In this lab exercise, you will become acquainted with the specialized functions of the ACH 400.

Objectives

After performing this lab, the student will:

1) 'Become familiar with the basic features and flexibility of the ACH 400 (programming, hardware, etc.)
2) Become familiar with the specific steps required in programming the drive and how modifications are made.

Materials Required

1 ACH 400 Training Demo
1 ACH 400 Users Manual

Procedure

1) Power up the ACH 400 Demo Unit and Verify that correct Motor Data is saved in memory in Group 99. (Per the demo unit Motor Nameplate)

2) Set-Up the drive to operate with the following customer requirements. Use whatever macro is necessary.

   A customer has a return fan that is started one minute after the supply fan. The return fan is being driven at about 1200 RPM in the reverse direction. The drive trips on overvoltage due to the overhauling load of the return fan.

   The customer also requires a contact closure to indicate that the fan / motor belt has broken. Program your ACH 400-demo unit to brake this free wheeling motor upon start command and to give the customer the broken belt indication.

Program the designated VFD demo unit to accomplish the customer requirements. Use the I/O Worksheet to sketch how you would wire the lead VFD and feedback signals.

Note: For demonstration purposes, use, use the demo mounted O-IO VDC pots to simulate the feedback signal.

I IO Worksheet

1	SCR	Reference Voltage
2	AI 1	10 vDC, 10 mA.
3	AGND	
4	+10 V	
5	AI 2	
6	AGND	
7	AO I	output 0 – 20 ma.
8	AGND	
9	+24V	Aux. Voltage Output +24VDC
10	DCOM 1	
11	DI 1	
12	DI 2	
13	DI 3	
14	DI 4	
15	DI 5	I
16	DCOM 2	
17	RO 1C	RELAY OUTUT #I
18	RO IA	
19	RO 1B	
20	RO 2C	RELAY OUTPUT #2
21	RO 2A	
22	RO 2B	

Fill in the Parameter Table with changes to your demo.

Parameter Settings Worksheet

Group 99 Start-Up Data	Setting / Value
Group 01 Operating Data	**Setting I Value’**
Groups 10 – 16 Parameters	**Setting / Value**
Groups 20 - 26 Parameters	**Setting / Value**
Groups 30 - 52 Parameters	**Setting I Value**

Summary Questions

1) What problems did you encounter when trying to set-up a wiring scheme?

2) Identify the similarities and differences between the ACH 500 (PI Macro) and the ACH 400 operation.

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Drives & Power Products
16250 West Glendale Drive
New Berlin, WI 53151

Student Information

ACH 400 AC Drive
Lab Exercise – Sleep / Wake Function

For use in the Advanced HVAC Schools

Introduction

In this lab exercise, you will become acquainted with the specialized functions of the ACH 400.

Objectives

After performing this lab, the student will:

1) -Become familiar with the basic features and flexibility of the ACH 400 (programming, hardware, etc.)
2) Become familiar with the specific steps required in programming the drive and how modifications are made.

Materials Required

1 ACH 400 Training Demo
1 ACH 400 Users Manual

Procedure

1) Power up the ACH 400 Demo Unit and Verify that correct Motor Data is saved in memory in Group 99. (Per the demo unit Motor Nameplate)

2) Set-Up the drive to operate with the following customer requirements. Use whatever macro is necessary.

A customer has a cooling tower application. He has a Johnson Controls Metasys System, but he is almost out of control points with his JCI hardware and does not want to buy another unitary controller. The JCI system has one point left that is close to the cooling tower application. The sump temperature sensor is to be loop-powered by the VFD and has a range of 50-150^0 F. The output of the sensor is 2-10 VDC. The *cooling* tower has a required control point of 80^0 F back to the chiller. The drive is to shut off below 70^0 F. The drive is to resume operation at 75^0 F.

The customer wants to control the cooling tower bypass valve over the JCI system using the 4-20 ma output from the VFD. Finally, the customer wants the drive **to go to 50% speed** upon loss of sump water temperature transducer.

Program the designated VFD demo unit to accomplish the customer requirements. Use the I/O Worksheet to sketch how you would wire the lead VFD and feedback signals.

Note: For demonstration purposes, use, use the demo mounted O-10 VDC pots to simulate the feedback signal.

I / 0 Worksheet

I	SCR	**Reference Voltage**
2	AI 1	10 vDC, **10** mA.
3	AGND	
4	+10 V	
5	AI 2	
6	AGND	
7	AO 1 Output	0 – 20 ma.
8	AGND	
9	+24V	Aux. Voltage Output +24VDC
10	DCOM 1	
11	DI 1	
12	D12	
13	DI 3	
14		
15	DI 5	
16	DCOM 2	
17	RO 1C	RELAY OUTUT #1
18	RO 1A	
19	RO 1B	
20	RO 2C	RELAY OUTPUT #2
21	RO 2A	
22	RO 2B	

Fill in the Parameter Table with changes to your demo.

Parameter Settings Worksheet

Group 99 Start-Up Data	Setting / Value
Group 01 Operating Data	**Setting I Value**
Groups 10 – 16 Parameters	**Setting / Value**
Groups 20 - 26 Parameters	**Setting I Value**
Groups 30 - 52 Parameters	**Setting I Value**

Summary Questions

1) What problems did you encounter when trying to set-up a wiring scheme?

2) Identify the similarities and differences between the ACH 500 (PI Macro) and the ACH 400 operation.

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ACS 401 Hardware
Lab Exercise

ACS 401
HARDWARE LAB WORKBOOK

SECTION #1 ACS 401 PRELIMINARY - STATIC

(no power applied)

1. • **Hardware, IC's and Connectors Seated Properly?** ___________

2. Input **Fuses** ___________**(ohms)**

3. **Input Diode Bridge:** + - / - +
(Check with digital meter using "diode" mode)

U_1 to + Buss .44 / OL **(Vdc)**
V_1 to + Buss .46 / OL **(Vdc)**
W_1 to + Buss .46 / OL **(Vdc)**
U_1 to - Buss OL / .45 **(Vdc)**
V_1 to - Buss OL / .46 **(Vdc)**
W_1 to - Buss OL / .46 **(Vdc)**

Note: +Buss = UDC+

4. **Output IGBT's:** + - / - +
(Check with digital meter using "diode" mode)

U_2 to + Buss .339 / OL **(Vdc)**
V_2 to + Buss .344 / OL **(Vdc)**
W_2 to + Buss .343 / OL **(Vdc)**
U_2 to - Buss OL / .334 **(Vdc)**
V_2 to - Buss OL / .344 **(Vdc)**
W_2 o - Buss OL / .343 **(Vde)**

Note: - Buss = UDC -

SECTION #2 ACS 401 Preliminary - Dynamic

(before enabling)

1. Input Voltage 490 (Vac) 491 (Vac) 490 (Vac)

2. Buss Voltage 675 (Vdc)

3. ________ (Vac ripple content on DC Buss)

3. Power Supplies:
   +5 5.1 (Vdc)
   +10 9.97 (Vdc)
   +12 14 (Vdc)
   +24 27 (Vdc)

SECTION #3 ACS 401 Preliminary - Dynamic

(enabled)

1. Drive at zero speed (Keypad Control)

   a. Input Voltage _______VAC_______VAC_______VAC

   b. Buss Voltage ________________________________(Vdc)

   ________________________________(Vac ripple content)

   c. Output Voltage _______ (Vac)_______(Vac)_______(Vac)

2. Drive at 5Hz

   a. Input Voltage _______VAC_______VAC_______VAC

   b. Buss Voltage ________________________________VDC

   ________________________________(Vac ripple content)

   c. Output Voltage _______(Vac)_______(Vac)_______(Vac)

3. Drive at 30Hz

a. Input Voltage _______VAC_______VAC_______VAC

b. Buss Voltage ________________________________(Vdc)

________________________________(Vac ripple content!

c. output Voltage _______(Vac)_______(Vac)_______(Vac)

4. Drive at 60Hz

a. Input Voltage _______VAC_______VAC_______VAC

b. Buss Voltage ________________________________(Vdc)

________________________________(Vac ripple content)

c. Output Voltage _______(Vac)_______(Vac)_______(Vac)

d. DC buss to Output Voltage:
U_2 to + Buss _______(Vdc)
V_2 to + Buss _______(Vdc)
W_2 to + Buss _______(Vdc)
U_2 to - Buss _______(Vdc)
V_2 to - Buss _______(Vdc)
W_2 to - Buss _______(Vdc)

5. Drive at any extended frequency

a. Input Voltage _______VAC_______VAC_______VAC

b. Buss Voltage ________________________________(Vdc)

c. Output Voltage _______(Vac)_______(Vac)_______(Vac)

Procedure For Registered Start-Up

1) Observation
   - Check Mechanical Connections for Proper Torque
   - Review Installation Procedures in User's Manual
   - Separate Cabling, Control Wiring, Input / Output
   - Ensure the Motor/Cable is Meggered

2) Paperwork
   - No Power Applied / Lock Out, Tag Out
   - Use Warranty Registration Form
   - Record Critical Info. (Motor Data)

Procedure For Registered Start-Up

3) Power Applied (Motor Disconnected)
   - Program "Start-Up Data" Section (Group 99)
   - Start Drive in Local Control & Reference to 60 HZ
   - Measure Output to Verify Phase Balance

4) Power Applied (Motor Connected)
   - Electrical Measurements (Use Registration Form)
   - Motor Rotation Check ("Bump Motor")
   - Operate the Process (Go to Process Speed)
   - No Load (Mtr. Disc'd) & Full Load Measurements

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Procedure For Registered Start-Up

5) Upload Program to Panel

- Make a Hardcopy of Final Parameters
- Save a Copy of Program To Drives Window

6) Certification

- Sign Registration Form (Note Exceptions)
- Have Customer Sign Form
- copy to:
    a) Technical Support Division (Support Line)
    b) Customer
    c) You

Procedure For Registered Start-Up

Safety Concerns During Start-Up

1) Remove all Loose-fitting Clothing, Jewelry, Metal Items
2) Approach Any Drive as if it were "Live"
   - No Bus LED to Rely On (LED may be covered up)
   - Take Meter Readings to Verify Voltages
   - Don't Believe Display - It May be Dead
   - Note: DC Bus is at 1.35 X Line Input Voltage
3) Never Work Alone (Perform Lock Out / Tag Out)
4) Use (1) Hand During Start-Up (As Much As Possible)

Procedure For Registered Start-Up

5) Some Boards Are Not Referenced to Ground Potential

6) With Meters, Use the Highest Range, Then Go Down (ex. Simpson Model 260 or Other Analog Meter)
   - Fuse or Breaker on Meter
   - Analog Gives True Output (RMS)
     Digital Meter Will Read 8 - 10% High (If at all)
   - Know What You're Measuring
     (ex. Volts, Amps, Ohms)

