Installation and Start-up

Release: **April 25th 2005**

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1 Description

1.1 Dimensions
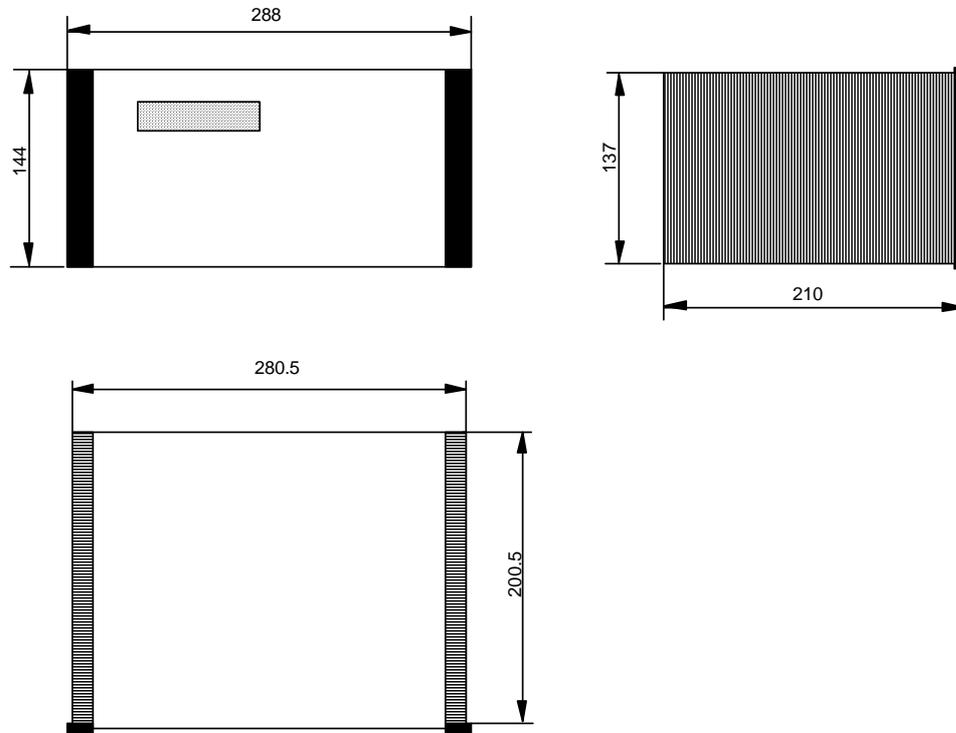
Figure 1-1. E-300 Dimensions (without the connectors)

1.2 Characteristics

The E-300 is a compact controller for 2 two phases step by step motors. It has 12 inputs and 8 24V outputs (extensible with external modules) plus an analog input and an analog output.

The serial communication is done through an RS-485 port.

Warning!

Don't connect serial cable directly between the PC and the E-300.

Connect an N300-SI EIP Adapter on RS-232 PC Port

If this is not respected, damage on the two devices can occurs.

This controller is based programmable with the APEX language from EIP.

Table 1-1. Technical Characteristics

Parameter	Min.	Typ.	Max.	Units
Power Supply		230		**V**
Motor Voltage		80		**V**
Phase Current	2		8 [1]	**A**
Digital Output Voltage		24		**V**
Digital Output Current		1		**A**
Digital Input Voltage	19	24	29	**V**
Digital Input Consumption		5.5		**mA**
Analog Output Voltage	0		10	**V**
Analog Output Current			20	**mA**
Analog Input Voltage	0		5 (10) [2]	**V**
Analog Input Consumption			Negligible [3]	**pA**
Motor Micro-steps		1600		**Step/rev.**
Motor Step Frequency			200 [4]	**kHz**
RS-485 Baud Rate		9600		**Bauds**
RS-485 cable length			150 [5]	**m**

[1] see § 2.3, ventilation
[2] a solder bridge (ADC), on Processor Card, must be set to work from 0 – 10V
[3] when analog input works from 0 – 10V, maximum input consumption is 150 uA
[4] can be product by electronic command but not supported by step motors.
[5] the interface supply current, who is passing through the cable, limits length at this value

2 Installation

2.1 Opening the box

To open the box upper cover for setting operation or system memory changing, the two M3 screws located on the upper side of rear panel must be removed:
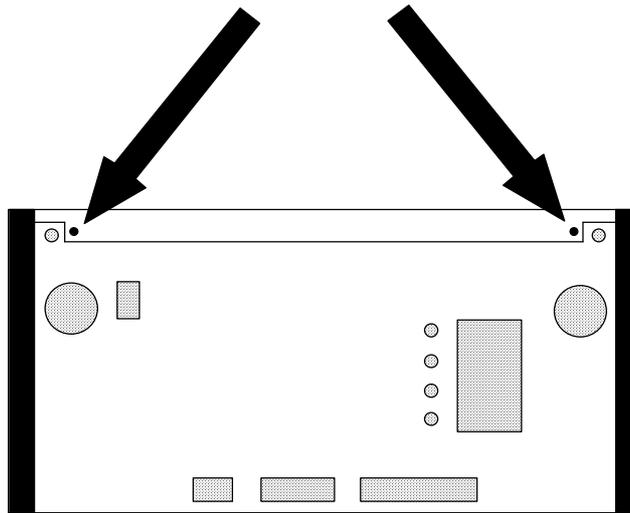
Figure 2-1. Cover Fixation Screws

The upper cover can be removed by slipping it to the rear. The same operation has to be done to remove the lower cover.

