MANUFACTURER DOCUMENT PACKAGE

Manufacturer's Manual

Amikon cover with selected ABB pages; not the complete manual

ASTAT / 3ASC25H203

DAPC100

ASTAT MOTION CONTROL BOARD

OFFICIAL SOURCES

ABB ASTAT 3BSE017422R0008EN, AST10_054. Selected identity, safety, replacement and technical pages remain unchanged.

ASTAT®
Manual
Version AST10_054

Crane motion controller

25-2000 A, 380-690 V





ABB

1.3. Control system

1.3.1. Stand alone Motion Control

The control board is built up around a micro controller unit, DAPC 100.
It has following main data:

- Data bus size 16 bit
- Address bus size 18 bit
- Clock frequency 16,384 MHz
- Interrupt levels 7
- Watch supervision 2 levels
- Time out supervision 50 μs
- Interval clock Programmable
- On board EPROM 512 Kbytes
- On board RAM 64 Kbytes
- MCU Internal RAM 2 Kbytes
- Debug interface (BDM) 1
- Thyristor bridges interface 2
- Power Supply Monitor

The system interface units, i. e. Process I/O, and Cabin I/O, are designed by using a common I/O communication controller board and a unit specific termination board.

The DSP-equipped Rotor observer board DATX 130 gets speed and condition status from the motor's or motors´ slip rings.

The DSP-equipped Torque observer board DATX 132 evaluates the shaft torque of the motor(s).

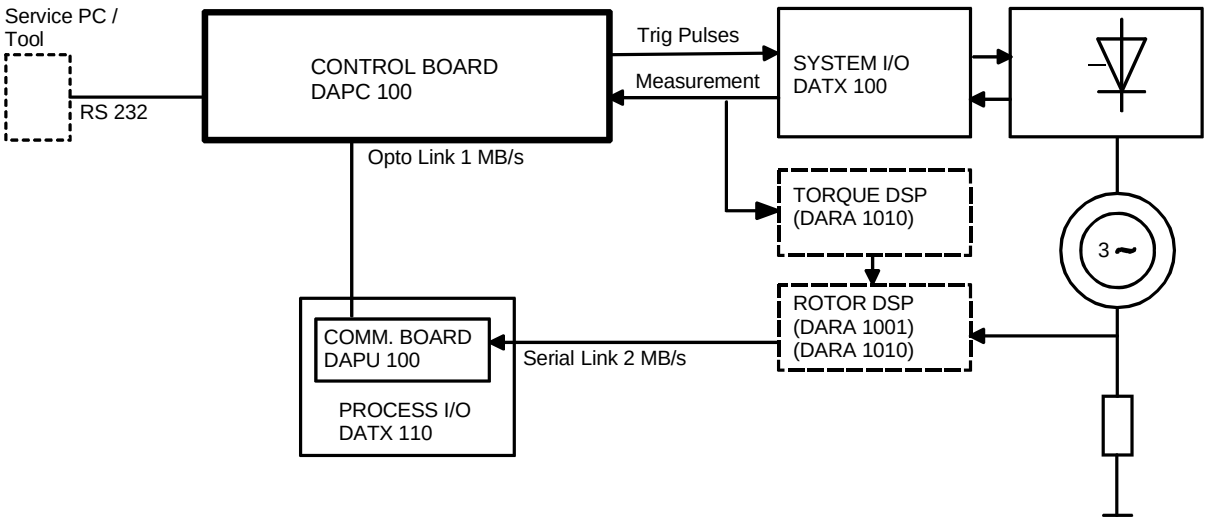
The boards mentioned above contain the latest generation of electronics, and have as a consequence short creepage distances between different potentials. The boards are for this reason specially adapted to the dusty conditions in the heavy industry by coating. It is allowed that the dust is conductive, like in metal industry.

All information channels between units, both inside modules and for longer distances, are based on fiber. With HCS technology, no practical limitation in distances exists on board a crane; see the Cabling instruction in Chapter 2.