7) Never Wear Wrist Strap When Working on "Live" Equipment

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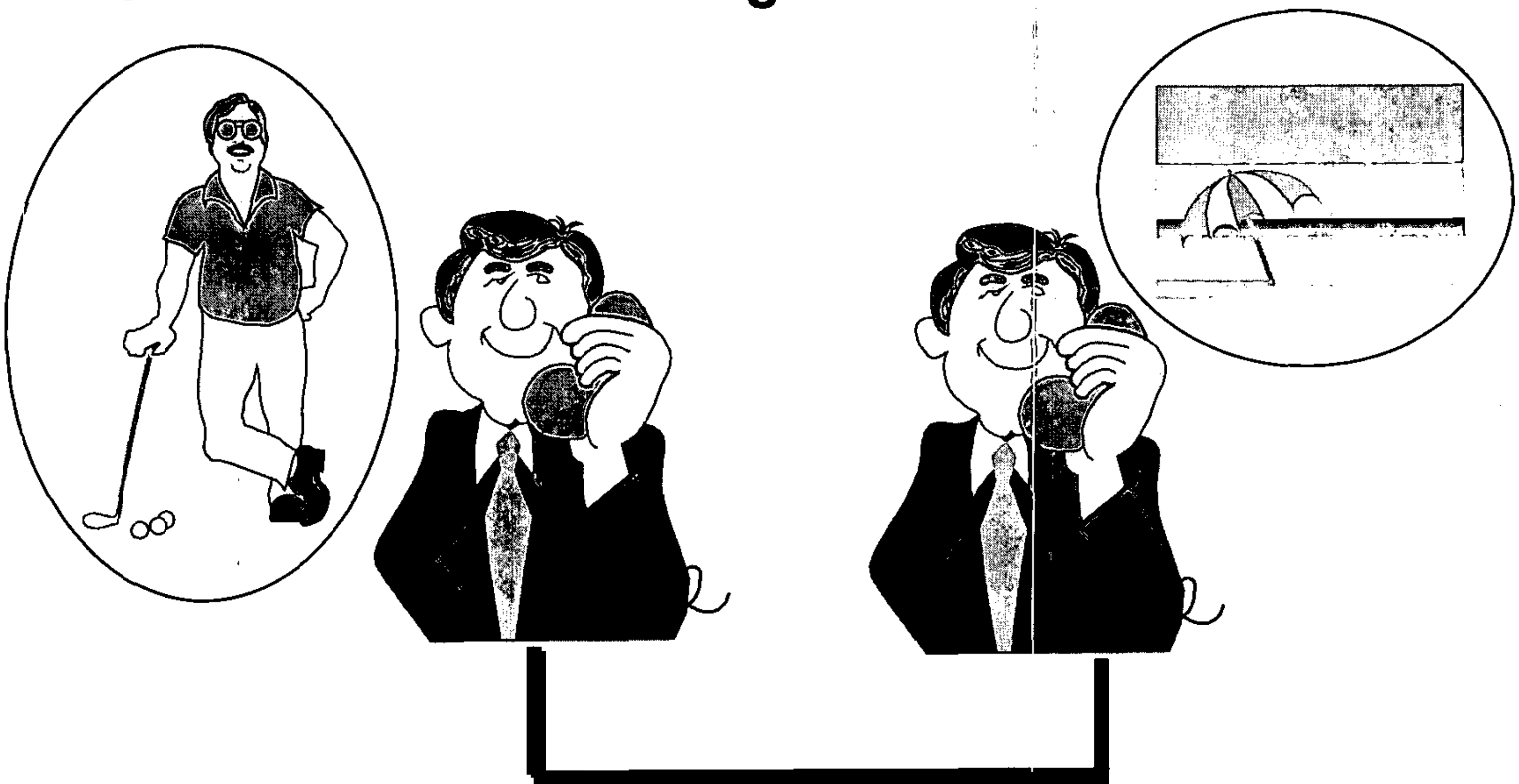
ACS 400 Communications Methods

A Connection does not guarantee communication



ACS 400 Communications Methods

Protocol - A set of rules that must be followed by the communicating parties.

Defines the language used to communicate

- **Includes:**
  - **Format of Data**
  - **Message types and their order**
  - **Error and Flow control**

- **Currently we use Modbus as a Standard**

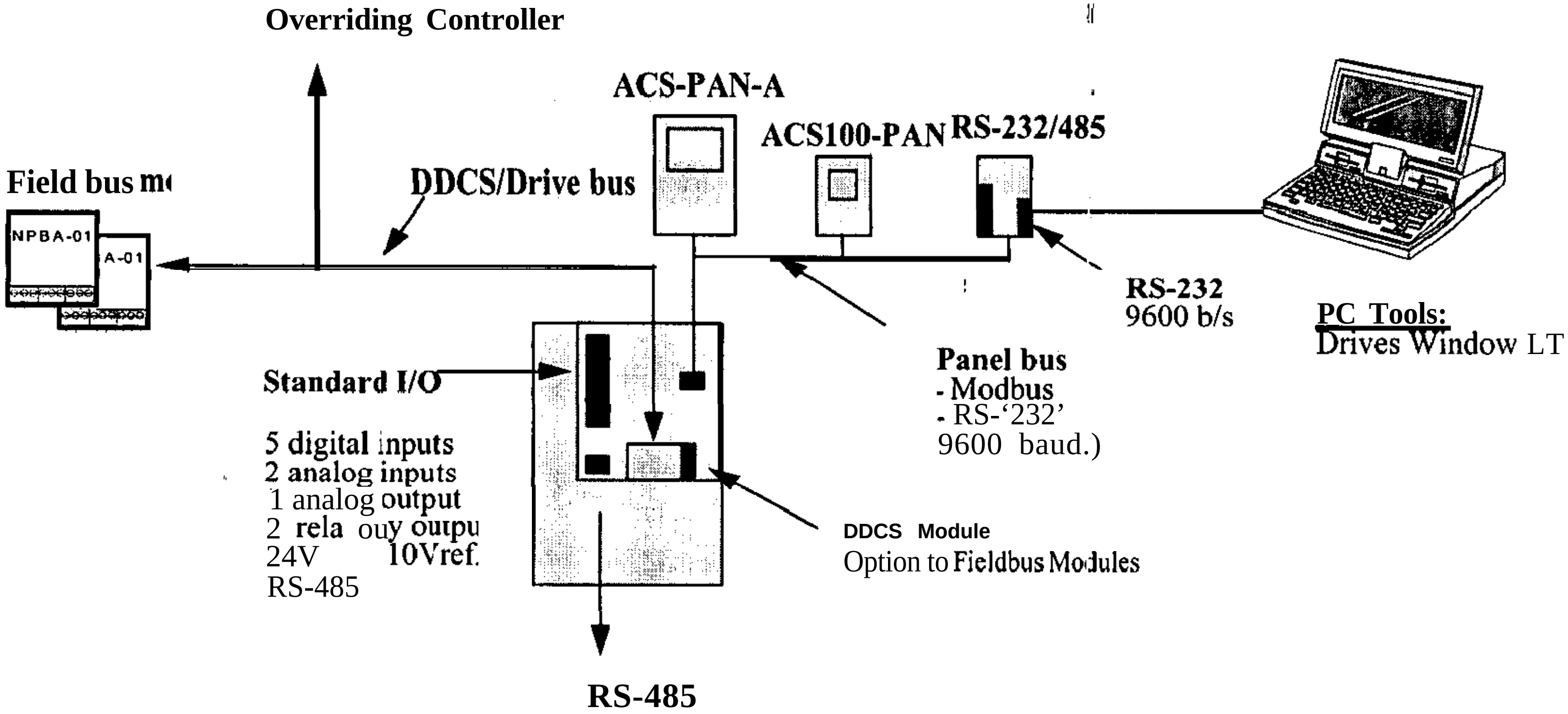
ACS 400 Communications Methods

- Leader / Follower Relationship
  - Remote Terminal is the Leader
  - Drive is the Follower
- Included as the standard Protocol
- Modbus RTU is an industry standard (i.e. GE PLC's)
- Direct connection to any Modbus Master (via RS-485 port)
- Easy to implement using a PC or other device
  (Write software to control . . .)
- Not to be confused with Modbus Plus (different protocol)
- Protocol used with Drives Window LT Software
  (Same Software use to connect to ACS 600)