2.2 Fixation

There are two manners to fix the E-300: it can be put on a surface (feet under the lower cover), or to be fit in a wall. In the last case, the procedure consists in the removing of the upper and lower panels (see 2.1) And the refitting of them after have fit the E-300 into the wall, the folded side first, to clamp the wall. The four knurled bolts have to be tighten at the rear to fix everything:
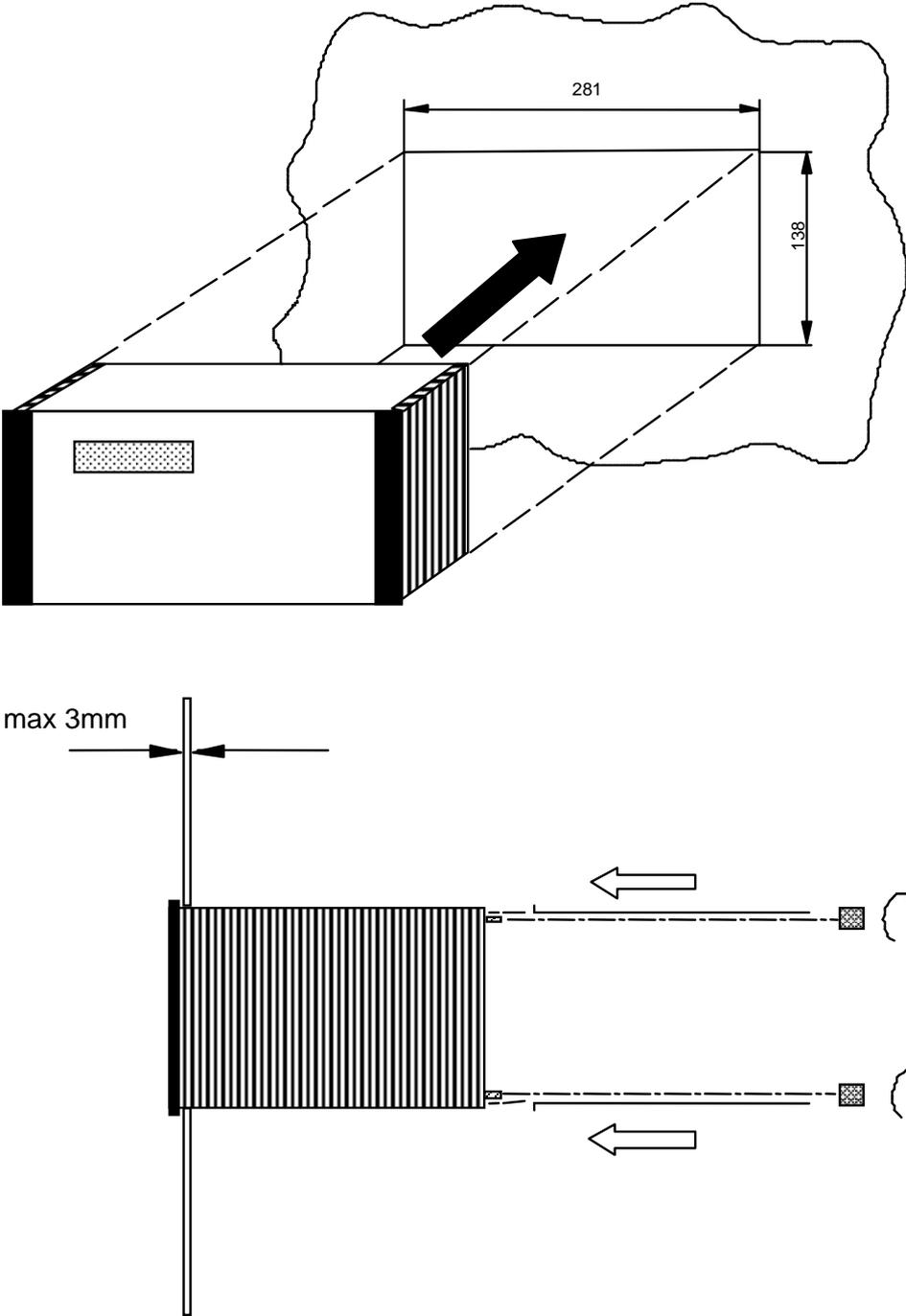
Figure 2-2. Fitting-in of the E-300

2.3 Ventilation

The E-300 has two box versions. The ventilator location depends of the version

- **Hermetic box**. This version is made for units working in dirty environments. The ventilator position is vertical in the middle of the box. Air is turning between the right and left radiators
- **Box with ventilation holes**. This version is made to work in clean environments. The ventilator position is horizontal in the bottom of the box.

Maximal motor current depends of the box version. Figure 2-3 represent maximal duty cycle of motor current in continual working.

Conditions:
- T_{amb} = 25°C
- Speed = 0.9 r/s
- Period = 10s
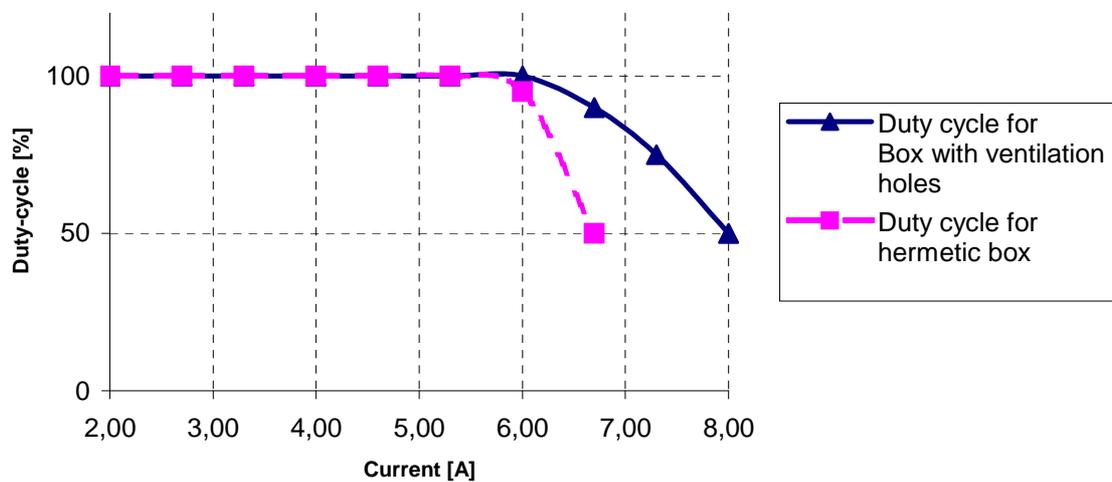
Figure 2-3. Maximal motor current

Remarks:

- Each motor amplifier has his own temperature sensor. These elements signals a fault to E-300 Processor when amplifier heat-sink temperature reaches 60 °C.
- These diagrams are valid if one or two motors are running.