The System I/O board is mounted inside the ventilated thyristor module. The board is designed with reasonable distances between potentials and its surface is coated to withstand the dust ingress. This board couples the control system to the power circuit by means of pulse transformers.

All parts of ASTAT are selected, designed or loaded in such a way that the installation temperature is permitted to reach more than +70 °C continuously.

ASTAT is a modular system that includes all options from the single drive without tachometer or pulse-encoder to a complete system for automating the crane.



Above: Stand alone ASTAT system

Comments: The not-dotted frame components in the figure above (except the PC and the RS 232-cable) are parts of Control System Module DARA 1000 and one Thyristor Module DASD. A tachometer or pulse-encoder is required for speed control. The Control System Modules DARA 1001 and DARA 1010 do not need tachometer or pulse-encoder.

2.2.2. Control System Module connection

Control System Module DARA 1000, DARA 1001 and DARA 1010
The modules have fixed as well as configuration dependent connections.

- **Power Supply Module**
  - **Supply 115 / 230 V AC**: L1 on -X1:1 and :(3).
    L2/N on -X1:2 and :(4)
    For connection with 115 V AC:
    Strap Power supply module
    -X1:5 to 7 as well as -X1:6 to 8

    For connection with 230 V AC:
    Strap Power supply module
    -X1:6 to 7
  - **Fan connections for DASD 145, 146, 147, 156, 157**:
    Connect the fan to 220 V AC without wiring inside the Control System Module DARA.
    We recommend via a contactor controlled by DO no. 1.
  - **Fan connections for DASD 102, 103, 104, 105, 152, 153, 154, 155**:
    Fan no.1 to -X3:1 and :2
    Fan no.2 to -X3:3 and :4 (DASD 104, 105, 152, 153, 154, 155)
    We recommend via a contactor controlled by DO no. 1.
  - **Fan connections for DASD 00x**:
    Fan no.1 to -X2:3 (red) and :4 (blue)
    Fan no.2 to -X2:3 (red) and :4 (blue) (two leads in same terminal)
    We recommend via contactor controlled by DO no. 1.
  - **110 V DC Detection Voltage**
    Directly grounded system (Normal) Power supply module -X2:9 to Ground.
    Floating grounded system (Special installations) Power supply module -X2:10 to Ground.

- **Control board system, DAPC 100**
  Information channels:
  - -X5: PC-connection via multi-drop RS 485 (DADT 114 and DADT 124) or point-to-point RS 232 Tool connection.
  - Opto links:
    Channel 1, Opto pair connection to TCP / IP controller (Vertical communication), or to other ASTAT in dynamic Horizontal communication mode. **MC**
    Channel 2, Opto pair connection to other ASTAT (Horizontal communication). **M/F**
    Channel 3, Internal fiber connection to Process I/O, DAPU 100. **I/O**
  - 24 V DC connection: -X4 (Internally connected)

    Thyristor Module Control cable: -X7 (System cable).
    Routed via DATX 130 for DARA 1001 and 1010 modules.

    Thyristor Module Control cable: -X8 (System cable); only used for parallel Thyristor modules.

3. Software for Design, Start up and Fault tracing

To set up a new installation and to keep an existing installation up to date, special Software and a connection cable from your PC to the ASTAT is needed.
To set up an installation, only parameters have to be set - there is no programming in the word's right meaning to do.

3.1. Configuration and installation

3.1.1. Installation

Installation consists of two parts. The hardware installation and configuration, and the software installation and configuration.

3.1.1.1. Hardware

Prior to starting the ASTAT Tool software, check the settings of the DAPC 100 circuit board(s) of the ASTAT Control System Module(s).