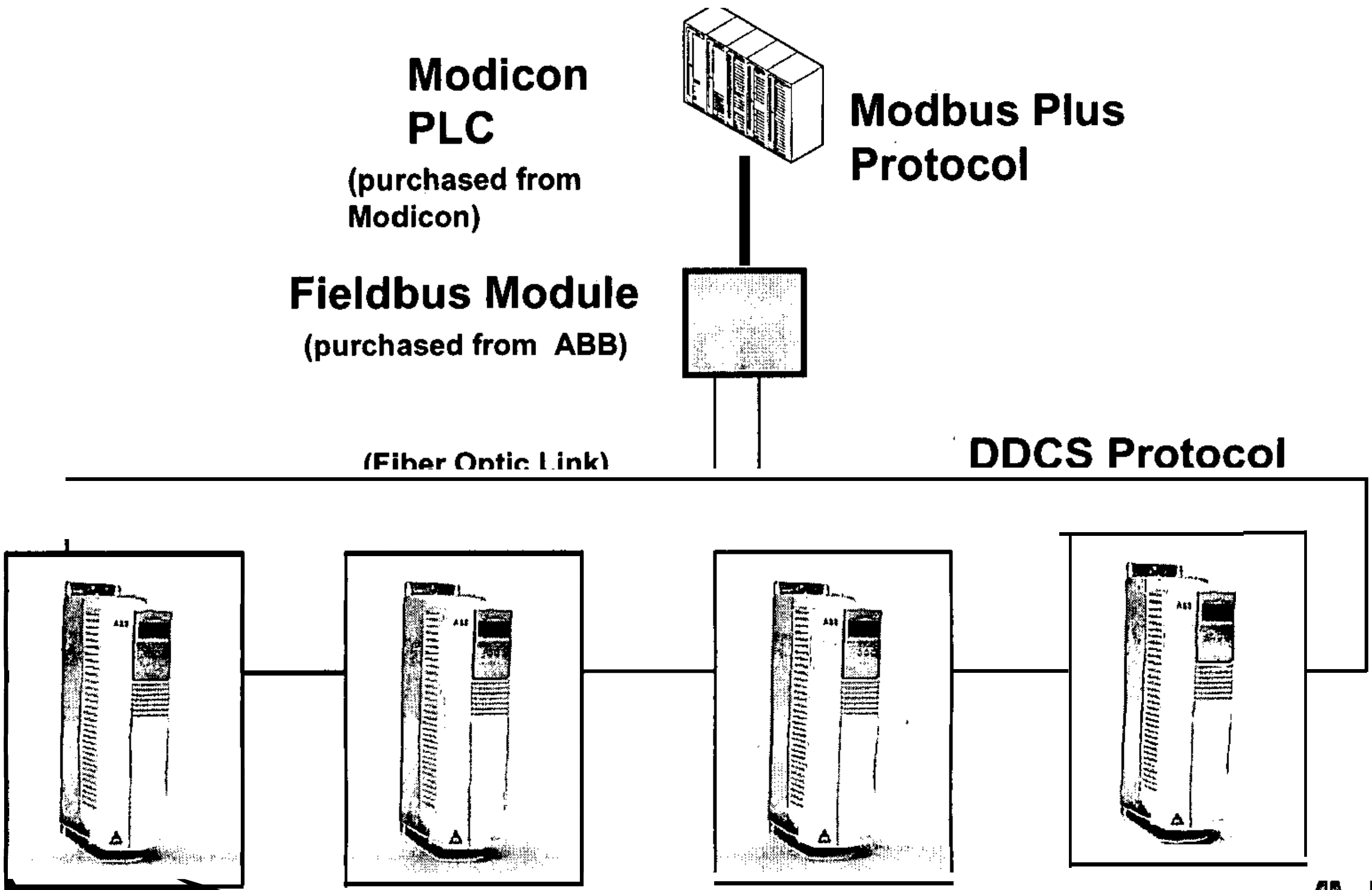
ACS 400 Optional Field Bus Adapters

- Control Panels : ACS100-PAN
  ACS-PAN-A
- DDCS module
- Fieldbus adapters (from ACS600 family):
  - Profibus(NPBA-02),
  - Modbus(NMBA-Ol),
  - Modbus + (NMBP-Ol),
  - CS31 (NCSA-Ol),
  - Interbus (NIBA-01),
  - DeviceNet(NDNA-01)

ACS 400 Drive Control Methods



ACS 400 Communications Methods



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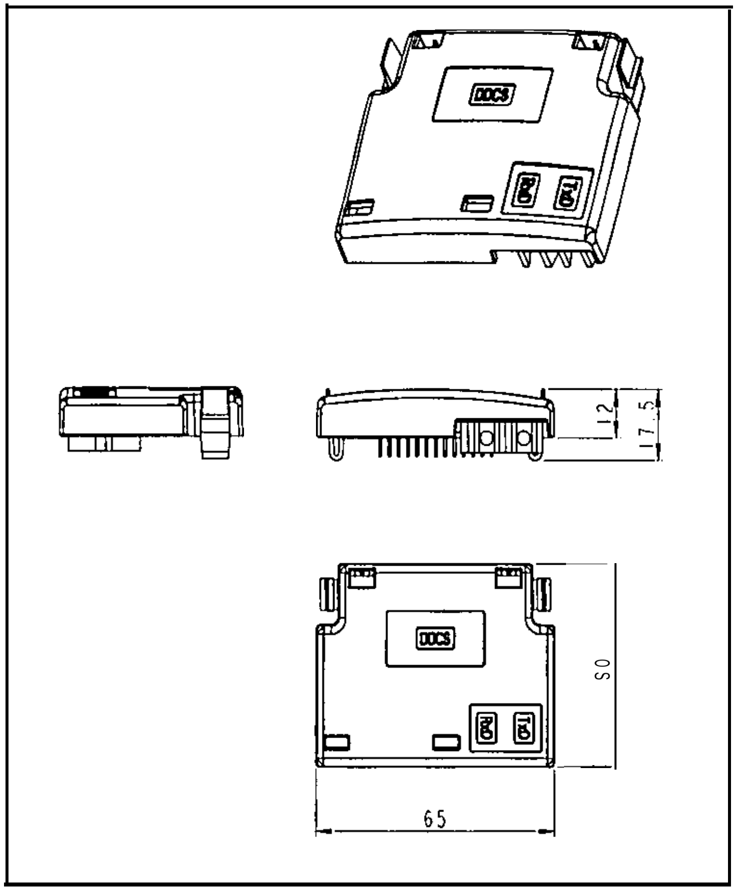
DDCS Module

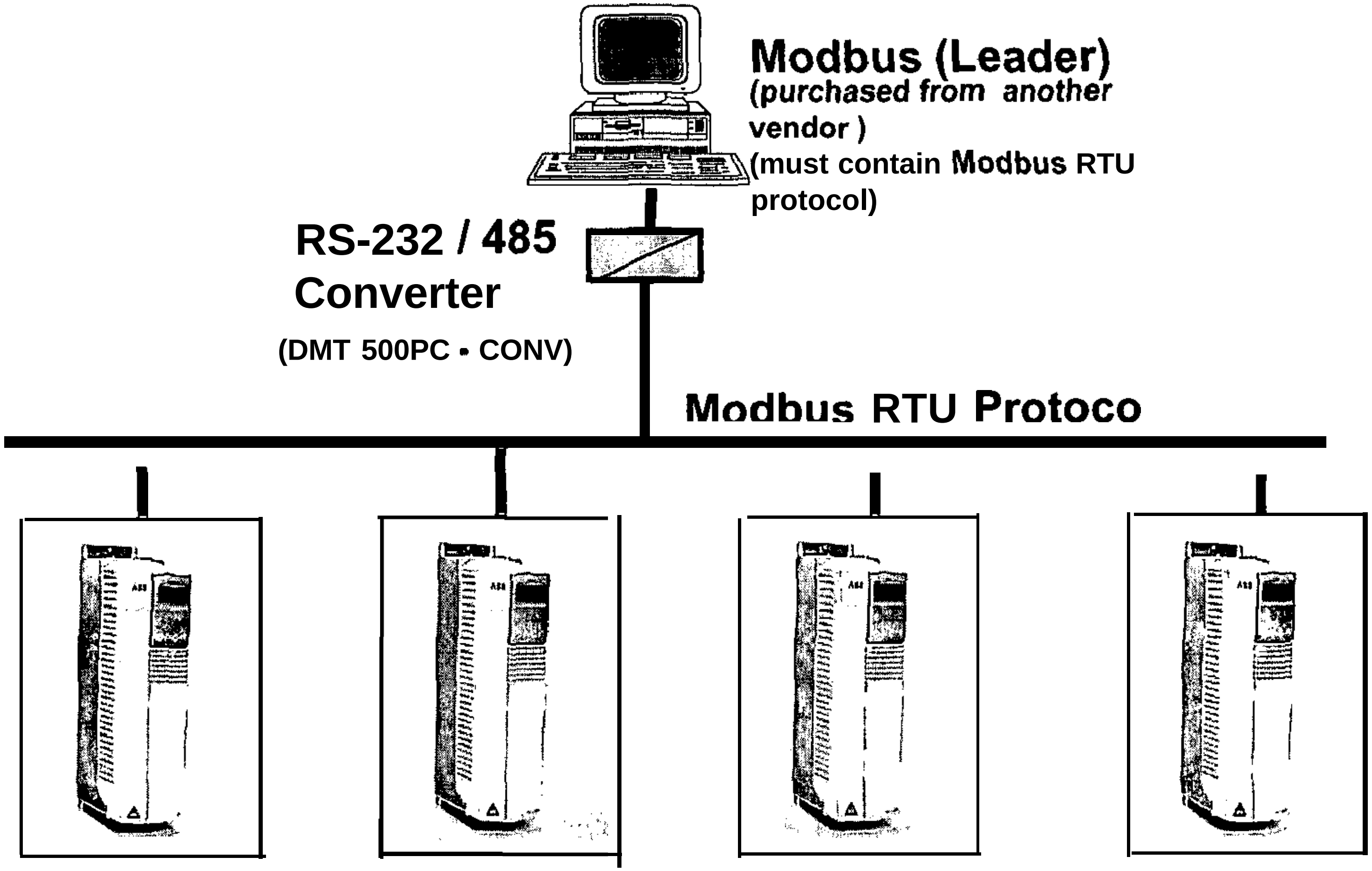


Converts the messages from the internal databus into DDCS-protocol messages

Messages are sent and transmitted using fiber optical cables.

The fiber optic cables are then connected to fieldbus modules.

ACS 400 Communications Methods



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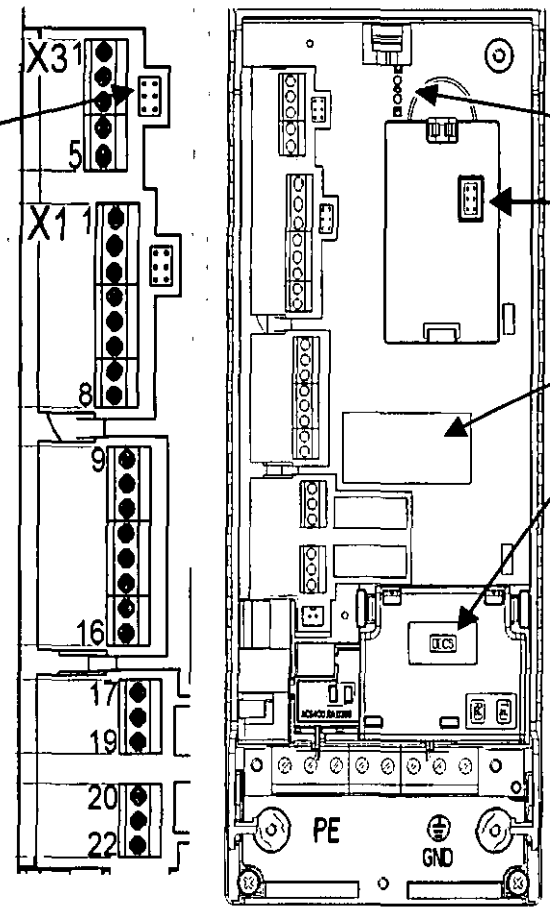
ACS 400 Communications Interface

RS485 connector

V/I jumper S2



Leds (green and red)

Panel connector X2

Warning sticker

DDCS connection X6

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Fieldbus Adapters

ACS600 & ACS400

ACS600 Fieldbus Parameters

ADAPTER MODULE CONFIGURATION (Module type dependent. See module manual.)			
51.01		-	
51.02		-	
51.03		-	
51.04		-	
51.05		-	
51.06		-	
51.07		-	
51.08		-	
51.09		-	
51.10		-	