3 Wiring

3.1 Rear Panel
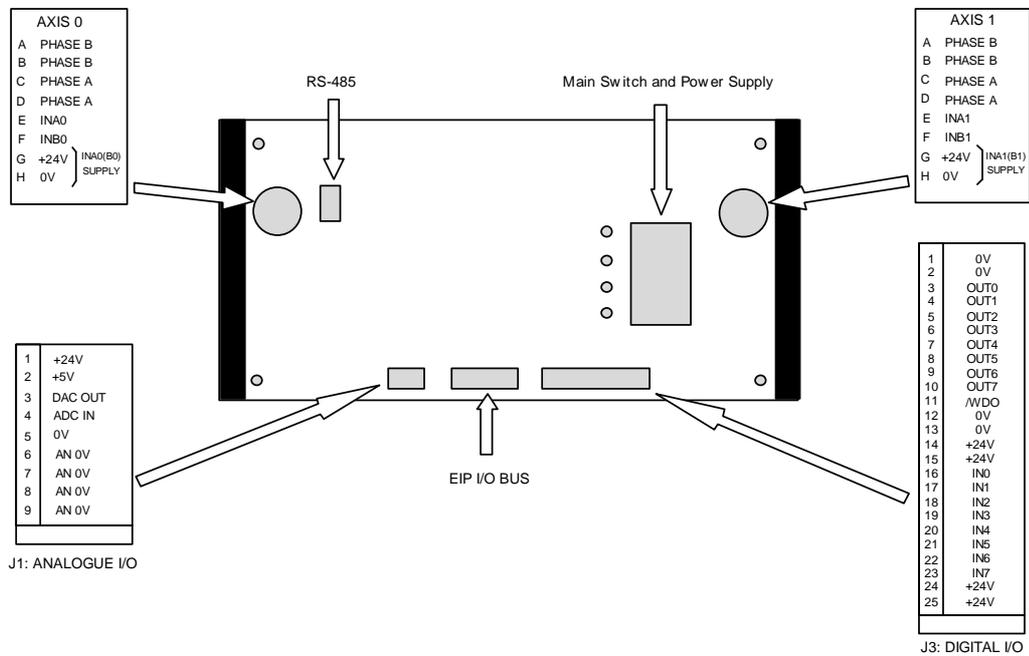
Figure 3-1. Rear Panel

3.2 Power supply and fuses

The sole power supply of the controller (230V) is done through the Europe type plug located at the rear, who contains the sector Fuse.

There are two others fuses on the internal 80V and 24V power supplies. Values of Fuses are indicated in the following table:

Supply	Fuse Value
230 VAC	T 5A
80 VDC	T 5A
24 VDC	T 6.3A

Table 3-1. Fuses values

3.3 Axis connectors

A	PHASE B
B	PHASE B
C	PHASE A
D	PHASE A
E	INA
F	INB
G	+24V	INA (B)
H	0V	SUPPLY
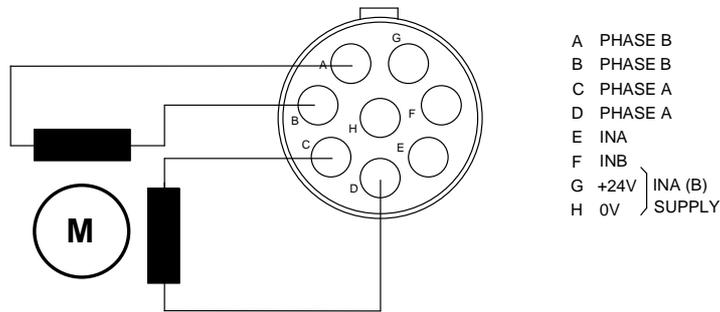
Figure 3-2. Motor Wiring

Note: To go the contrary way, the A-B and C-D pairs must be exchanged.

3.3.1 Reference switches

The inputs for the reference switches are located in each motor connector and are labeled INA and INB. They are of the same type as the general-purpose inputs (See Figure 3-3. Reference Switch Wiring) and can be used for other functions. The three-wire switches must be of PNP type.

AXE 0
A	PHASE B
B	PHASE B
C	PHASE A
D	PHASE A
E	INA
F	INB
G	+24V	INA (B)
H	0V	Supply
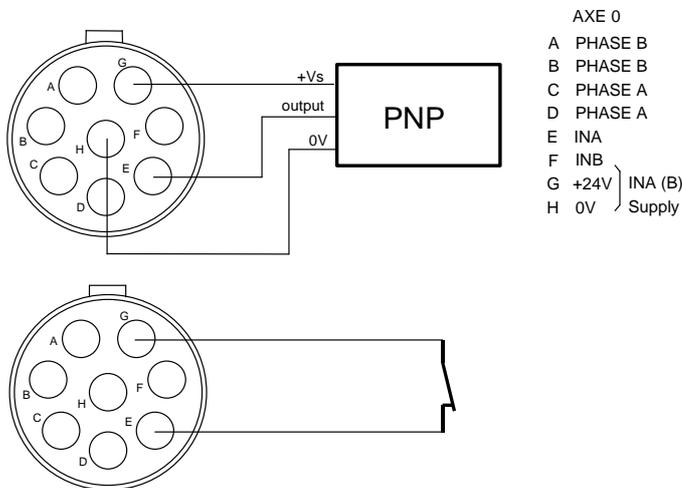
Figure 3-3. Reference Switch Wiring

3.3.2 Reference switches with EIP index motors

Use of EIP index motors allows better accuracy when taking reference position when using low accuracy sensors.
The Principle is to use low accuracy sensor to take approximate reference position. Then motor index is used to determine the accurate reference position. Sensor must be NAMUR 2-wire or mechanical switch type.

3.4 J1 connector: Analog I/O

It's a 9 pins male D-SUB connector.