3.1.1.1.1. Point-to-Point set-up

A Point-to-Point configuration consists of a single physical serial connection between the ASTAT Hardware and the PC using the RS-232 protocol.
To enable Point-to-Point configuration set jumpers according to:

All S2 jumpers removed

All S3 jumpers installed

3.1.1.1.2. Multi-Drop set-up

In a multi-drop configuration several ASTAT Hardware units can be connected to a single PC using the RS-485 protocol. Multi-drop requires an RS-485 ↔RS-232 conversion box connected between the ASTAT Hardware chain and the PC. Thus the PC only needs to be equipped with a standard serial communication port (RS-232).
To enable multi-drop configuration set jumpers according to:

All S2 jumpers installed in all ASTAT

All S3 jumpers removed in all ASTAT

3.1.1.1.3. Communication speed

The communication speed is determined by the **S4** jumper according to:

Position 1-2 = 9600 bps

Position 3-4 = 19200 bps

Position 5-6 = 38400 bps

Position 7-8 = 115200 bps (Rightmost jumper)

A speed of 115200 should normally be used. In case of excessive errors or a complete communication failure check the cables, install a higher quality communication port or try a lower communication speed.

3.1.1.1.4. Connection

Use Tool cable 3ASC262741H1 to connect between the PC and the ASTAT hardware.

3.1.2.1. Required files and replacement of ASTAT board

3.1.2.1.1. Software recovery

For proper function, ASTAT Tool application uses the following files:

ASTAT.EXE (main executable)

PARAMETERS4.INI (parameters definition file)

SIGNALS4.INI (signals definition file)

MIDAS.DLL (used for rapport generation. If missing or corrupted printing will not work)

You do NOT need to use the installer to run Tool. This provides for quick recovery in situations where you don't have the distribution media, e.g. a computer crashes at the site and the OS has to be reinstalled. As long as the main executable is not lost, the software will run.

Further, ASTAT Tool will create and use files with following extensions:

AST – Project file (parameter settings)

ATT – Project template file (same structure as AST)

ASG – Monitor graph recording

LOG or TXT – Basic text file output of the logger

DEFMONx.INI – Default settings for monitor tool

3.1.2.1.2. DAPC 100 replacement

In case replacing a DAPC 100 board you will need:

A PC with the ASTAT Tool application installed and a parameter file (*.ast) for the motion concerned.

Tool cable 3ASC262741H1 RS 232

24 V DC power supply 10 A if switched type, 2 A if linear type (inrush current sets the size)

Terminal block Phoenix 1777280, FRONT-MSTB2,5/2-ST-5,08, 2 poles, plug-in part (if you don't have, use the one of the board you are to replace - do not mix polarities!)

A new DAPC 100 board.

Recovery procedure:

Place the board with the display on top.

DAPC 100 Generation No. 1: Remove all S2 jumpers and install all S3 jumpers

Place Jumper S4 in position 7-8 (115200 bps communication rate)

Connect 24 V DC to X4 terminal. Polarity Left: - Right: +

Watch the display of DAPC 100 light up (do not mind what it shows)

Connect the Tool cable 3ASC262741H1 between COM1 of your PC and the DAPC 100 board (On top of the board). The cable can only be inserted correctly as it is keyed.

Start ASTAT Tool application on the PC and configure the application to use COM1 and 115200 bps communication speed.

Load the parameter file (*.ast).
If the new DAPC 100 board has a newer Software than the original ast-file was created for, the Tool will add default values for all additional functions in the new DAPC 100 software. Watch the motion properties after installation.

Switch to ONLINE mode and synchronise the parameters using SEND TO ASTAT method.

3.1.3. Software configuration

The configuration of the software is handled via the **Preferences** function in the **Options** submenu (shortcut key **F9**). The Preferences dialog features a set of categories presented by tabs. Below is a description of the preferences contained within each tab.

8. Maintenance of ASTAT

8.1. Personal safety

CAUTION!

!	Follow all applicable rules regarding personal safety.
!	All people concerned must know how to disconnect mains and auxiliary voltage.
!	Do not perform any kind of work on the controller if there is any risk of touching live parts.
!	Control System Modules DARA .... are connected to maximally 250 V AC. Disconnect at its source voltage prior to perform any maintenance work of the DARA .... module.
!	Thyristor Modules DASD .... are connected to maximally 600 V AC. Disconnect all three phases at its source voltage prior to perform any maintenance work of the DASD .... module. The fans of the DASD .... modules are supplied from the DARA .... module. Also disconnect the fan supply voltage at its source prior to any maintenance work of the DASD .... module.