FIELDBUS REFERENCE TARGET SELECTION			
90.01 D SET 3 VAL 1	0 ... 8999 Default: 0 (None selected)		Defines the drive parameter into which the value of Data word 3.1 (RllF3) is written. Format: xxyy, where xx = Parameter Group (10 to 89). yy = Parameter Index. E.g. 3001 = ksrameter30.01.
90.02 D SET 3 VAL 2	0 ... 8999 Default: 0 (None selected)		Defines the drive parameter into which the value of Data word 3.2 (RllF4) is written. Format: see Parameter 90.01.
90.03 D SET 3 VAL 3	0 ... 8999 Default: 0 (None selected)		Defines the drive parameter into which the value of Data word 3.3 (REF5) is written. Format: see Parameter 90.01.
FIELDBUS ACTUAL SIGNAL SELECTION			
92.01 D SET 2 VAL 1	Fixed to 302 (Actual Signal 3.02 MAIN STATUS WORD).		he Status Word is transmitted as Data word 2.1. (Setting cannot be changed.)
92.02 D SET 2 VAL 2	0 9999 Default: 102 (Actual Signal 1.02 SPEED)		Selects the Actual signal or Parameter value to be transmitted as Data word 2.2 (ACT1). Format: (x)xyy, where (x)x = Actual Signal Group or Parameter Group, yy = Actual Signal or Parameter Index. E.g. 103 = Actual Signal 1.03 FREQUENCY; 2202 = Parameter 22.02 ACCEL TIME 1.
92.03 D SET 2 VAL 3	0 9999 Default: 105 (Actual Signal 1.05 TORQUE)		Selects the Actual signal or Parameter value to be transmitted as Data word 2.3 (ACT2). Format: see Parameter 92.02.
92.04 D SET 4 VAL 1	0 ... 9999 Default: 305 (Actual Signal 3.05 FAULT WORD 1)		Selects the Actual signal or Parameter value to be transmitted as Data word 4.1 (ACT3). Format: see Parameter 92.02.
92.05 D SET 4 VAL 2	0 ... 9999 Default: 308 (Actual Signal 3.08 ALARM WORD 1)		Selects the Actual signal or Parameter value to be transmitted as Data word 4.2 (ACT4). Format: see Parameter 92.02.
92.06 D SET 4 VAL 3	0 ... 9999 Default: 306 (Actual Signal 3.06 FAULT WORD 2)		Selects the Actual signal or Parameter value to be transmitted as Data word 4.3 (ACTS). Format: see Parameter 92.02.

COMMUNICATION INITIALISATION			
98.02 COMM. MODULE	NO; FIELDBUS; ADVANT	FIELDBUS (ADVANT for ABB Advant)	Initializes communication between drive and adapter module. Activates module parameters (Group 51).
98.07 COMM PROFILE	ABB DRIVES; CSA 2.8/3.0	Use ABB DRIVES if allowed by the adapter module. See module parameters at Group 51.	Selects the communication profile used by the drive. Must match the profile setting of the adapter module.
CONTROL COMMAND SOURCE SELECTION			
10.01 EXT1 STRT/STP/DIR	NOT SEL; DI1; ...; COMM.MODULE	COMM.MODULE	Enables the Control Word (except bit 11) when EXT1 is selected as control location.
10.02 EXT2 STRT/STP/DIR	NOT SEL; D1; ...; COMM.MODULE	COMM.MODULE	Enables the Control Word (except bit 11) when EXT2 is selected as control location.
10.03 DIRECTION	FORWARD; REVERSE; REQUEST	REQUEST	Enables rotation direction control as defined by Parameters 10.01 and 10.02.
11.02 EXT1/EXT2 SELECT	DI1; ...; COMM.MODULE	COMM.MODULE	Enables EXT1/EXT2 selection by Control Word bit 11 EXT CTRL LOC.
11.03 EXT REF1 SELECT	KEYPAD; ...; COMM.REF; COMMREF+AI1; COMMREF*AI1	COMM.REF, COMMREF+AI1, or COMMREF*AI1	Fieldbus Reference REF1 is used when EXT1 is selected as control location. See section References below for information on the alternative settings.
11.06 EXT REF2 SELECT	KEYPAD; ...; COMM.REF; COMMREF+AI1: COMMREF*AI1	COMM.REF, COMMREF+AI1, or COMMREF*AI1	Fieldbus Reference REF2 is used when EXT2 is selected as control location. See section References below for information on the alternative settings.
OUTPUT SIGNAL SOURCE SELECTION			
14.01 RELAY RO1 OUTPUT	READY; ...; COMM.MODULE	COMM.MODULE	Enables Relay output RO1 control by Data word 3.1 (REF3) bit 13.
14.02 RELAY RO2 OUTPUT	READY; ...; COMM.MODULE	COMM.MODULE	Enables Relay output RO2 control by Data word 3.1 (REF3) bit 14.
14.03 RELAY RO3 OUTPUT	READY; ...; COMM.MODULE	COMM.MODULE	Enables Relay output RO3 control by Data word 3.1 (REF3) bit 15.
15.01 ANALOG OUTPUT1	NOT USED; P SPEED; ...; COMM.MODULE	COMM.MODULE	Directs the contents of Data word 3.2 (REF4) to Analog output AO1. Scaling: 20000 = 20 mA
15.06 ANALOG OUTPUT2	NOT USED; P SPEED; ...; COMM.MODULE	COMM.MODULE	Directs the contents of Data word 3.3 (REF5) to Analog output AO2. Scaling: 20000 = 20 mA.
COMMUNICATION FAULT FUNCTIONS			
30.18 COMM FAULT FUNC	NO; FAULT; CONST SP 15; LAST SPEED	-	Determines drive action in case the DDCS communication between the drive and the module is lost. Note: The communication loss function is based on supervision of Data set 1 Write.
30.19 COMM FLT TIME-OUT	0.1 to 60 s	-	Defines the time between DDCS communication loss detection and the action selected by Parameter 30.18.
30.20 COMM FLT RO/AO	ZERO; LAST VALUE	-	Determines the value to which Relay outputs RO1 to RO3 and Analog outputs AO1 and AO2 are set upon DDCS communication loss.

ACS600 Command /Status Word

Bit	Name	Value	Enter STATE/Description
0	ON	1	Enter READY TO OPERATE
	OFF1	0	Emergency OFF, stop by the selected deceleration ramp (Group 22). Enter OFF1 ACTIVE; proceed to READY TO SWITCH ON unless other interlocks (OFF2, OFF3) are active
1	OFF2	1	Continue operation (OFF2 inactive)
		0	Emergency OFF, coast to stop. Enter OFF2 ACTIVE; proceed to SWITCH-ON INHIBITED
2	OFF3	1	Continue operation (OFF3 inactive)
		0	Emergency stop, stop according to fastest possible deceleration mode (limited by ACS 600 current limit). Enter OFF3 ACTIVE; proceed to SWITCH-ON INHIBITED. Warning: Ensure motor and driven machine can be stopped using this stop mode.
3	START	1	Enter OPERATION ENABLED (Note that also the Run enable signal must be present on a digital input - see Parameter 16.01)
		0	Inhibit operation. Enter OPERATION INHIBITED
4	RAMP_OUT_ZERO	1	Normal operation. Enter RAMP FUNCTION GENERATOR: OUTPUT ENABLED
		0	Force Ramp Function Generator output to zero. Drive ramps to stop (current and DC voltage limits in force)
5	RAMP_HOLD	1	Enable ramp function. Enter RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED
		0	Halt ramping (Ramp Function Generator output held)
6	RAMP_IN_ZERO	1	Normal operation. Enter OPERATING
		0	Force Ramp Function Generator input to zero
7	RESET	0 ⇒ 1	Fault reset if an active fault exists. Enter SWITCH-ON INHIBITED
		0	(Continue normal operation)
8	INCHING_1	1	Not in use.
		1 ⇒ 0	Not in use.
9	INCHING_2	1	Not in use.
		1 ⇒ 0	Not in use.
10	REMOTE_CMD	1	Fieldbus (DDCS) control enabled
		0	Control Word <> 0 or Reference <> 0: Retain last Control Word and Reference. Control Word = 0 and Reference = 0: Fieldbus (DDCS) control enabled. Reference and deceleration/acceleration ramp are locked.
11	EXT CTRL LOC	1	Select External Control Location 2 (EXT2). Effective if Par. 11.02 is set to COMM.MODULE
		0	Select External Control Location 1 (EXT1). Effective if Par. 11.02 is set to COMM.MODULE
12 to 15			Reserved

Bit	Name	Value	STATE/Description
0	RDY_ON	1	READY TO SWITCH ON
		0	NOT READY TO SWITCH ON
1	RDY_RUN	1	READY TO OPERATE
		0	OFF1 ACTIVE
2	RDY_REF	1	OPERATION ENABLED
		0	
3	TRIPPED	1	FAULT
		0	No fault
4	OFF_2_STA	1	OFF2 inactive
		0	OFF2 ACTIVE
5	OFF_3_STA	1	OFF3 inactive
		0	OFF3 ACTIVE
6	SWC_ON_INHIB	1	SWITCH-ON INHIBITED
		0	
7	ALARM	1	Warning/Alarm
		0	No Warning/Alarm
8	AT_SETPOINT	1	OPERATING. Actual value equals reference value (= is within tolerance limits)
		0	Actual value differs from reference value (= is outside tolerance limits)
9	REMOTE	1	Drive control location: REMOTE
		0	Drive control location: LOCAL
10	ABOVE_LIMIT	1	Actual frequency or speed value equals or is greater than supervision limit (Par. 32.03). Valid in both rotation directions regardless of value of Par. 32.03
		0	Actual frequency or speed value is within supervision limit
11	EXT CTRL LOC	1	External Control Location 2 (EXT2) selected
		0	External Control Location 1 (EXT1) selected
12		1	Run Enable signal received
		0	No Run Enable received
13 to 14			
15		1	Error in DDCS communication (between fieldbus adapter module and drive). Adapter ceases to communicate with the master
		0	DDCS communication OK

ACS600 CSA2.8/3.0 Command/Status

Bit	Name	Description
0	READY	1 = Drive Ready to Start 0 = Initalising, or Initalisation Error
1	ENABLED	1 = Enabled 0 = Not Enabled
2	ON/OFF	1 = Main Contactor Closed (DC) 0 = Main Contactor Open
3	RUNNING	1 = Drive Running w. Selected Reference 0 = Drive Stopped
4	QUICK_STOP	1 = Quick Stop Active 0 = No Quick Stop
5	REMOTE	1 = Drive in Remote Mode 0 = Drive in Local Mode
6	*reserved*	
7	AT_SETPOINT	1 = Drive at Reference 0 = Drive not at Reference
8	FAULTED	1 = Active Fault 0 = No Active Faults
9	WARNING	1 = Active Warning 0 = No Active Warnings
10	LIMIT	1 = Drive at Limit 0 = No Active Limits
11 ... 15	*reserved*	