Pin nb	Signal name	Remark
1	+24 V	Power supply
2	+5V	Power supply
3	DAC Out	Digital-analog converter output
4	ADC IN [1]	Analog-digital converter input
5	0V	Power supply 0V
6	AN 0V	Analog 0V
7	AN 0V	Analog 0V
8	AN 0V	Analog 0V
9	AN 0V	Analog 0V

Table 3-2. J1 connector, Analog I/O

[1] The analog input can be used with the front panel potentiometer or through pin 4 of J1 connector. This choice is done with the jumper located on the motherboard (see Figure 4-1)

3.4.1 ADC Input: simplified schematic
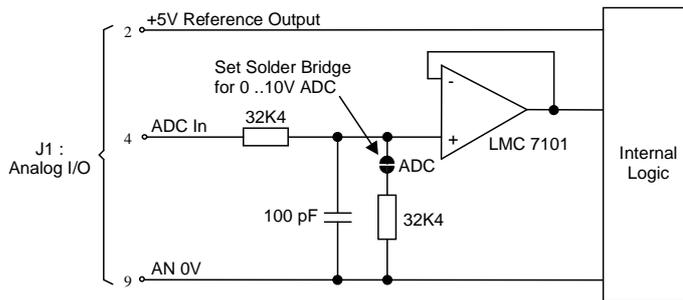
Figure 3-4. ADC input, simplified schematic

3.4.2 DAC Output: simplified schematic
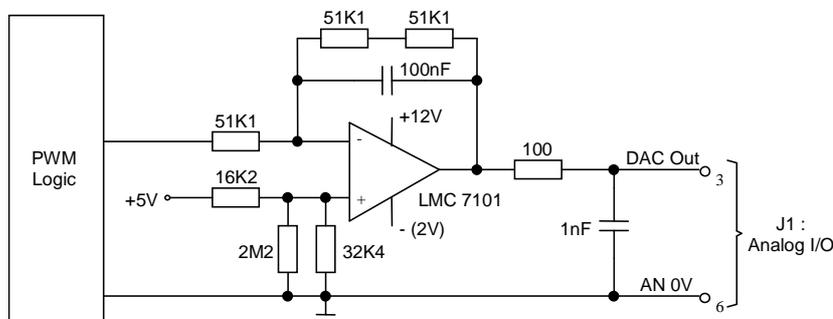
Figure 3-5. DAC output, simplified schematic

3.5 J2 connector: External I/O Bus

It's a 15-pins D-SUB female connector.

Pin nb	Signal name	Remark
1	BDATA	Data Output
2	BRES	Bus Reset
3	+12V	Supply to external Bus
4	BWR	Bus Write
5	BA0	Bus addressing line 0
6	BA2	Bus addressing line 2
7	BA4	Bus addressing line 4
8	0V	Ground
9	0V	Ground
10	/BDI	Data input
11	+12V	Internally connected to pin 3
12	BA1	Bus addressing line 1
13	BA3	Bus addressing line 3
14	BA5	Bus addressing line 5
15	BA6	Bus addressing line 6

Table 3-3. J2 connector, External I/O

3.6 J3 connector: Digital I/O

It's a 25-pins D-SUB female connector.

Pin nb	Signal name	Remark
1	0V	0V return line
2	0V	Internally connected to pin 1
3	OUT0	+24V logical output 0
4	OUT1	+24V logical output 1
5	OUT2	+24V logical output 2
6	OUT3	+24V logical output 3
7	OUT4	+24V logical output 4
8	OUT5	+24V logical output 5
9	OUT6	+24V logical output 6
10	OUT7	+24V logical output 7
11	/WDO	+24V watchdog output [1]
12	0V	Internally connected to pin1
13	0V	Internally connected to pin1
14	+24V	+24V supply
15	+24V	Internally connected to pin14
16	IN0	Logical input 0
17	IN1	Logical input 1
18	IN2	Logical input 2
19	IN3	Logical input 3
20	IN4	Logical input 4
21	IN5	Logical input 5
22	IN6	Logical input 6
23	IN7	Logical input 7
24	+24V	Internally connected to pin 14
25	+24V	Internally connected to pin 14

Table 3-4. J3 connector, Digital I/O

[1] /WDO Security Output goes low when the Processor becomes inactive (non correct functionality)

3.6.1 Input: simplified schematic and wiring example
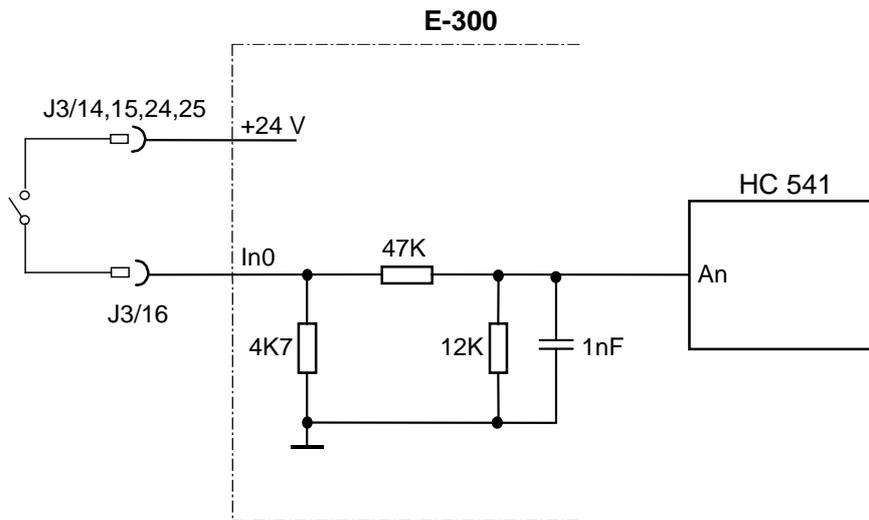
Figure 3-6. Logical Inputs IN, INA, INB