8.2. General

The controller contains no parts subject to mechanical wear except some pilot relays and, for some current ratings, one or two fans. In addition to the checkpoints below the controller requires only general upkeep to ensure reliable operation. This type of maintenance is common to all industrial electrical equipment and can therefore be included in general maintenance routines.

The controller should be inspected at regular intervals, determined by the nature of the operation and environmental factors (vibrations, humidity, dust etc.).

8.3. Cleaning

Use a vacuum cleaner.

Be careful to avoid mechanical damage of circuit board components.

An inspection should be made after this cleaning to detect mechanical damage, overheated components etc.

8.4. Plug-in components

Check that the connectors of the circuit boards and power pack are firmly in place.

8.5. Terminal connections

Tighten the main terminals L1 ... T3 and PE-connection.

Tighten the main fuses of DASD 106, 107, 108, 126, 127, 116 and 117.

8.6. Screwed joints

Check that the different units in the controller are screwed firmly in place and that there are no loose screws or nuts.

Check that no cables or leads wear against sharp edges.

8.7. Cooling air fan

Check that the fan(s) rotates freely and that there is no abnormal sound.

Check that the electrical connections are firmly in place.

9.1.5. Equipment and tools

Beside the circuit diagram set and the parameter list for the ASTAT following equipment and tools are recommended.

- Digital Multimeter, ranges: Voltage: 0-1000 V DC and AC, Resistance 0,1 Ohm resolution or better
- Set of screwdrivers. Including Torx.
- Set of spanners of metric type.
- Pair of side cutters
- Pairs of tongs to move jumpers
- Cable tie spanner
- Draw out tool for Phoenix circuit board separators

In case it is needed to replace the board DAPC 100, the same installed program version and the parameter set that is stored in the DAPC 100 to replace must be entered in the new board:

- Laptop PC with (normal) COM 1 port, or USB-port with USB/Serial-converter
- PC-Tool for ASTAT Crane Motion Controller and cable.

In case it is needed to replace thyristors in Thyristor modules with puck thyristors the gate leads are soldered to the thyristors. The reason for this is a pay-off between risk for the leads to come out in case of heavy vibrations and the risk for a thyristor failure of other reasons.

- Soldering iron
- Soldering tin for installation of new thyristor.

Follow the instructions of the Tool to make this procedure.

9.2. Standard fault tracing scheme

Following the scheme below can identify most malfunctions in the equipment. The scheme should be followed step by step in the following order:

Error code	Note the LED annunciation and if needed the Error Code of DAPC 100. ASTAT will automatically try to reset all faults and restart the motion at main voltage power up, so to find error codes there are the following ways: 1) The display of the DARA is viewed before restart. 2) The PC Tool is used. 3) The error remains at power on.
Symptoms	Note the driver's observations in connection with the malfunction.
Electric power♠	Check the electrical power supply to the controller (mains and auxiliary) and the cable connections between the ASTAT controller, the motor and the resistor. Check main fuses (DASD 106, 107, 108, 126, 127,116, 117) and measuring fuses (all DASD).
Internal voltages	Check 24 V DC and 110 V DC. Look for instructions below.
External control♠	Do the external interlocking to prevent a release of the controller Attempt a manual start of the controller. Execute a manual release and reference generation.
Limit switches♠	Are the end, slow-down position and brake limit switches in order
Speed reference♠	Is the speed reference available. Is the external master control equipment serviceable
Speed feedback♠	Is the speed feedback available **and stable**?
Rotor circuit♠	Status of the slip rings and brushes. Status of the rotor resistors
Excessive heat / dangerous dust	Inspect the controller for overheated components and for excessive dust.

♠ Check for loose connections!

9.5. Circuit boards

If circuit boards must be replaced, the actual settings from the replaced board must be implemented on the replacement boards. When possible, the setting / jumpering is done on the connector rather than on the boards, and in that case no setting / jumpering is needed.

