INSTRUCTION MANUAL

SERIES 1300

(single board)

April 1995

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AC BRUSHLESS SERVO-AMPLIFIERS

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A. DESCRIPTION AND TECHNICAL DATA

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A.1 INTRODUCTION

The servo-amplifiers series 1300 are intended for the control of 3 phase AC servo-motors with electronic commutation, equipped with resolver.

The 3 phase AC servo-motors with electronic commutation are generally called AC or DC Brushless.

To avoid any confusion, the motors regulated by the series 1300 servo-amplifiers should have the following characteristics.

- Rotor constructed with permanent magnets arranged in 1, 2, 3, 4, 5 or 6 pole pairs, without commutator or sliprings.

- Stator constructed with 3 windings connected in star or delta.

- Electronic commutation is only effected by means of a **speed one** resolver (motors with Hall effect sensors and tachogenerator are not suitable).

Note :

Servo-amplifiers which deliver a 3 phase sinusoidal supply are usually called AC Brushless. The name DC Brushless is reserved for servo-amplifiers whose the output supply is trapezoidal.

A.2 DESCRIPTION

The main characteristics of the servo-amplifiers series 1300 are as follows :

- Digital servo-amplifier with analogic speed command +/- 10V, for Brushless motor with resolver.
- Compact unit for connection to 3 phase power supply comprising braking module.
- Monobloc and Rack versions. Double Eurocard Format. Technology SMD.
- Completely programmable by RS 232 serial link.
- Sinusoidal current output assures smooth torque and optimal performance at low speed.
- Power and command circuits are opto isolated from each other.
- Protections and ruggedness for use in severe conditions.
- Simulation of an incremental encoder output with adjustable resolution to 1024 ppr and adjustable marker pulse. Differential line driver outputs.
- Input for proximity sensor.
- 7 segment status indicator for diagnostic display.
- Short-circuit protected output stage.
- I^2t protection.
- Detection of resolver fault, motor overheating.
- Velocity or current regulation.
- Auxiliary voltages are produced within the equipment.
- End limit switch.
- Enable optocoupled or 24V DC.
- Possibility of external supply to the control board (position data and alarms keeped in case of supply interruption 220V).

A.3. TECHNICAL DATA

A 3.1 General data for all types

- Supply frequency	45 to 65 Hz
- Supply voltage	3 x 220V AC +/- 15%
- Operating temperature range	0 to 60° C
- Operating temperature range at full power (from 45°C, reduce output current by 2%/°C to 60°C)	0 to 45° C
- Storage temperature range	- 20 °C to + 70 °C
- PWM chopper frequency	9,99 kHz
- Differencial input reference	+/- 10V
- Speed control range	1/5000 with speed factor = 127
- Bandwidth :	
speed loop	300 Hz
current loop	2 kHz
- Rated power dissipation during braking with standard resistance	125 W
- Max. output to motor	3 x 210 V, 0 to 500 Hz

General data for all types

- Incremental encoder : output 5V
  - parameter "low speed" 128, 256, 512, 1024 ppr
  - parameter "high speed" 128, 256, 512 ppr

- Theoretical max. speed for motor with resolver **"speed one"** :
  - parameter "low speed" 3500 rpm
  - parameter "high speed" 6000 rpm

- Switching threshold of brake module 385 V DC
- Trip threshold of overvoltage 415 V DC
- Trip threshold of voltage drop 180 V DC

- Serial link

baud rate	Standard :	9600 Bd
	Configurable by solder bridge :	19200 Bd
transmission		Full duplex
format		1 START bit 8 DATAS bit no parity 1 STOP bit

Transmission stop possible by the CTS signal

A.3.2 Electrical data

Servo-amplifier type :		**1302**	**1304**	**1306**	**1308**	**1310**	**1318**
Rated rms current	(A)	2,1	4,2	5,9	8,3	10,0	17,4
Rated peak current	*(A)*	3,0	*5,9*	*8,3*	*11,8*	*14,2*	*24,5*
Max. rms current	(A)	4,2	8,3	11,8	16,7	20,1	34,7
Max. peak current	*(A)*	*5,9*	*11,8*	*16,7*	*23,5*	*28,4*	*49,0*
Rated power	(kW)	0,8	1,5	2,1	3,0	3,6	6,3
Max. power	*(kW)*	*1,5*	*3,0*	*4,3*	*6,0*	*7,3*	*12,6*