3.6.2 Output: simplified schematic and wiring example
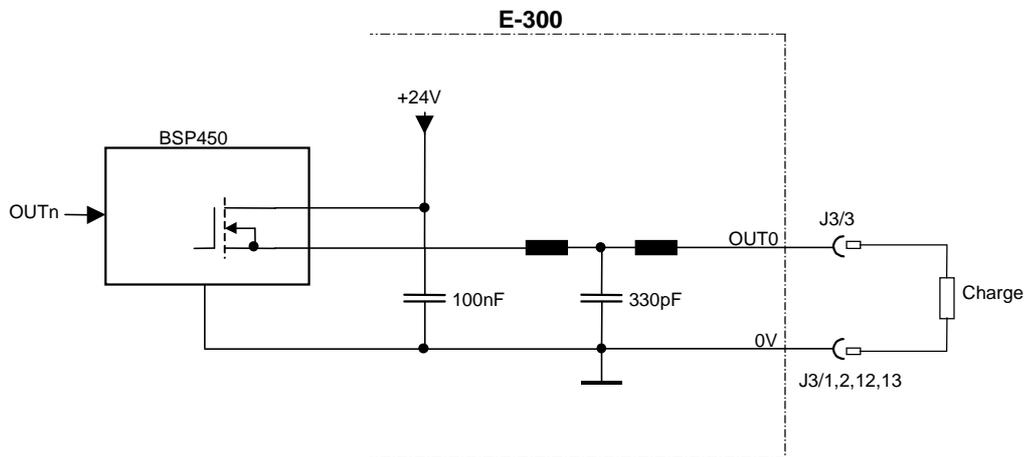
Figure 3-7. Logical Outputs

3.7 RS-485 connector

It's a 9-pole D-SUB female connector.

Pin Nb	Function
1	+5V
2	0V (across an 100 Ohm resistor)
3	TXD/RXD, inverted channel
4	DTR/DSR, inverted channel
5	GND
6	+5V
7	+24V (If supply jumper closed. Normally closed)
8	TXD/RXD, non inverted channel
9	DTR/DSR, non inverted channel

Table 3-5. E-300, RS-485 connector

3.7.1 RS-485 interface

A special Interface, who converts RS-485 to RS-232, is needed to connect a PC with an E-300. This Interface is provided by EIP and is called **N300-SI**.

This Interface must be connected directly to the PC's RS-232 Port. Thus the line length can be greater. The cable between the RS-485 connector of the E-300 and the interface must be 1:1.

E-300 Side :
RS-485
D-SUB 9 Pins
male

PC Side :
RS-232
D-SUB 9 Pins
female
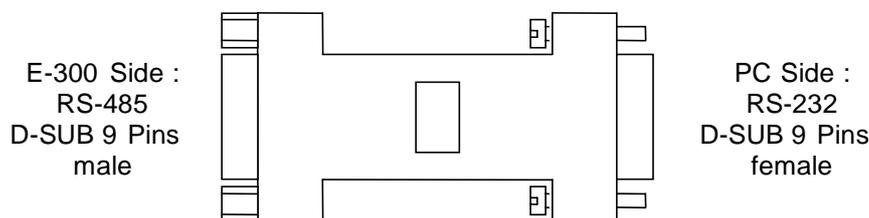
Figure 3-8. N300-SI adapter

D-SUB 9 pins Male connector	Function
1	+5V
2	N.C.
3	TXD/RXD, inverted channel
4	DTR/DSR, inverted channel
5	GND
6	+5V
7	N.C.
8	TXD/RXD, non inverted channel
9	DTR/DSR, non inverted channel

Table 3-6. RS-485 interface, RS-485 side

D-SUB 9 pins Female connector	Signal direction	PC signal name
1		N.C.
2	N-300-SI $\rightarrow$ PC	RXD
3	N-300-SI $\leftarrow$ PC	TXD
4	N-300-SI $\leftarrow$ PC	DTR
5		GND
6	N-300-SI $\rightarrow$ PC	DSR
7	N-300-SI $\leftarrow$ PC	RTS
8	N-300-SI $\rightarrow$ PC	CTS
9		N.C.

Table 3-7. RS-485 interface, RS-232 side

4 Settings
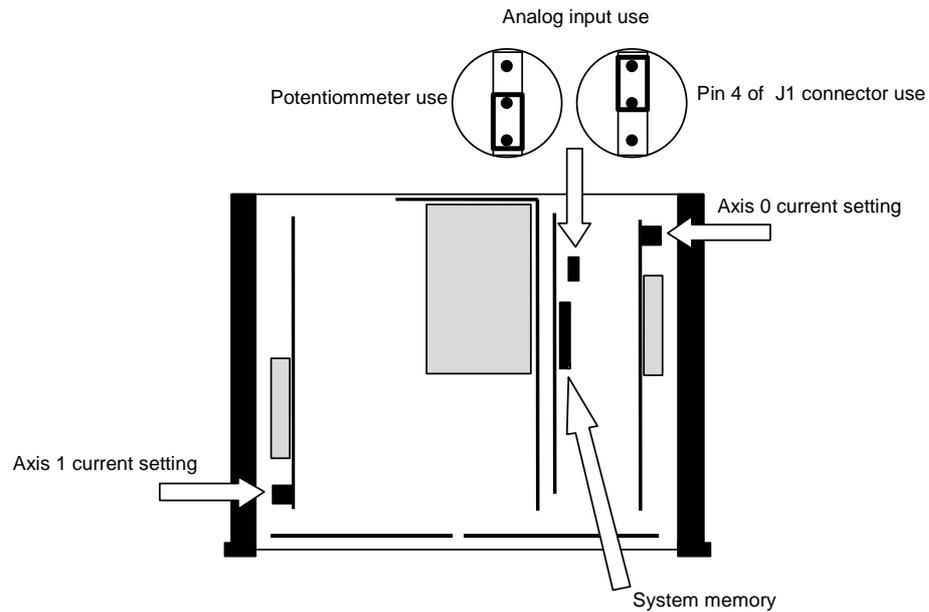
Figure 4-1. E-300 Internal

4.1 Analog Input

The analog input can be used with the front panel potentiometer or through the pin 4 of J1 connector. This choice is done with the jumper located on the motherboard (see Figure 4-1)

4.2 Motor current

The motor current is set in regard of the motor characteristics and the application. The setting is done with the miniature rotate switches located on each translator (see Figure 4-1). The following table gives the phase currents for each switch position:

Table 4-1. Motor Current Setting

Position	Phase Current [A]	Motor Type
0	2	
1	2.7	
2	3.3	23-3A
3	4	34-1A
4	4.6	
5	5.3	
6	6	34-2A
7	6.7	
8	7.3	
9	8	34-3