Handle all circuit boards with care mechanically and with respect to static electricity discharge.
Boards with variable software:

DAPC 100[17]

Boards with setting / jumpering:

DATX 110
DATX 120
DAPC 100[18]
DATD 100[19]

Boards without setting / jumpering:

DAPU 100
DATX 100
DATX 130 + DATX 132

Boards with plug in PROM (8 pin DIL):

DATX 130 + DATX 132

Boards that are part of Modules: DADT 100 and DASA 110.

[17] The Tool program, the file with extension AST for the motion, a PC and either a RS 232-cable or a RS 485 network must be available to replace DAPC 100.

[18] In most cases there will be no changes from the delivered state.

[19] In most cases there will be no changes from the delivered state.

10. Spare parts list

Modules and items that are no longer delivered in new equipment but available as spare parts only are marked with Grey shading: Old part

Category	Type	Description	Identity	Used where
Circuit boards	DAPC 100	Control board	3ASC25H203	DARA 1000, 1000+AO, 1001, 1010, 1010+AO
	DAPU 100	I/O Control board	3ASC25H204	DARA 1000, 1001, DAPM 100, DAPM 101 (Som reservdel)
	DATX 100	Pulse transformer board	3ASC25H208	DASD 0xx, 1xx
	DATX 110	I/O board, No AO, Control Module	3ASC25H209	DARA 1000, 1001, 1010
	DATX 110+AO+PU	I/O board, with I/O Control board 2 AO, Control Module	3ASC25H209+AO +PU	DARA 1000, 1001, 1010
	DATX 111	I/O board No AO, Supervision system	3ASC25H224	DARA 2000
	DATX 111+AO	I/O board 2 AO, Supervision system	3ASC25H224+AO	DARA 2000
	DATX 120	I/O board Remote I/O DI+DO+AI+AO	3ASC25H210	DAPM 100
	DATX 121	I/O board Remote DI+DO+AI	3ASC25H218	DAPM 101
	DATX 130	Rotor feedback board	3ASC25H214	DARA 1001, 1010
	DATX 132	Torque observer board	3ASC25H216	DARA 1001
	DATX 133	Pulse repeater board	3ASC25H219	DARA 1010
Thyristors[21]	Thyristor Module		3ASC485811H11	DASD 001 ... 103 (5x)
	Thyristor Module		3ASC485812H11	DASD 104 and 105 (6x)
	Thyristor Module		3ASC485813H11	DASD 151..155 (5x)/(6x)
	Thyristor Module		3ASC485814F1	DASD 145 (5x)
	Thyristor		3ASC485506E19	DASD 146 (10x)
	Thyristor		3ASC485506E23	DASD 156 (10x)
	Thyristor		3ASC485514E19	DASD 147 (10x)
	Thyristor		3ASC485514E23	DASD 157 (10x)
	Thyristor		3ASC485506E17	DASD 106 (10x).
	Thyristor		3ASC485506E13	DASD 126 (10x).
	Thyristor		3ASC485514E17	DASD 107 (10x).
	Thyristor		3ASC485514E13	DASD 108, 127 (10x).
Fans	Ziehl ebm W2S 142-BB 05-01	Compact fan 115 VAC, 330 m^3/h, 172 mm	3ASC648020H1	DASD 102, 103 (1x) DASD 104 .. 107 (2x)
Replaced with3ASC648030A1	Ziehl ebm Papst 8314 HLR	Compact fan 24 VDC, 60 m^3/h, 80 mm	3ASC648030A1	DASD 002 (1x), DASD 003 (2x)
	Ziehl ebm Papst 8124 K	Compact fan 24 VDC, 60 m^3/h, 80 mm	3ASC648040A1	DASD 002 (1x), DASD 003 (2x)
	Ziehl ebm D4E133-ASTAT	Radial fan 220-230 VAC, 760 m^3/h	3ASC648050E1	DASD 146, DASD 156 (1x)
	Ziehl ebm D4E160-ASTAT	Radial fan 220-230 VAC, 1310 m^3/h	3ASC648051E1	DASD 147, DASD 157 (1x)
	DAFU 145	Fan unit for DASD 145 including D4E160-ASTAT	3ASC25H229	DASD 145 (1x)

[21] The thyristors listed here are always suitable as spare. The installed thyristors are not always the same. Always change both devices that are fixed with a common cooler in DASD 10x and DASD 12x!