Table 5-3 The Status Word

Bit	Name	Description
0	*reserved*	
1	ENABLE	1 = ENABLED 0 = Coast to stop
2	ON/OFF	1 = Close main contactor (DC Only) 0 = Open main contactor
3	START/STOP	0 -> 1 Start the drive 0 = Stop the drive to normal stop mode
4	FLUX_ON	0 -> 1 = Generate a flux to the motor 0 =
5	CNTRL_MODE	0 = Select Control Mode 1 1 = Select Control Mode 2
6	QUICK_STOP	1 = Stop the drive to quick stop mode 0 =
7	*reserved*	
8	RESET FAULT	0->1 Reset drive fault
9 – 15	*reserved*	

Table 5-2 The Command Word

aCS400 Fieldbus Parameters

Code	Description
5001	DDCS BIT RATE DDCS link baud rate in Mbits/s.
5002	DDCS NODE NR DDCS link node number.
5003	COMM FAULT TIME Communication time out delay. This applies both to standard Modbus and DDCS link.
5004	COMM FAULT FUNC Communication fault function. This applies both to standard Modbus and DDCS link. 0 = not sel No operation. 1 = fault A fault indication is displayed and the ACS 400 coasts to stop. 2 = const sp 7 A warning indication is displayed and the speed is set according to parameter 1208 const speed7. 3 = last speed A warning indication is displayed and the speed is set to the level the ACS 400 was last operating at. This value is determined by the average speed over the last 10 seconds. Caution: If you select const speed 7 or last speed, make sure that it is safe to continue operation if communication is lost.
5005	PROTOCOL SEL Defines what communication protocols are used. Options 1 (DDCS) and 3 (STD MDB+DDCS) should be selected only if DDCS communication module is installed. 0 = not sel No serial communication is active. 1 = ddcs DDCS serial communication is active. 2 = std modbus Standard Modbus protocol is active. 3 = std mdb+ddcs Both standard Modbus and DDCS are active.
5006	COMM COMMANDS This parameter controls the commands source protocol selection. Although the ACS 400 can communicate simultaneously via several serial communication channels, the controlling commands - start, stop, direction and reference - can be received only from a single communication channel, selectable by this parameter. 0 = not sel Controlling commands are not received via serial communication. 1 = std modbus Controlling commands can be received through Channel 1 standard Modbus protocol.

Code	Description
5101	FIELDBUSPAR 1 Parameter 1 of communication module in DDCS link. Value reflects the type of connected DDCS option module.
5102 - [illegible]	FIELDBUSPAR 2 - FIELDBUSPAR 15 Refer to option module documentation for

[illegible]

Value	Module type
0	[illegible]
1	[illegible]
2	[illegible]
3	[illegible]
4	[illegible]
5	[illegible]
6	[illegible]
7	[illegible]
8	[illegible]
9	[illegible]

Code	Description
5201	Sets the slave number for the ACS 400 in Modbus network. Range: 1 - 247 **Modifications take effect only on the next power up.**
5202	Defines the communication speed of the ACS 400 in bits per second (bps). 3 = 300 bps 6 = 600 bps 12 = 1200 bps 24 = 2400 bps 48 = 4800 bps 96 = 9600 bps 192 = 19200 bps **Modifications take effect only on the next power-up.**
5203	PARITY Defines the parity to be used with the Modbus communication. Parameter also defines the number of stop bits. With Modbus communication, the number of stop bits is 2 with no parity bit, and 1 with even or odd parity. 0 = none 1 = even 2 = odd **Modifications take effect only on the next power-up.**
5206	bad messages This diagnostics counter increases by one every time the ACS 400 finds any kind of communication error. During normal operation, this counter hardly ever increases.
5207	good messages This diagnostics counter increases by one every time a valid Modbus message has been received by the ACS 140. During normal operation, this counter is increasing constantly.
5208	buffer overruns Longest possible message length for the ACS 400 is 32 bytes. If a message exceeding 32 bytes is received, this diagnostic counter increases by one every time a character is received and cannot be placed in the buffer.
5209	frame errors This diagnostic counter increases by one every time when a character with a framing error is received from the bus. • Communication speed settings of the devices connected in the bus differ. • Ambient noise levels may be too high.
5210	parity errors This diagnostic counter increases by one every

ACS400 Command / Status Words

Bit	Value	Description
0	1	Enter ready to operate
	0	Emergency OFF. Ramp to stop according to parameter 2203 decel time 1. Enter off1 active; proceed to ready to switch on unless other interlocks (OFF2, OFF3) are active.
1	1	Continue operation (OFF2 inactive)
	0	Emergency OFF, coast to stop. Enter off2 active; proceed to switch-on inhibited.
2	1	Continue operation (OFF3 inactive)
	0	Emergency stop. Drive ramps to stop according to parameter 2205 decel time 2. Enter off3 active; proceed to switch-on inhibited.
3	0-1	Enter operation enabled (Note that also the Run enable signal must be present on a digital input - see parameter 1601 run enable.
	0	Inhibit operation. Enter operation inhibited
4		Unused.
5	1	Normal operation. Enter ramp function generator: accelerator enabled
	0	Halt ramping (Ramp Function Generator output held)
6	1	Normal operation. Enter operating
	0	Force Ramp Function Generator input to zero.
7	0-1	Fault reset (enter switch-on inhibited)
	0	(Continue normal operation)
8 to 10		Unused
11	1	Select external control location 2 (ext2)
	0	Select external control location 1 (ext1)
12 to 15		Unused

Bit	Value	Description
0	1	ready to switch on
	0	not ready to switch on
1	1	ready to operate
	0	off1 active
2	1	operation enabled
	0	Not ready (operation inhibited)
3	0 - 1	fault
	0	No fault
4	1	off2 inactive
	0	off2 active
5	1	off3 inactive
	0	off3 active
6	1	switch-on inhibited
	0	
7	1	Any alarm except AL1-AL7, AL15, AL27, and AL28.
	0	No alarm
8	1	operating. Actual value equals reference value (= is within tolerance limits).
	0	Actual value differs from reference value (= is outside tolerance limits)
9	1	Drive control location: remote
	0	Drive control location: local
10	1	The value of first supervised parameter equals to or is greater than supervision limit. Refer to Group 32 Supervision.
	0	The value of first supervised parameter is below supervision limit
11	1	External control location 2 (ext2) selected
	0	External control location 1 (ext1) selected
12	1	Run Enable signal received
	0	No Run Enable signal received
13 to 15		Unused

Modbus Parameter Mapping

- Data sets
  - Data set 1 : Control word
  - Data set 2 : Reference 1
  - Data set 3 : Reference 2
  - Data set 4 : Status word
  - Data set 5 : Actual value 1
  - Data set 6 : Actual value 2

- Actual values
  - Actual values 1 to 32 as in control panel

- Groups
  - Groups 1 to 99 as in control panel

Register addresses 4GGPP are shown in *Table 6-1 'Parameter Mapping:* **In this table GG is the group number, and PP is the parameter number within the group.**

4GGPP	GG	PP
40001 – 40006	00 Data sets	01 Data set 1 02 Data set 2 ... 06 Data set 6
40101 – 40126	01 Actual Values	01 Process Speed ... 26 Control Dev.
41001 – 41003	10 Group 10	01 Param 10.1 ... 03 Param 10.3
...	...	...
49801 – 49805	98 Group 98	01 Param 98.1 ... 05 Param 98.5
49901 – 49909	99 Start-up Data	01 Language ... 09 Motor ID Run

Table 6-1 Parameter Mapping

Modbus Register Configuration

- Modbus Registers are configured as 4xxxx register numbers
- Take the Group # and the Index # and place a 4 in front of the Group
  - Parameter 1.02 SPEED = 40102
  - Parameter 22.02 ACCEL TIME 1 = 42202
  - Parameter 30.12 STALL TIME = 43012

Modbus DataSet Register Numbers

- DataSet 1 Register Numbers
  - DataSet 1 Word 1 (Command) = 40001
  - DataSet 1 Word 2 (Speed Refl) = 40002
  - DataSet 1 Word 3 (Speed Ref2) = 40003
- DataSet 2 Register Numbers
  - DataSet 2 Word 1 (Status) = 40004
  - DataSet 2 Word 2 (Actual 1; Param 92.02) = 40005
  - DataSet 2 Word 3 (Actual 2; Param 92.03) = 40006

Modbus DataSet Register Numbers

- DataSet 3 Register Numbers
  - DataSet 3 Word 1 (Param 90.01) = 40007
  - DataSet 3 Word 2 (Param 90.02) = 40008
  - DataSet 3 Word 3 (Param 90.03) = 40009
- DataSet 4 Register Numbers
  - DataSet 4 Word 1 (Actual 3; Param 92.04) = 40010
  - DataSet 4 Word 2 (Actual 4; Param 92.05) = 40011
  - DataSet 4 Word 3 (Actual 5; Param 92.06) = 40012

Modbus Setup

- Hardware:
  - Connection of twisted pair data cable (Belden 9841)
  - Connection of 24V dc power supply
  - Earthing strip

X1		Description
1	D(P)	D(P) = Data Positive (Conductor 1 in twisted pair)
2	D(N)	D(N) = Data Negative (Conductor 2 in twisted pair)
3	DG	DG = Data Ground
4	SHF	Filtered Shield (Grounded via an RC Filter)
5	SH	Shield (Grounded)
6	0V	Power Supply for the module (3W)
7	+24V	From the NIOC card of the ACS 600 (Terminals X23.1 = +24V, X23.2 = Ground) or from other stable power supply
8	PE	Ground

- Software:

  *Activation of adapter through par. 98.2

  o Modbus settings in group 51

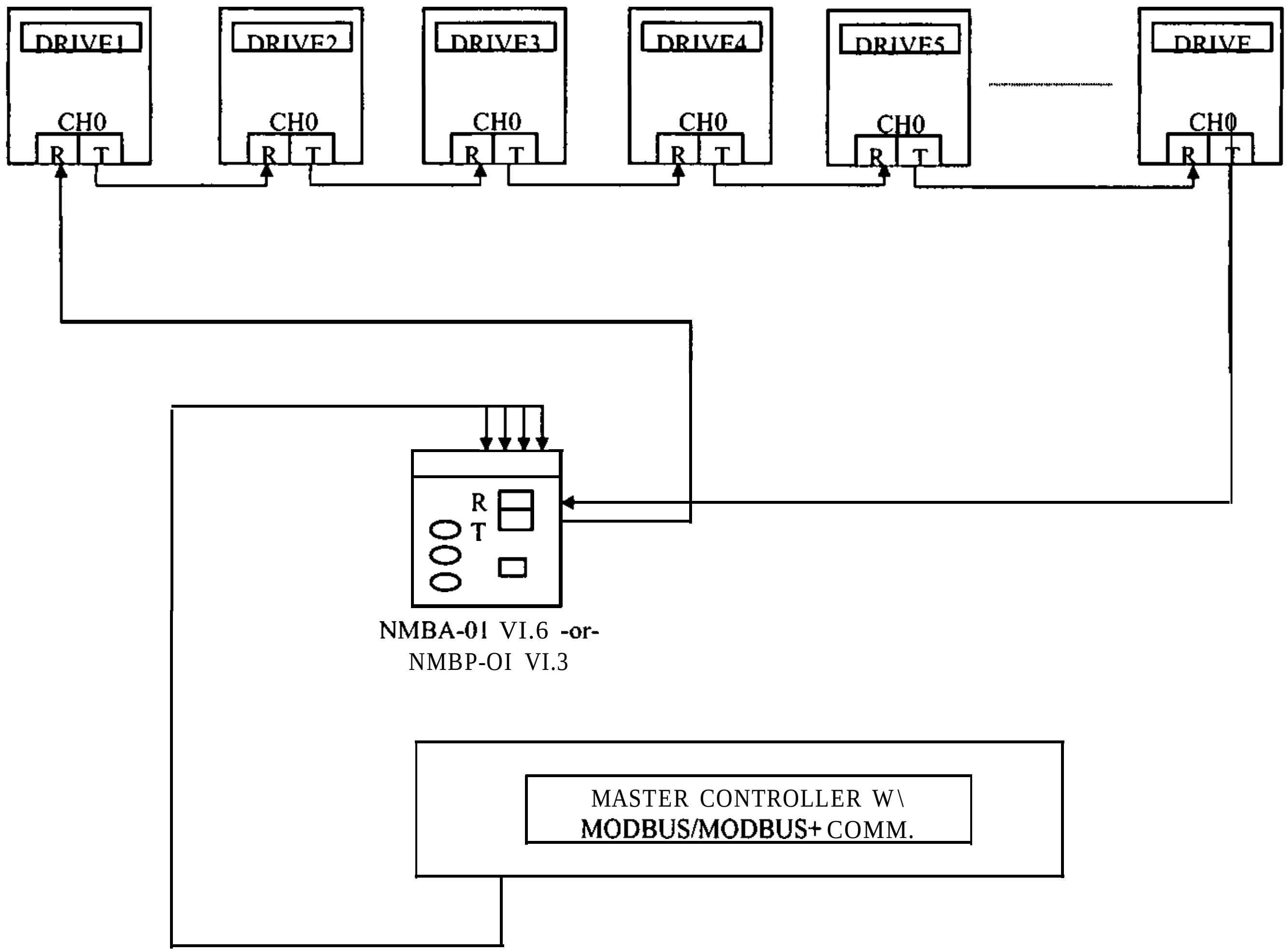
Number	Parameter	Settings	Default
Group 51 – COMM MOD DATA			
51.1	FIELD BUS	NMBA-01 V0.8	
51.2	MODBUS MODE	RTU wdg:flt / RTU wdg:rst	RTU wdg:flt
51.3	STATION NUMBER	1 - 247	247
51.4	BAUD RATE	1200 / 2400 / 4800 / 9600 / 19,200	9600
51.5	PARITY	NONE / ODD / EVEN	NONE
51.6	GOOD MESSAGES	0 - 32767	0
51.7	BAD MESSAGES	0 - 32767	0

- Application:

  o Setting of start/stop, reference, enable, fault reset location(s)

  0 Setting of communication time-out time and function

Modbus & Modbus Plus Multidrop



NOTES:

I. Maximum plastic fiber optic link is 10 m.

2. NMBA-01 Module may be powered from the ACS 6001400 24v DC supply (capacity permitting)

3. NMBA-01 Module theoretically will support 247 ACS 600/400 inverters. NMBP-01 only supports up to 8 inverters.

Modbus Plus Register Configuration

- Modbus Registers are configured as 4xxxx register numbers
- Take the Group # and the Index # and place a 4 in front of the Group
  - Parameter 1.02 SPEED ❑ 40102
  - Parameter 22.02 ACCEL TIME 1 = 42202
  - Parameter 30.12 STALL TIME = 43012

Modbus Plus DataSet Register Numbers

- DataSet 1 Register Numbers
  - DataSet 1 Word 1 (Command) = 40001
  - DataSet 1 Word 2 (Speed Refl) = 40002
  - DataSet 1 Word 3 (Speed Ref2) = 40003
- DataSet 2 Register Numbers
  - DataSet 2 Word 1 (Status) = 40004
  - DataSet 2 Word 2 (Actual 1; Param 92.02) = 40005
  - DataSet 2 Word 3 (Actual 2; Param 92.03) ❑ 40006

Modbus Plus DataSet Register Numbers

- DataSet 3 Register Numbers
  - oDataSet 3 Word 1 (Param 90.01) = 40007
  - oDataSet 3 Word 2 (Param 90.02) = 40008
  - oDataSet 3 Word 3 (Param 90.03) = 40009
- DataSet 4 Register Numbers
  - oDataSet 4 Word 1 (Actual 3; Param 92.04) = 40010
  - oDataSet 4 Word 2 (Actual 4; Param 92.05) = 40011
  - oDataSet 4 Word 3 (Actual 5; Param 92.06) = 40012

MSTR Block Write Function Config

		MSTR: Modbus Plus Network Node Transaction					Page 1 / 1
MSTR Operation Function Code:				40200	INT =	1	DEC
Error Status:				40201	INT =	0	DEC
Number of Registers Transferred:				40202	INT =	3	DEC
Function-dependent Information				40203	INT =	1	DEC
Routing 1, Destination Device Address:				40204	INT =	3	DEC
Routing 2, Destination Device Address:				40205	INT =	1	DEC
Routing 3, Destination Device Address:				40206	INT =	0	DEC
Routing 4, Destination Device Address:				40207	INT =	0	DEC
Routing 5, Destination Device Address:				40208	INT =	0	DEC
Function Codes:							
1->WRITE DATA				2->READ DATA			
3->GET LOCAL STATISTICS				4->CLEAR LOCAL STATISTICS			
5->WRITE GLOBAL DATABASE				6->READ GLOBAL DATABASE			
7->GET REMOTE STATISTICS				8->CLEAR REMOTE STATISTICS			
9->PEER COP HEALTH							

MSTR Block Read Function Config

		MSTR: Modbus Plus Network Node Transaction					Page 1 / 1
MSTR Operation Function Code:				40200	INT =	2	DEC
Error Status:				40201	INT =	0	DEC
Number of Registers Transferred:				40202	INT =	3	DEC
Function-dependent Information				40203	INT =	1	DEC
Routing 1, Destination Detice Address:				40204	INT =	3	DEC
Routing 2, Destination Detice Address:				40205	INT =	1	DEC
Routing 3, Destination Detice Address:				40206	INT =	0	DEC
Routing 4, Destination Device Address:				40207	INT =	0	DEC
Routing 5, Destination Detice Address:				40208	INT =	0	DEC
Function Codes:							
1->WRITE DATA			2->READ DATA				
3->GET LOCAL STATISTICS			4->CLEAR LOCAL STATISTICS				
5->WRITE GLOBAL DATABASE			6->READ GLOBAL DATABASE				
7->GET REMOTE STATISTICS			8->CLEAR REMOTE STATISTICS				
9->PEER COP HEALTH							

Modbus Plus Setup

- Hardware:
  - *Connection of twisted pair data cable (Belden 9841)
  - *Connection of 24V dc power supply
  - ◆ Earthing strip

X1		Description
1	+24V	+24VDC (to X23:1 of ACS600)
2	GND	GND = Signal Ground
3	0V	OVDC (to X23:2 of ACS600)

- Software:
  - ◆ Activation of adapter through par. 98.2
  - ◆ Modbus **settings in group 51**

Number	Parameter	Settings	Default
Group 51 – COMM MOD DATA			
51.1	FIELD BUS	NMBP-01	
51.2	PROTOCOL	MODBUS PLUS; MBP FAST	MODBUS PLUS
51.3	STATION	1 – 64	64
51.4	GOOD MSG	0 – 32767	0
51.5	BAD MSG	0 – 32767	0
51.6	GD OUT 1	0 – 6	0
51.7	GD OUT 2	0 – 6	0
51.8	GD OUT 3	0 – 6	0
51.9	GD IN1 STN	0 – 64	0
51.10	GD IN1 WRD	0 – 31	0
51.11	GD IN2 STN	O-64	0
51.12	GD IN2 WRD	o-31	0
51.13	GD IN3 STN	O - W	0
51.14	GD IN3 WRD	o-31	0

- Application:
  - ◆ Setting of start/stop, reference, enable, fault reset location(s)
  - ◆ Setting of communication time-out time and function

Modbus Plus Multidrop

- NMBP-01 VI .3 supports Multidrop applications
- Up to 8 Slave drives are supported by One NMBP-01
- NMBP-01 module resembles a Modicon Bridge Multiplexer, which means Global Data is not supported when configuring module to support Multidrop applications
- MSTR Instruction used to Read / Write information to individual slaves
- Slave Drives Number Channel 0 Node Address consecutively by there location in the DDCS fiber optic ring. Number the First Slave Channel 0 Node as "1".
- MSTR Instruction Changes "Routing 2" designation to write to each individual slave drive

DeviceNet Networks

The NDNA-01 Adapter normally receives its 24VDC module power via the DeviceNet Network Cable and not from the ACS600/ACS400 24VDC power supply. However this can cause problems with the network in a certain situation:

- If the Network and the Drives are not powered up simultaneously. Because the NDNA-01 module is configured by the ACS600 / ACS400, if the Drive is not powered up along with the module, it will never be configured and the DeviceNet Network will Fault.
- A way to correct this problems is power the NDNA-01 adapter from the ACS600 / ACS400 24VDC power supply. This guarantees that the module will always power-up with the drive, thus being configured properly.