4.3 Changing Flash Memory

4.3.1 Opening the E-300

To remove the upper cover to do a setting or to change the system memory, remove the two M3 screws from the top of the rear Panel:
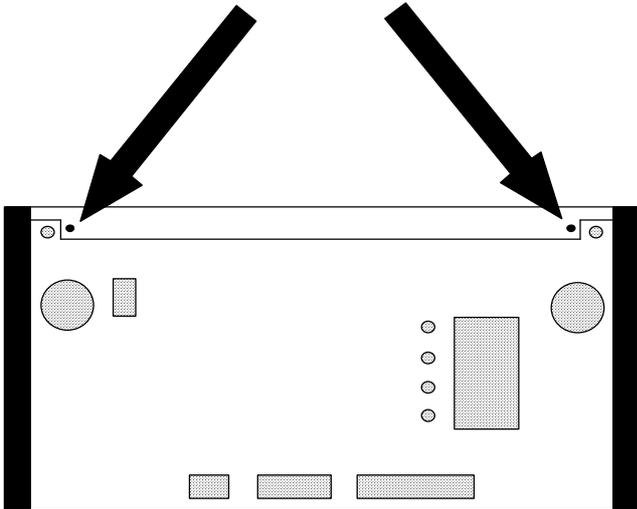
Figure 4-2: Cover Fixation Screws

The upper Cover can now be removed by slipping it to the rear. The same procedure is to be done to remove the lower Cover.
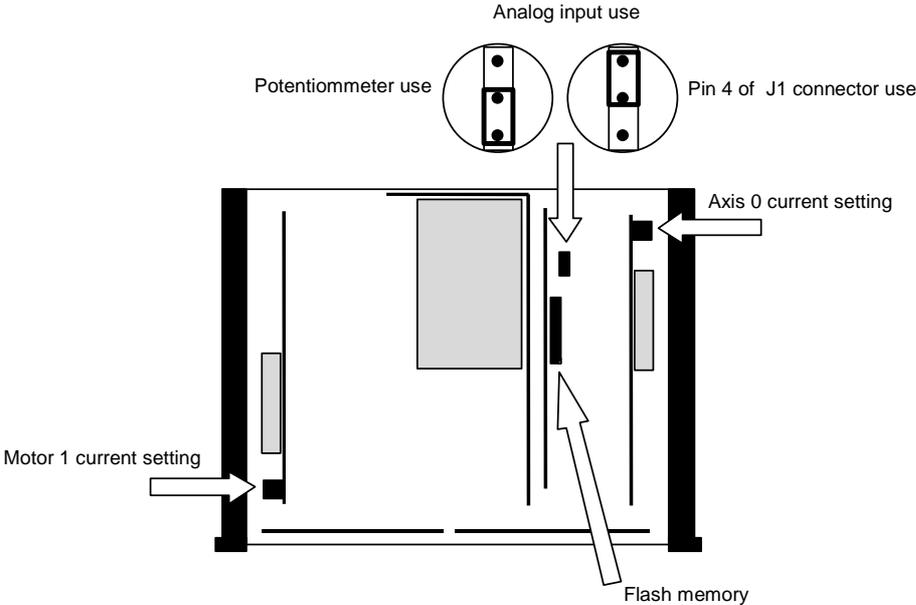
Figure 4-3. Inside the E-300

4.3.2 Changing the Flash Memory

The Flash memory of the E-300 contains the system and the user program (UNIPROG for example). If a new version of the system is offered, the Flash memory of the E-300 has to be changed. The memory has a DIL-32 package and is situated on a socket on the processor board (Figure 4-1). This operation has to be done carefully. The user program must be reloaded.

4.4 Loading of User's Program

Loading or updating of user's program (UNIPROG for example) must be done through the RS-485 serial line.

Warning!

Don't connect serial cable directly between the PC and the E-300.

Connect an N300-SI EIP adapter on RS-232 PC port.

If this is not respected, damage on the two devices can occurs.

Procedure: (for APEX programmers, don't care from point 5)

1. Switch off the E-300.

2. Connect the RS-485 serial adapter to the COM1 port of the PC respecting the orientation. Connect a 9-pole 1:1 cable between the adapter and the E-300.

3. Power on the E-300 while **depressing** F10 key. The menu **RUN DEB FPR BAUD** must be displayed.

4. Depress F2 (DEB) then F3 (HOLD), the message **DEBUG MODE, HOLDING** must appear on the display.

5. On the PC, at DOS prompt, type CHARGE, then press ENTER key. In the A300 window, the messages ASSEMBLING then SERIAL TRANSFER must blink. Program transfer takes about one minute. It is now in the RAM memory.

6. The user program (I.E. UNIPROG) must start.

7. Power off the E-300.

8. Power on the E-300 while **depressing** F10 key. The menu **RUN DEB FPR BAUD** must appear on the display.

9. Depress F3 (FPR), the message **FLASH MEMORY** must appear.

10. Depress F4 (GO), the message **flashing page** must appear, then **FLASH OK**. The program is now in Flash memory.

11. Depress a key then depress F1 (RUN).

---

5   Starting Procedure

This starting Procedure is only valid for Units who are UNIPROG Language equipped. See UNIPROG Manual for Details.

5.1   Configuration

To be able to test inputs and outputs and to effect manual displacements it's necessary to configure the E-300 Command. This can be made by the following procedure:

5.1.1   Power-up

- After Power-up, the display shows the version number during 2 seconds.

```
         UNIPROG+ V x.xx

E-300  x.xx        mm.dd.yy
```

- After this, the following message can appear depending of the momentary configuration of the Unit. **If you are in this case, choose NO (F4 Key)**

```
RAM ERROR

FORMAT           YES   NO
```

- After this, The Display shows the fist Menu. Use the ↑ and ↓ Keys to select an other Menu. Use **F1** to **F4** to call the function displayed above the Key. Use **ESC** Key to rise up one level.
  The following list shows available menus.

```
1  MOTION CONTROL

  TOOL  JOG  CLOS  MODE
```

```
2  PROGRAMMING

  EDIT  VECT FEED  SAVE
```

```
3  DEBUGGING

  TRACE            I/O
```

```
4  FILE UTILITIES

  DIR   DEL  COPY  LOAD
```

```
5  CONFIGURATION

       MGEN  REF  CTRL
```

```
6  OTHER

  VER  COUNT     ACCES
```