12. Reference section

12.1. Technical information

12.1.1. LEDs

12.1.1.1. Board DAPC 100

LED name	Colour	Function
5V OK	Green	
I/O	Yellow	Process I/O Communication
MC	Yellow	Horizontal link I
M/F	Yellow	Horizontal link II
STATUS	Two 7-segment indicators	
TOOL	Yellow	Tool/ Terminal connector

12.1.1.2. Board DAPU 100

I/O	Yellow	Process I/O Communication
I/O E	Yellow	Process I/O Communication Extended
RUN OK	Green	
TERM	Yellow	Terminal connector

12.1.1.3. Board DATX 110

110V OK	Green	
ASYM	Red	Asymmetry between two bridges
EARTH FAULT	Red	Earth fault on 110V
AI 1- AI 4	Yellow	Analogue Input software controlled level
DI 1- DI 16	Yellow	Digital Input active
DO 1- DO 8	Yellow	Digital output active

12.1.1.4. Board DATX 130

V1	(top)	Motor 4	(top) Green: Speed feedback OK. Yellow: Supervision OK Red: Fault
V2		Motor 3	Green: Speed feedback OK. Yellow: Supervision OK Red: Fault
V3		Motor 2	Green: Speed feedback OK. Yellow: Supervision OK Red: Fault
V4		Motor 1	Green: Speed feedback OK. Yellow: Supervision OK Red: Fault
V24		Green	5V OK

12.1.1.5. Board DATD 100

OVER TEMP PTC	Red
BRAKE	Red
OVERCURRENT MOTOR	Red
ROTOR / SPEED MEAS	Red
MECH OVERLOAD	Red
MECH OVERSPEED	Red
THYR OVERTEMP	Red
ASTAT OK	Green

12.1.3. Process indication codes

The following codes are used to indicate errors detected internally or externally by the Control System Module.

For software before AST10_04: If no Fault, it will show the CPU-load of the control system in percent for Pulse Encoder / Tachometer speed feedback or the Rotor frequency in Hertz for Rotor frequency feedback. Values larger than 99 Hz are presented as EE.

For software including AST10_04 and later: If no Fault, it shows program version and revision letter, "40" for AST10_0**4** without revision.

In case there is an error, the display will toggle "F1" and the error code. Example: PHASE SEQUENCE WRONG will display F1-01-F1-01-F1-01.....

Generally: Load related signals would disappear when the master switch is returned to the neutral position. All other indications will remain until pushbutton "RESET" is pressed or Crane is turned ON. For most faults RESET will be disabled until crane is turned OFF. All non-persistent fault will disappear at the same time when pressing.

From release 10_054 the code will stay until reset is activated, although the motion is ready to run after a motion OFF -> ON sequence.

All start of motion, Fault or not fault, must be initialised by "ZERO POS-signal"