Note :

$I_{rms} = I_{peak} / 1,41$

$P = 1,73 \times I_{rms} \times V_{rms}$ or $P = 3 \times I_{rms\ phase} \times V_{rms\ phase}$

- in star $V_{rms\ phase} = 210V / 1,73$
  $I_{rms\ phase} = I_{rms}$

- in delta $V_{rms\ phase} = 210V$
  $I_{rms\ phase} = I_{rms} / 1,73$

Ex: Type 1306 $I_{rms\ max} = 11,8$ A $I_{rms\ rated} = 5,9$ A

$P_{max} = 1,73 \times 11,8 \times 210 = 4,3$ kW

$P_{rated} = 1,73 \times 5,9 \times 210 = 2,1$ kW

A.3.3 Analog reading on test points

The control board includes 3 test points + one common ground which permit an analog reading of the 3 following quantities.

Test point	Description	Scaling
Current	Instantaneous Current	10V corresponds to the max. current of the unit
Command	Internal command voltage	$V_{command} = V_{ext.\ cmd}$
Speed	Motor speed	+/- 10V +/- 10% corresponds to the max. speed of 6000 rpm

The tests points are suitable for the use of a pocket multimeter equiped with a plug of 2 mm.

The right position of the test points is given in fig. 3 chapter C.1.2.

A.4. CONFIGURATION AND FUSES

The location of the configuration elements and fuses is given in appendix **D.2**.

A.4.1 Servo-amplifier configuration

NAME	ELEMENT	FUNCTION
REF	Jumper	**1-2** : differential input **"SPEED-IN -"** connected to 0V **2-3** : differential input **"SPEED-IN +"**connected to 0V
TREF	Jumper	Enable the servo-amplifier by means of a contact : 2 jumpers between **1-2** and **3-4** Enable the servo-amplifier by means of 24V DC : 1 jumper between **2-3** only (ground 24 V connected to CO4/14)
SAD	Solder bridge	**1-2** : analog command voltage (in standard) **2-3** : numeric command voltage through serial link RS 232 or RS 485 (option)
VITCRT	Solder bridge	**1-2** : speed regulation (in standard) **2-3** : current regulation
USER	Solder bridge	Supply voltage of the proximity detector **1-2** : 5 V **2-3** : 12 V (in standard)
BD	Solder bridge	Baudrate serial link RS 232 : **1-2** : 9600 Bd (in standard) **2-3** : 19200 Bd

A.4.2 Fuses of the servo-amplifier

The following fuses are works equipped in all units of the series 1300 :

Servo-amplifier type	**1302**	**1304**	**1306**	**1308**	**1310**	**1318**
DC-BUS	10 AT	10 AT	10 AT	15 AT	15 AT	20 AT
Braking module	4 AF	4 AF	4 AF	5 AF	5 AF	8 AF
Supply	1 AT	1 AT	1 AT	1 AT	1 AT	1 AT

Fuse of DC-BUS (F1)

The fuses "Littelfuse 326" are used on the BUS-DC. Dimensions : 6,3 x 32 mm.

Fuse of the braking module (FFRA or FFRB)

For units type 1302, 1304 and 1306, the fuses "Wickmann 19194" are used.
Dimensions : 5 x 20 mm.

For other types of unit series 1300, the fuse "Littelfuse 314" are used.
Dimensions : 6,3 x 32 mm.

Fuse of supply (FHT)

All units of the series 1300 have a fuse of dimensions 5 x 20 mm.

Warning :

The replacement of a defect fuse by a fuse of the same type should only have been by a technical specialist of the series 1300, after have been found and corrected the defect.

A.5 OPTIONS LIST

DIGITAL COMMAND

Option digital command (12 bits). The command is transmitted by serial link RS 232 or RS 485 (option BUS).

EARTH DEFAULT

This option detects a short circuit of any motor cable with the earth. Works only with an auto-transformer or with a transformer if secondary star point is connected to the earth.

MULTI-MODULES

Option 4 modules RDC. Each module define a max. speed motor for a command of +/- 10V.