DeviceNet Setup

- Hardware:
  - ◆ Connection of Belden YR-29790 or equivalent
  - ◆ Connection of 24V dc power supply
  - ◆ Earthing strip

- Software:
  - *Activation of adapter through par. 98.2
  - ◆ DeviceNet settings in group 51
  - ◆ Allen-Bradley DeviceNet Manager

- Application:
  - ◆ Setting of start/stop, reference, enable, fault reset location(s)
  - No Parameter access allowed
  - ◆ Setting of communication time-out time and function

X1		Description
1	PE	Ground
2	PE	
3	PE	
4	+24V	Power Supply +24VDC
5	CAN_H	DeviceNet Bus Signal High
6	SHF	Cable Screen AC Grounding (via RC filter)
7	CAN_L	DeviceNet Bus Signal Low
8	0V	Power Supply Common

Number	Parameter	Settings	Default
1	FIELD BUS	NDNA-01 V2.x	NDNA-01 V2.x
2	MAC ID	0 – 63	63
3	BAUD RATE	(0) 125kBit/s; (1) 500 kBit/s	(0) 125 kBit/s
4	STATUS	(0) SELF TEST; (1) NO CONNECT; (2) CONNECTED; (3) TIMEOUT; (4) DUP. MAC ERR; (5) BUS_OFF; (6) COM. ERROR; (7) WRONG ASMBLY	Read only (parameter). The module shows value NO CONNECT after first power-up
5	PROFILE SELECTION	(0) ABB DRIVES; (1) CSA 2.8/3.0	(0) ABB DRIVES (1) CSA 2.8/3.0 (acs 600 or before)
6	POLL OUTPUT SELECT	(0) BASIC SPEED; (1) TRANSPARENT; (2) PARAMETERS; (3) EXT. TRANSP.	(0) BASIC SPEED
7	POLL / COS INPUT SELECT		
8	COS DATA OUTPUT		
9	BIT STROBE OUTPUT	(0) BASIC SPEED; (1) TRANSPARENT; (2) PARAMETERS	
10	DATASET INDEXES	(0) FBA DSET; (1) FBA DSET 10	(0) FBA DSET 1
11	SPEED REF. SCALE	0 – 32767	1500
12	SPEED ACT. SCALE	0 – 32767	1500
13	ABB DRIVES STOP M.	(0) COAST STOP; (1) RAMP STOP	(0) COAST STOP
14	RAMP STOP LEVEL	0 -20000	1000

NPBA-02 V2.2 .GSD File Example

- ;==========================
- : Profibus Device Database of :
- ; ABB-NPBA-02 PROFIBUS slave
- ; Model : ABB-ACS600-NPBA-02
- : Description : PROFIBUS slave Device
- ; Language : English
- ; File Create Date : 03/1111997
- ; Author : ABB Industrietechnik AG- jebril
- ;==========================
- #Profibus_DP
- ; Device identification
- Vendor-Name = “ABB-DRIVES
- Model-Name = "ABB-ACS600-NPBA02"
- Revision ▫ "B
- Ident_Number = 0x0815
- Protocol_Ident = 0
- Station-Type = 0
- FMS_Supp▫ 0
- Hardware_Release = “NPBA-02
- Software-Release = “2.0”

- : Supported baudrates
- 9.6_supp = 1
- 19.2_supp = 1
- 93.75_supp = 1
- 187.5_supp = 1
- 500_supp = 1
- 1.5M_supp = 1
- 3M_supp = 0
- 6M_supp = 0
- 12M_supp = 0

- ; Maximum responder time for supported baudrates
- MaxTsdr_9.6▫ 60
- MaxTsdr_19.2 = 80
- MaxTsdr_93.75 = 60
- MaxTsdr_187.5 = 60
- MaxTsdr_500 = 100
- MaxTsdr_1.5M = 150

- ; Supported hardware features
- Redundancy=0
- Repeater_Ctrl_Sig = 0
- 24V_Pins = 0

- ; Suppotted DP features
- Freeze-Mode-Supp = 1
- Sync-Mode-Supp = 1
- Auto_Baud_Supp = 1
- Set-Slave-Add_Supp = 0

- ; Maximum length of user parameter
- User_Prm_Data_Len = 0

- ; Maximum polling frequency
- Min_Slave_Intervall = 40
- Modular-Station = 1
- Max-Module = 3
- Max_Input_Len = 32
- Max_Output_Len = 32
- Max-Data-Len = 64
- Max_Diag_Data_Len = 8

- ;Diagnose byte = 6 + 2 = 8 (bzw. 16)
- Unit_Diag_Bit(1) = "Ueberlauf SPM-FIFO
- Unit_Diag_Bit(2) = "Istwert wird nicht aktualisiert"

Profibus Register Number Config

Profibus has the capability to Read / Write to all parameters in ACS600 & ACS400. Below is a list of Groups and the number parameters within the Group that Profibus will support.

- Group 1 > 1 to 50
- Group 2 > 1 to 25
- Group 3 > 1 to 25
- Group 10 - 51 > 1 to 25
- Group 52 - 97 > 1to18
- Group 98, 99 > 1 to 25

Profibus Register Number Config

Profibus has two formulas used to calculate the Profibus Register number for Parameters within the ACS600 & ACS400.

- Formula 1: 25[Group# - Offset + (Index# / 25)]
  - Group 10 - 41 Offset = 6
  - Group 50 - 51 Offset = 10
  - Group 98, 99 Offset = 22
- Formula 2 :1050 + [(Group# - 52) * 18] + Index#
  - Use only for Groups 52 to 97

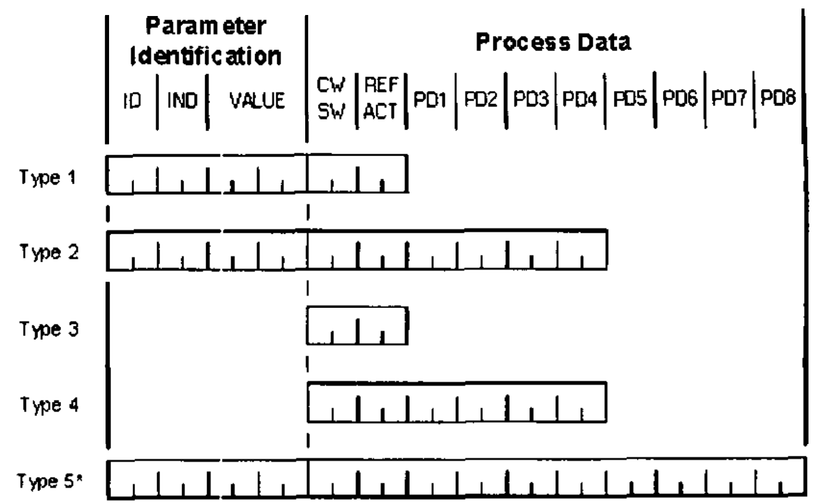
Profibus FMS / DP

- Profibus includes 2 profiles
  - FMS for acyclic communication
  - DP for cyclic communication

- Profibus-FMS
  - Makes use of parameter numbers
  - Reduces I/O on the PLC side

- Profibus-DP
  - Makes use of so called PPO-types
  - Most commonly used in industrial applications

Table 6-2 PPO Message Types.



*PROFIBUS-DP Only

Parameter Identification:
ID - Parameter Identification
IND - Index for Arrays
VALUE - Parameter Value (Max. 4 bytes)

Process Data:
CW - Control Word from Master to Slave (see Table 6-3)
SW - Status Word from Slave to Master (see Table 6-4)
REF - Reference Value (from Master to Slave; see page 6-11)
ACT - Actual Value (from Slave to Master; see page 6-13)
PD - Process Data (Data sets)

Profibus Earthing

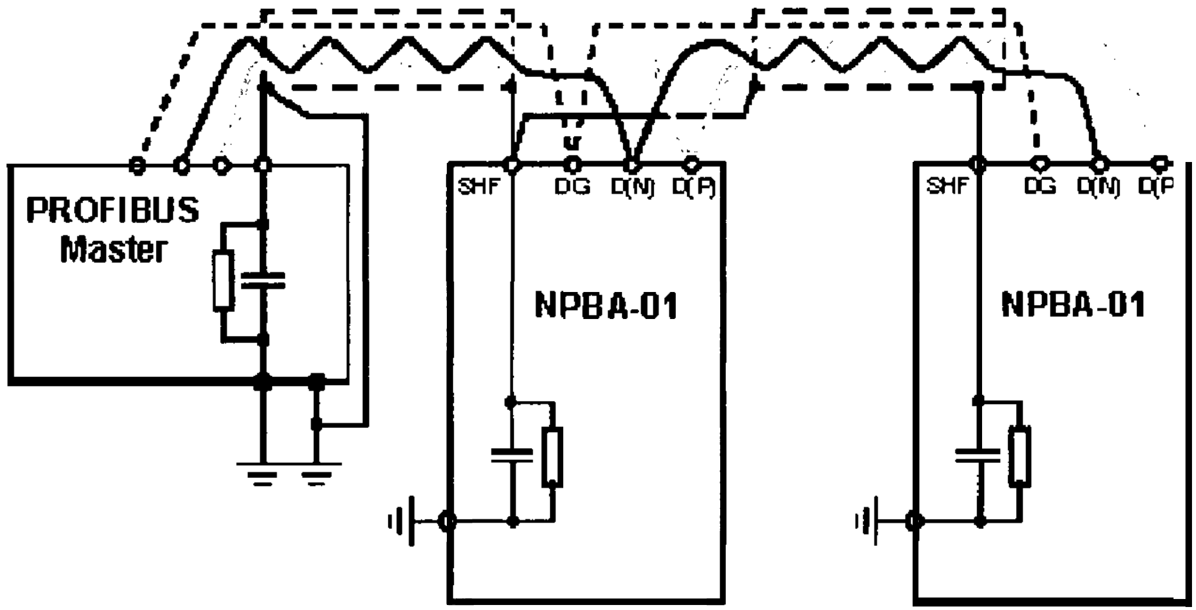


Figure 4-3 PROFIBUS bus cable connections.

ACS 400 Standard Drive RS 485 Connection
ACS 400 Std. Drive RS232/Drives Window LT Connection

Section 1 General Information

1.1 Description

This lab will guide you through the use of a RS 485 / 232 connection unit to communicate to a computer using Drive Window Light or Drive Window.

1.2 Objectives

To familiarize user with connection and configuration of RS 485/ 232 converter. Parameters and parameter settings to accomplish successful connection and communication with computer. Gain larger familiarization with Drive window Software and Modbus Protocol.