no.	Name	Action	How to Reset?	Blocked in Factory test mode?
01	PHASE SEQUENCE WRONG or FREQUENCY OUT OF RANGE	Motion stopped	OFF	
02	PHASE L1 MISSING	Motion stopped	OFF	
03	PHASE L2 MISSING	Motion stopped	OFF	
04	PHASE L3 MISSING	Motion stopped	OFF	
05	LINE VOLTAGE L1 < Set level	Motion stopped	OFF	
06	LINE VOLTAGE L2 < Set level	Motion stopped	OFF	
07	LINE VOLTAGE L3 < Set level	Motion stopped	OFF	
31	DAPC 100 ERROR	Motion stopped	OFF	
32	DATX 110 NOT FOUND	Motion stopped	OFF	
33	DATX 120:1 NOT FOUND	Motion stopped	OFF	
34	DATX 120:2 NOT FOUND	Motion stopped	OFF	
35	DATX 120:3 NOT FOUND	Motion stopped	OFF	
36	MASTER-FOLLOWER ERROR	Motion stopped	OFF	
37	DATX 130 NOT FOUND	Motion stopped	OFF	
43	110 V DC TOO LOW	Motion stopped	OFF	
44	110 V DC EARTH FAULT	None	OFF OR RESET	
45	Not possible combination of direction and zero position signals from master switch	Motion stopped	OFF	
46	UNBALANCE; PARALLEL BRIDGES	Motion stopped	OFF	
47	ERROR IN THYRISTOR TEMPERATURE MEASUREMENT	None	OFF OR RESET	
48	CRANE UNCONTROLLED STOPPED	Motion stopped (by itself)	CONTROL VOLT. OFF	
49	4 - 20 mA load cell signal broken	None	OFF OR RESET	
50	Mismatch of reference polarity and direction signals of joystick	None	OFF	
51	Manual operation: JOYSTICK NOT IN NEUTRAL SWITCHING WHEN SHARED MOTION WAS SELECTED / Computer operation: REMOTE OPERATION ABNORMALLY ENDED. MASTER SWITCH OUT OF ZERO or COMMUNICATION BREAK DOWN	Joystick must back to neutral before the new motion is active / Motion stopped	OFF	
52	PTC TRIP no.1	Motion stopped	OFF	
53	PTC TRIP no.2	Motion stopped	OFF	
54	PTC TRIP no.3	Motion stopped / None	OFF or RESET if the PTC is for Warning	
55	PTC TRIP no.4	Motion stopped / None	OFF or RESET if the PTC is for Warning	
57	BRAKE NO ACK. no.1	Motion stopped	OFF	
58	BRAKE NO ACK. no.2	Motion stopped	OFF	
59	BRAKE NO ACK. no.3	Motion stopped	OFF	
60	BRAKE NO ACK. no.4	Motion stopped	OFF	

12.1.4. Jumpers

Jumper (x=Delivery) Function name setting

12.1.4.1. Board DAPC 100

12.1.4.1.1. Generation 1

Generation 1 boards have four pairs of opto couplers in the left part of the upper edge

S1:1-2	**x**	Single bridge	
:3-4		Double bridge	
S2:1-2		TXD_UP to Terminal	(RS232)
:3-4		RXD_UP to Terminal	(RS232)
:5-6		TXDA2 to Tool	(RS485)
:7-8		RXDA2 to Tool	(RS485)
S3:1-2	**x**	TXD_UP to Tool	(RS232)
:3-4	**x**	RXD_UP to Tool	(RS232)
:5-6	**x**	TXDA2 to Terminal	(RS485)
:7-8	**x**	RXDA2 to Terminal	(RS485)
S4:1-2	**x**	Baud rate 9,6k	
:3-4		Baud rate 19,2k	
:5-6		Baud rate 38,4k	
:7-8		Baud rate 115 k	(**Try this setting first**)

12.1.4.1.2. Generation 2

Generation 2 boards have three pairs of opto couplers in the left part of the upper edge

S1:1-2	**x**	Single bridge	
:3-4		Double bridge	
S4:1-2		Baud rate 9,6 k	
:3-4		Baud rate 19,2 k	
:5-6		Baud rate 38,4 k	
:7-8	**x**	Baud rate 115,2 k	

Jumper (x=Delivery) Function name setting

12.1.4.2. Board DATX 120

BOARD ADDRESS x = 2

S1:1-2		Shunt resistor (500 ohm) for current input signals AI 1
:3-4	**x**	Ground connection of negative input AI 1
:5-6		Shunt resistor (500 ohm) for current input signals AI 2
:7-8	**x**	Ground connection of negative input. AI 2

1.1.3.5 Board DATD 100

S2:1-2	**x**	LED pos1, red
:3-4	**x**	LED pos2, red
:5-6	**x**	LED pos3, red
:7-8	**x**	LED pos4, red
:9-10	**x**	LED pos5, red
:11-12	**x**	LED pos6, red
:13-14	**x**	LED pos7, red
S1:1-2	**x**	LED pos8, green

12.1.5. Test terminals

12.1.5.1. Board DAPC 100

T1	Current feedback
T2	0V