Ex : 6000 rpm - 3000 rpm - 1500 rpm - 700 rpm

BUS

Option Bus. This option give a serial link of type RS 485 with adressing of 15 servo-amplifiers at maximum**.**

HOUSING

Option housing aluminium as :

- *untreated or*
- *treated aluminium*

B. DRIVE PARAMETERS

B.1 SERIAL LINK

- The serial link is used to set or monitor drive parameters stored in non-volatile memory using the configuration program.

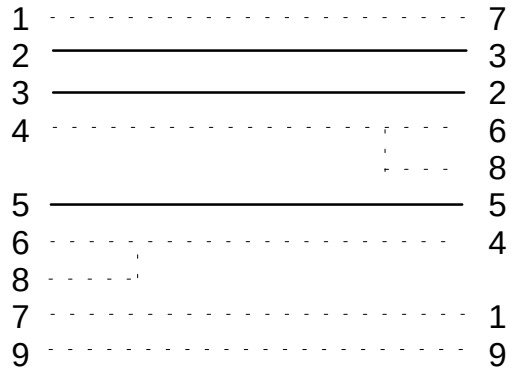
- This program allows the user to :

  - *set all user adjustable parameters*
  - *monitor inputs and fault status*

- With the serial link connted it is possible to monitor the position of the resolver (0-4095) within one motor revolution.

- Hardware :

  A personnal computer and a RS 232 serial cable showing the following wiring :



——— necessary connection

- - - - - - - Connection not necessary but present in the cable type DCA-339

B.2. GETTING AROUND THE CONFIGURATION PROGRAM

- The specific program 1300.EXE developped by IRT and installed on the PC makes it easy to set the drive parameters and to monitor the servo-amplifier status.

- This program presents the servo parameters using four pages or screens. The first three pages involve the setup of the servo-amplifier and the absolute position of the resolver. The last page is used to monitor the inputs and alarm states. Only the parameters on the first three pages can be modified through the computer program.

- CHANGE PAGES :

  The page displayed on the computer is changed by pressing the **<TAB >** key.

- SELECT PARAMETERS :

  The up/down arrow keys **< 🡻 >** and **< 🡹 >** are used to select the desired parameter on each page. The selected parameter appears in reverse video.

- CHANGE VALUES :

  The plus key **< + >** and terminus key **< - >** change the value of the selected parameter displayed in reverse video. Note page 4 is not affected by these keys.

- SAVE SETTINGS :

- The **< F2 >** key saves all settings on the first three pages to non-volatile (E EPROM) memory.

- EXIT PROGRAM :

  Press **< ESC >** to exit the program.

- NEW RELEASE

  For more informations on new release please look at the file **README.TXT** .

B.3 PARAMETERS DESCRIPTION

B.3.1 Parameters on the 1st page

The parameters on the first page are displayed as follows :

```
<ESC> = QUIT F2=Save  +- = Value TAB = Page

==================I R T  1 3 0 0 =================
              configuration's utility, version 0.4
=============================================
                                          pg1
> Proportional Gain          >          30
  Integral Gain                         20
  Zeroimpuls Shift                       0
  Automatic Offset Control             OFF


  Speed offset                           0
  Rotor position                      4095
```

- **Proportional Gain and Integral Gain :**

  These two parameters determine the proportional and integral gain of the servo velocity control loop.

  They are programmable from 0 to 127. Higher values represent higher gains.

  The integral gain is canceled for a value lower or equal to 3.

- **Zeroimpuls Shift :**

  This parameter is used to shift the simulated Z pulse by +/- 180° relative to the null position of the resolver. It is programmable over a range of -512 (-180°) to +512 (+180°).

- **Automatic Offset Control :**

  This parameter is switched ON or OFF in order to enable or disable the automatic control of offset voltage in the command signal.

  When switched **ON**, this feature keeps the motor at zero speed in the following cases :

  - external null command : 0V +/- 3 mV
  - end switch input active
  - speed command stopped

  When switched **OFF**, the motor is immobilized by mean of the OFFSET potentiometer showed in fig. 3 chapter C.1.2.

B.3.2 Parameters on the 2nd page

The parameters on the second page are displayed as follows :

```
<ESC> = QUIT F2=Save  +- = Value TAB = Page

==================I R T  1 3 0 0 =================
            configuration's utility, version 0.4
=============================================
                                        pg2
>  Endswitches normally      >          OPEN
   Resolver Ratio                        2 : 1
   Speed command stop
   Encoder Resolution                 1024
   Zeroimpuls Width                     1/2
   Max speed / max resolution      3500 / 1024
   Thermostat motor normally          CLOSED

   Display Period                        15
```

- **Endswiches normally OPEN or CLOSED :**

  This parameter allows the end switches connected to the end switch inputs to be selected as normally OPEN or normally CLOSED. If selected as normally closed, motion will stop in the appropriate direction when one of the end switch inputs is opened.