5.1.2 Giving access at configuration menus

- From menu "6. OTHER", choose "ACCES" with F4 Key. The Display show

```
ENTER ACCESS CODE
█
```

- Enter **31415** code and press ENTER Key. Verify that value "1" is present on second line of the following display. If not, type "1" and press ENTER Key. Repeat this operation for all the following Menus.

```
REF-JOG-CLOS
1█
```

```
START VECTORS
1█
```

```
FEED RATES
1█
```

```
DIRECTORY
1█
```

```
DELETE-COPY
1█
```

```
EDITION
1█
```

```
LOAD FLASH
1█
```

```
SAVE TO FLASH
1█
```

```
I/O
1█
```

```
CONFIGURATION
1█
```

5.1.3 Configuration of the motion Generator

To use an E-300 command to pilot Motors under UNIPROG language it is necessary to attribute values to the following parameters:

5.1.3.1 Description of parameters

DIV   Define the maximum frequency applicable to the step motor. DIV represent frequency division between electronic command and motor. It can be calculate with the following formula, **when the motor has 200 steps/revolution**:

$$\text{DIV} = \frac{15875}{\text{f}_{max}[kHz]} \quad \textbf{or} \quad \text{DIV} = \frac{595303}{\text{n}_{max}[t/\min]}$$

f_{max} = maximum step frequency (in kHz) supported by the motor
n_{max} = maximum rotation speed of motor in revolution/minute

NOTE: with the E-300 command a 200 steps/revolution motor is piloted with 1600 micro-steps/revolution. (1 step = 8 micro-steps). Maximal frequency is 200 kHz (TRANS-2). Maximal DIV value is 80.

SCALEK   Define the number of micro-steps required at the input of motor to execute one unit of travel on the machine.
Unit of travel can be choose by user, for example in [mm] or in [°].

FEEDK   Define the speed unit. FEEDK represents micro-step frequency (in kHz) for one Speed Unit on the machine.
Speed unit can be choose by user, for example in [mm/s] or [m/min].

STROKE+ Define the maximum positive travel in unit travel of the machine.

STROKE- Define the maximum negative travel in unit travel of the machine.

KUP   Acceleration constant. This parameter defines acceleration ramp. His unit is in [kHz/s] or [Kpulse/s^2]. His value can vary between 200 to 10'000 kHz/s (see Note 1).

KDN   Deceleration constant. This parameter defines deceleration ramp. His unit is in [kHz/s] or [Kpulse/s^2]. His value can vary between 200 to 10'000 kHz/s (see Note 1).

BOOST   This parameter controls the action of the /BOOST line. Its range is limited from 0 to 3.
BOOST=0   low level current, permanently
BOOST=1   high level current during movements
BOOST=2   high level current, permanently
BOOST=3   high level current in standby position

NOTE: low level current represent a 60% reduction of selected current.

Note 1:

To determine KUP (and KDN) value it is possible to ask itself this question "How-many time needs the system to reach a given speed?"

If "v" is the speed used to FEEDK determination, the time (t) necessary to reach this speed is done by one of the following formula:

- Approximate value:

$$KUP = \frac{v}{t} \cdot FEEDK \cdot DIV \cdot \frac{2^{31}}{2.56 \cdot 10^{11}}$$

- Exactly value:

$$KUP = -\ln\left(1 - \frac{v \cdot FEEDK \cdot DIV}{1.6 \cdot 10^4}\right) \cdot \frac{2^{31}}{1.6 \cdot 10^7 \cdot t}$$
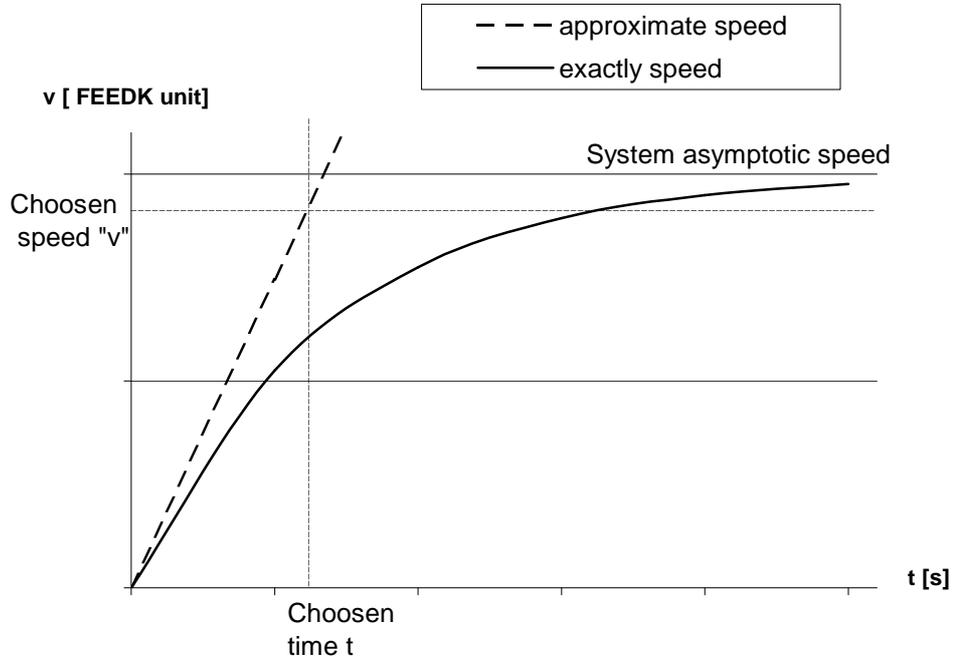
5.1.3.2 Example of parameters calculation