Reference Documentation

Acs 140/400 Modbus Protocol

ACS 140 RS 485 and 232 Adapter, Installation and Start-Up Guide

3AFY61492828

ACS 400 User Manual

Section 2 Drive Set - Up

2.1 Identifying components of Adapter

1. What are the names used to identify the two serial ports used by an ACS 400?

   a. ______________________

   b. ______________________

2. What interface typically is used with RS 485 Protocol?______________________

   a. What drive channel is this? ____________

3. What interface typically is used with RS 232 Protocol?______________

   a. What drive channel is this?____________

4. What connectors are used for RS 485 connection?

   a. ______________

   b. ______________

5. What is the purpose of S5? ______________________________

6. What is the purpose of S1? ______________________________

   a. What setting choices are available?

   ____

   ____

7. What is the purpose of X4? ______________________________

8. What two items select the communication speeds?

   a. ______________________

   b. ______________________

9. What would S 1 have to be set to, to accomplish a communication speed of 19200bps?

   a. ______________________

10. What size termination resistors are need for an RS 485 network? ____________

11. How many resistors total will be needed to complete a network? ____________

12. What is the purpose or function of these resistors and how are they placed in the circuit?____

____

2.2 Using Adapter for RS 485 Operation With Modbus Protocol

1. Ensure that all drive parameters are at standard Macro default settings.What did you do to accomplish this task?

____

2. Follow the instructions for Installation to RS 232 Bus in the *ACS* 140 *RS 485 and 232 Adapter, Installation and Start-Up Guide*

3. Confirm the operation mode is RS 485 (via jumper S5)

4. What parameters have to be set for successful communication at the drive when using the adapter?

a. ______________________

b. ______________________

c. ______________________

NOTE: *If any of the parameters 5201 Station ID, 5202 Comm Speed and 5203 Parity have been altered. the modification takes effect only upon the next power-up and the ACS IOO-PAN is not connected.*

5. What are the default communication settings for the drive as used with the ACS 100-PAN control panel connected with standard Modbus communication?

a. ______________________

b. ______________________

c. ______________________

NOTE: *Note: the RS 232-485 connector can be connected with drive power on it, however it is preferred that it be connected with power off.*

6. How is proper communication wiring accomplished using the RS 485 Bus?

____

____

____

2.3 Using Adapter for RS 232 Operation With Modbus Protocol (To PC)

1. Set the operation mode of the adapter to RS 232 with jumper S4.

2. Connect serial cable from drive X4 to computer serial port.

3. Start computer. If computer is passworded, the password is ABB.

Note: do <u>not</u> check the box that says 'do not show this window again' in drives window when you start drive windows. Selecting this checkbox will permanently configure the Drive Windows software for that connection configuration, which will prohibit you from connecting other drives with different configuration. i.e. ACS 600 with DDCS Protocol.

4. Start Drive Window program. When asked if you would like Modbus Protocol click on **OK** button. When asked if you would like HSLC Communication Protocol select cancel button. When asked if you would like the DDCS Protocol select cancel.

The software will now begin a search for your drive and begin conununication with it.

5. From control panel of Drive Window select the 'local' control button, the button should change to a yellow color. This allows you to control the drive via the local control panel on the PC.

6. Go to the System Configuration screen. What information is displayed?

____

____

____

7. Set the reference frequency to 30 Hz from the "Drive Window" control panel (click in the white box below where it displays "Tool Reference" type in the value and hit enter), then start the drive with the green start button. Check the actual speed from the PAN-A Control Panel. After this, try reversing direction from "Drives Window" (click on the counter-clockwise arrow next to the "Local" icon).

NOTE: ***The motor symbol on the far left of the "Control Panel" shows direction.***

Practice making a few more speed changes and direction reversals as well as start / stop and coast stop. When comfortable with the local control set the speed reference back to 30 Hz with the motor running.

8. What are the reference units on an ACS 400?___________

9. By now you have seen the confirmation window when you perform certain functions with the drive. Turn the confirmations off. How is this accomplished?

____

2.4 Drive Window LT Signals and Parameters

Select **"Signals and Parameters"** From the "Tools''-menu". Then select **"Group" & "Open All** Groups" After this set the program to **"On-line".** (When prompted select: **"No download".)**

1. Changing to on-line mode causes a menu box to appear.What is the function of four button prompts that appear in the menu box?

A. ____

____

____

____

2. Can individual groups of signals and parameters be opened/expanded?

If so, how is this accomplished?

3. With the drive is running, record the following measured values from operating data signal display.(with one decimal accuracy):

1.2 Motor speed____________________

1.3 Output frequency____________________

1.5 Motor torque ________________

1.7 DC bus voltage____________________

1.9 Motor voltage__________________

4. Change the acceleration and deceleration times to .1 sec. (this is done in the Parameter group number 22 "ACCEL\DECEL"). Make sure that the changes took place by changing the speed reference up and down (you should notice a faster speed ramp up and down). If you didn't notice a difference in the drives performance double check that you made the changes using the **"On-Line"** mode. How is an individual parameter value changed via Drive Window? ____?

5. Save the parameter tile (under "File" => **"Save-As"). Name the file using your first** name and the comment: **"first parameter change exercise".** Return to Main Menu (System Configuration Menu) by closing the Parameters & Signals window.

6. How can a custom set of signals and parameters be chosen/selected?

____?

7. How can you close all opened groups simultaneously?

____?

8. If one changes a parameter value off-line, how is this indicated?

____?

2.5 Drives Window LT Monitoring exercise

1. From **"Tools"-** menu select **"Monitor"** and select **"Tool Reference"& " Operating Data"** from the left window using double click.

From the operating data list, select motor speed, motor current and motor torque (as you select them they should appear in the box on the right-hand side of the screen)

NOTE: ***Selecting can be done by either double-clicking on the name or by highlighting the signal names and using the "select" or "remove" icons.***

Click **"OK"** at the bottom of the menu and also again in the **"Monitor Settings"** screen, start the drive and increase the speed to approximately half of the maximum speed.

2. Start the monitoring function by clicking the black arrowbox in the upper left of the monitor window or from **"Monitor" /** "Go" menu.

After that, the program will automatically scale the selected signals.

3. Change the acceleration and deceleration times to 3s. (You have to go to the **"Signals and Parameters"** tools menu). Record the Min and Max values for these parameters.

A____

____

4. Increase the drive speed to max. speed and try reversing.

5. Stop the monitoring window and save these responses to a file for later use.

6. Using right mouse button click on a waveform and observe the values that can be measured digitally.

7. Re-scale the signals manually now so that you can see them on the screen during reversing. First pause the graph using the black square next to where it says **"Monitoring".** Next select: (Menus: **"Monitor" -> "Settings" -> "Autoscale" [you'll** have to click in the box next to the word autoscale to turn it on/off for each signal that you select and then manually enter the min and max values for each]).

8. Reverse the **drive** from maximum forward speed, stop monitoring and save the display with **your name** (i.e. Dennis-l) and **the** comment **first monitoring exercise.**

11. Locate the triggering conditions screen. Knowing the value of current from the previous step, set a trigger to occur when current reaches a certain value. Start the drive to make this trigger condition occur. When a triggering condition is set and activated, how is continuous trigger mode different from single trigger mode?

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2.6 Drive Window Fault Logger

1. From **"Tools"-** menu select **"Fault Logger."** What response do you observe?

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ACS/ACH 400 Serial Communication
DDCS Connection to NBAA-01 Fieldbus Adapter Module

Section 1 General Information

1.1 Description

This lab will guide you through the use of DDCS option module to communicate to a fieldbus module.

1.2 Objectives

To familiarize user with connection and configuration of the DDCS module. Utilize proper parameter settings to accomplish successful connection and communication with the fieldbus module and become more familiar with DDCS control.

Reference Documentation

Installation and Start-Up Guide ACS 400DDCS Option Module

Installation and Start- Up Guide Building Automation Adapter Module

ACS/ACH 400 Drives User's Manuals

Section 2 Drive/DDCS Module Set - Up

2.1 Identifying components of Adapter

1. What is the definition of DDCS? ______________________________

2. What is the drive connection point for the DDCS module? ________________

3. What are two categories of devices which can be connected to the DDCS Option Module?

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NOTE: Never connect or disconnect the DDCS Module to the drive while the drive is powered!

4. Load the default "PID Macro" into the drive. How is this accomplished?

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5. What parameter(s) must be set on drive in order to establish communication via the DDCS module?

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6. If the DDCS module were being used to work with fieldbus adapters what parameter in the drive would indicate the type of module being connected?

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2.2 Connecting/Using the DDCS Adapter Module in conjunction with a fieldbus adapter

1. Unpack the DDCS module from the storage box.

Note: The DDCS adapter must not be connected or disconnected with drive power on. Doing so will cause a failure in power supply!

2. Disconnect power from the drive & connect the DDCS adapter to drive on connector X6 of the control board.

3. Connect fiber cable from DDCS module to the fieldbus module. Follow the appropriate color matching of the fiber optic cables and connectors.

4. Activate the communication between the drive and the fieldbus adapter via setting parameter 5005 Protocol SEL and 5006 Comm Commands to (DDCS).

5. Set up the other Group 50 parameters per the "settings for fieldbus control" in the DDCS manual.

6. Set the necessary parameters in Groups 10, 11 & 16 to the proper settings per the "setting for fieldbus control" in the DDCS manual. For example 'Comm" is a necessary setting for a start/stop or reference value, thus telling the drive the control is coming from the fieldbus communication module. Refer to Tables 3, 4 & 5 of the DDCS manual.

7. Relay outputs 1 & 2 and the analog output can be programmed to be controlled by any serial communication channel including DDCS.

8. Relay outputs can be controlled in the following way:

a) Configure the drive to supervise the value of any of the operating data parameters 131, 132 or 133 using the parameters in Group 32 Supervision.

b) Configure a relay output to respond to the status of one of the supervised parameters

c) The selected relay can now be tamed on or off by writing to supervised parameter 13 1-133 some value that is either above or below the given supervision limits (See Table 6 in the DDCS Manual).

9. The analog output can be controlled in the following way:

a) Set the AO content in parameter 1501 to be Operating parameter 133.

b) Writing a value of 255 to parameter 133 will give a 20 ma output. Parameter 1503 sets the maximum for analog output content (See Table 7 of the DDCS manual).

2.3 Fieldbus Module Setup

1. NBAA-0 1 Building Automation Adapter Module Overview

a) FLN LAN protocol is a master/follower serial communication protocol used by Siemens Building Automation systems.

b) System has three levels of communication:

- CLN Campus Level Network
- BLN Building Level Network
- FLN Floor Level Network

c) This lab exercise is dealing with the drive end or FLN end of the system.

c) Each drive can be accessed by a full complement of System 600 features.

6. What does a continuously flashing error LED indicate?

7. What is a CMD point and what is an ACT point?

8. How can a trim pot be incorporated with serial communication with the NBAA module?