- **Resolver Ratio :**

  This parameter has no effect !

  The ratio and the amplitude to the primary of the resolver are fitted with resistances RSIN, RCOS and RREF.

  Standard equipment :

  RSIN = RCOS = 0 (bridge) for resolver ratio 2 : 1
  RREF = 12 k ohm to obtain 4 V_{eff} to the resolver primary.

  Special cases :

  Use the following formula :

$$RREF = \frac{88}{V_{ref}} - 10 \quad (k\ ohm)$$

  where : - Vref is rms voltage applicated to the primary of the resolver.
  Vref max. = 6 V !

$$RSIN = RCOS = \frac{4400 \times Kr}{10 + RREF} - 100 (k\ ohm)$$

  where : - RREF is introduced in k ohm
  - Kr is the resolver ratio
  (Resolver ratio 2 : 1 corresponds to Kr = 0,5)

- **Speed Command Stop :**

  This parameter allows various directions of motor rotation to be prohibited. The following possibilities are programmable :

Parameter	Speed Command Prohibited
<blank>	none
+	positive
-	negative
+/-	no movement permitted

- **Encoder Resolution :**

  This parameter selects the number of pulse channel A or B from the servo-amplifier by resolver turn. The following values are available :

  128, 256, 512 and 1024 ppr (resolver speed one)

- **Zeroimpuls Width :**

  This parameter selects the width of the simulated encoder marker pulse (Z pulse) relative to the width of the A channel period.

  The following values are available : 1/4 , 1/2 and 1

- **Max. speed / max. resolution :**

  This parameter selects one of two maximum motor speeds in order to enable the servo-amplifier for the appropriate encoder resolution range.

  The limits are :

  (1) Max. speed = 3500 rpm
  Max. resolution = 1024 ppr

  (2) Max. speed = 6000 rpm
  Max. resolution = 512 ppr

  The simulated encoder signals are out of function in the following case of parameters selection :

Encoder Resolution	:	1024
Max. speed/max. resolution	:	6000/512

- **Thermostat motor normally :**

  The servo-amplifier is suitable to the motor thermal switch type by selecting :

  CLOSED : for motor thermal switch normally CLOSED (or for PTC)
  OPEN : for motor thermal switch normally OPEN (or for NTC)

B.3.3 Parameters on the 3rd page

The parameters on the 3rd page are displayed as follows :

```
<ESC> = QUIT F2=Save  +- = Value TAB = Page

==================I R T  1 3 0 0 =================
            configuration's utility, version 0.4
=============================================
                                    pg3
> Speed factor                   >     -64
  Maximal current                      127
  Nominal current                       64
  Pair of motorpoles                     3
  Phase advance                         20
  Resolver Shift Angle                   0
```

- **Speed factor :**

  This parameter sets the max. speed and the direction of rotation of the motor.

  This parameter is programmable from -127 to 127 corresponding to a speed of -6000 rpm to +6000 rpm +/- 10%.

- **Maximal current :**

  This parameter sets the peak current delivered to the motor.

  This parameter is programmable from 0 to 127 (127 = max. rms current of the amplifier shown in section A.3.2).

- **Nominal current :**

  This parameter sets the continuous current delivered to the motor.

  This parameter is programmable from 10 to 64
  (64 = rated rms current of the amplifier shown in section A.3.2).

- **Pair of motorpoles :**

  This parameter sets the number of motor pole pairs for proper commutation.

  This parameter is programmable from 1 to 6 (number of motor pole pairs).

- **Phase advance :**

  This parameter is used to optimize the phase advance angle for each type of motor.

  At max. speed (speed factor parameter = 127), this parameter can vary the phase advance angle from 0 to 180 electrical degrees.

  This parameter is programmable from 0 to 180° (typical value : 20).

- **Resolver Shift Angle :**

  This parameter is used to set the resolver shift angle in software. Indeed the motor manufacturer use his own procedure for the resolver alignment.