We have the following system:
- A step motor with 200 steps/revolution (with E-300 command this represent 1600 micro-steps), and with a maximum speed of 600 rev/min
- A gear 2:1
- A screw with a 2 mm pitch
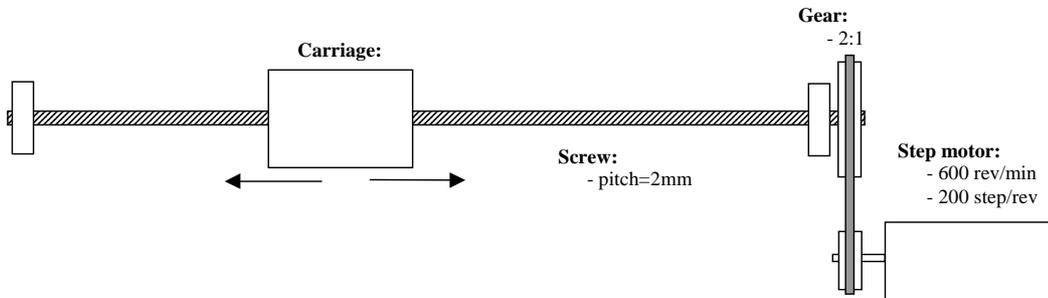
We want to calculate the motion controller parameters, using [mm] as travel unit and [m/min] as speed unit:

a) DIV parameter: (frequency division)

$$\text{DIV} = \frac{595303}{\text{n}_{\max}[t/\min]} = \frac{595303}{600}$$

> **DIV = 992**

b) SCALEK parameter: (Step NB for one unit travel. In this case, steps NB for 1 mm)

- Micro-steps NB for one revolution of gear: 1600 * 2 = 3200 micro-steps
- Micro-steps NB for one unit travel: 3200 [micro-steps] * $\frac{1}{2}$ [mm]

> **SCALEK = 1600** micro-steps/mm

c) FEEDK parameter: (in this case, speed factor to obtain speed unit, in m/min)

- SCALEK = 1600 micro-steps/mm.
- To travel 1 meter, we need 1600*1000 micro-steps.
- With a 1600 kHz frequency, the speed will be of 1 m/s.
- With a 1600/60 kHz frequency, the speed will be of 1m/min.

> **FEEDK = 26,6** kHz per m/min

d) STROKE+, STROKE– parameters: (maximum and minimum travel)

We decide that home position of the screw is minimum travel, and that maximum travel is 500 mm far away from home position.

> **STROKE- = 0** mm
> **STROKE+ = 500** mm

5.1.3.3 Giving parameters

1. If your are not at top level of menus, press **ESC** Key the number of time necessary to go back at this level.
2. With ↑ and ↓ Keys, choose menu: **5. CONFIGURATION**.
3. Press **F2** key to access **MGEN** menu (Configuration of motion generator).
4. Parameter name is displayed at same time with selected axes and his actual value.
   - To choose parameter value use ↑ and ↓ Keys.
   - To change axes, use **F10** and **F9** Keys (X and Y-axes).
   - To introduce numerical value, use **numerical** Keys and validate with **ENTER** Key. In numerical value editing, **CLR** Key allows to clear the last editing value.

5.2 Jogging motions

Jogging is the name used to call manual displacement of motors. A menu of E-300 command is dedicated to this function.

JOG menu can also be used to record the origins for the different tools. This option will not be describe here, for more details on this see UNIPROG+ manual.

To call JOG menu, follow this procedure:

- At top level of menus, use ↑ and ↓ Keys to select menu **1: MOTION CONTROL.**
- Press **F2** key to access **JOG** menu.

Display of the JOG menu is the following:

First line contain:
- Selected axis
- Axis The current position

Second line contain:
- Current tool
- Value of incremental move (editable value)

F8 Key moves the cursor on the first or second line.
F10, F9 Keys selects X or Y axes.

There is two different ways to create manual displacements:

1. Use ← and → keys (X axes) or ↑ and ↓ keys (Y axes) to move desired axes. The movement starts when one of the keys is depressed. If the key is left before the end of movement, the axis stops with a deceleration governed by parameter KDN (see § 5.1.3.1), else he moves of the value displayed on the second line.
2. When cursor is on the **second line**, use numerical Keys to modify **relative displacement** value (increment)**.**

5.3 I/O control utility

This utility is intended to test and debug the hardware functions. It can do the following tasks:

- Displaying the states of inputs, outputs, and DAC output value
- Changing the state of outputs
- Modifying the DAC output value

```
┌─────────────────────────────────┐
│                                 │
│   IN      OUT      DAC = zz %    │
│                                 │
│   xx      yy  ←←←    ON/OFF      │
│                                 │
└─────────────────────────────────┘
```

```
┌─────┐  ┌─────┐  ┌─────┐  ┌─────┐
│ F1  │  │ F2  │  │ F3  │  │ F4  │
└─────┘  └─────┘  └─────┘  └─────┘
```
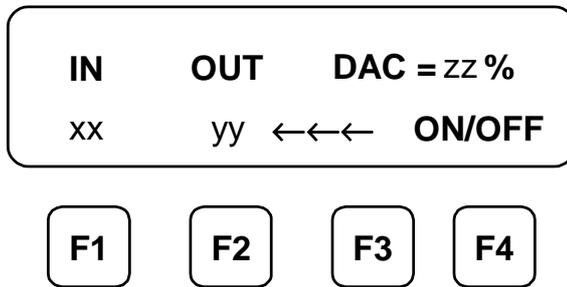
xx =	input number who state is displayed by F10 led.
yy =	output number who state is displayed by F9 led.
zz =	DAC output value
F1:	place cursor on INPUT NUMBER
F2:	place cursor on OUTPUT NUMBER
F3:	place cursor on DAC output value
F4:	toggles state of selected output

1. **To see the state of an input:**
   - Press **F1** Key to place cursor on input number
   - Type input number and press **ENTER** key

   → The F10 LED displays the state of input**.**

2. **To see (or change) the state of an output:**
   - Press **F2** key to place the cursor on output number.
   - Type output number and press **ENTER** key.

   → The state of output is displayed on the **F9 LED**
   → The state of output can be toggled with **F4 key**.

3. **To modify DAC output value:**
   - Press **F3** key to place cursor on DAC output number.
   - Type the new DAC output value (in [%] of 10 V) and press **ENTER** key.

5.4 More information

To have more informations about UNIPROG language and E-300 menu description see the **E-300 UNIPROG+** manual.