  This parameter is programmable from -180 to +180 (electrical degrees).

B.4 DESCRIPTION OF INPUTS AND ALARMS STATE

The inputs and alarms state on the fourth page are displayed as follows :

```
<ESC> = QUIT F2=Save  +- = Value TAB = Page

==================I R T  1 3 0 0 =================
              configuration's utility, version 0.4
=================================================
                                          pg4

01 Torque enable                           ON
 2 Alarm I2 x t                            OFF
 3 Thermostat motor                        OFF
 4 Thermostat heatsink                     OFF
 5 RDC-converter fault                     OFF
 6 Resolver fault                          OFF
 7 Power fault                             OFF
 C Link motor fault                        OFF
>                                 >
END_SW1      END_SW2      SPD_CMD+      SPD_CMD-
  OFF          OFF          ON            OFF
```

B.4.1 Alarms state

Torque enable	ON	--->	servo-amplifier enabled
	OFF	--->	servo-amplifier disabled
Alarm I2 x t	ON	--->	limit of continous current reached
	OFF	--->	continous current within limits
Thermostat motor	ON	--->	motor overheating
	OFF	--->	motor within temperature limits
Thermostat heatsink	ON	--->	amplifier heatsink over temperature
	OFF	--->	amplifier heatsink within temperature limits
RDC-converter fault	ON	--->	resolver/digital converter fault
	OFF	--->	resolver/digital converter OK
Resolver fault	ON	--->	resolver fault (check resolver wiring)
	OFF	--->	resolver OK
Power fault	ON	--->	alarm of the power part
	OFF	--->	power OK
Link motor fault	ON	--->	motor wiring failure
	OFF	--->	motor wiring OK

B.4.2 Inputs state

END_SW1	OFF	--->	negative speed command free
	ON	--->	negative speed command canceled
END_SW2	OFF	--->	positive speed command free
	ON	--->	positive speed command canceled
SPD_CMD+	OFF	--->	speed command zero or negative
	ON	--->	speed command positive and non zero
SPD_CMD-	OFF	--->	speed command zero or positive
	ON	--->	speed command negative and non zero

C. SETTING TO WORK

The setting to work of AC Brushless servo motors and servo-amplifiers requires a little more attention than that of DC servo-drives. We recommand that setting to work should be done according to the following instructions.

C.1 Preparation

C.2 Switching the servo-amplifier without motor

C.3 Switching the servo-amplfier on with motor

C.4 Trouble shooting **47**

C.1 PREPARATION

C.1.1 Installation

C.1.1.1 Monobloc version

The servo-amplifier series 1300 **"monobloc"** version is available in a compact unit placed in a box and provided with a support plate. It allows the mounting on the back panel inside the control box.

The brake resistance and the cooling fans are an integral part.

A free space of 100mm above and below the servo-amplifier is required in order to guarantee good cooling.

The dimensions for the **"monobloc"** version are given in appendix **D.3**.

C.1.1.2 Rack version

The **racks** are constructed from aluminium and one or more motherboards.

2 axes can be fitted to each motherboard.

Each axis is equipped with one braking resistor, mounted at the top of the rack. Each braking resistor is connected to the appropriate motherboard.

The brake resistance and the cooling fans are an integral part.

A free space of 100mm above and below the rack is required in order to guarantee good cooling.

The dimensions for the rack are given in appendix **D.4**.

C.1.2. Wiring and connectors

The wiring of the servo-amplifiers series 1300 must be carried out according to the schematic in these instructions. Local wiring regulations must be observed.

Special attention should be paid with respect to wiring rules regarding ground, earth and neutral.

The earth wire to the amplifier, motor and housing must be as short as possible and connected to a common earth point.

The complete wiring plan is represented in **fig. 1** on the next page.

C.1.2.1 Cable lenghts and crossections

We recommend to use the following cable crossections :

		1302	**1304**	**1306**	**1308**	**1310**	**1318**
Supply voltage	mm^2	1,50	1,50	1,50	1,50	2,50	4,00
Motor	mm^2	1,50	1,50	1,50	1,50	2,50	4,00
Earth	mm^2	1,50	1,50	1,50	2,50	2,50	4,00
Command signals	mm^2	0,18	0,18	0,18	0,18	0,18	0,18

Length of cable between servo-amplifier and motor : max. 15 m.

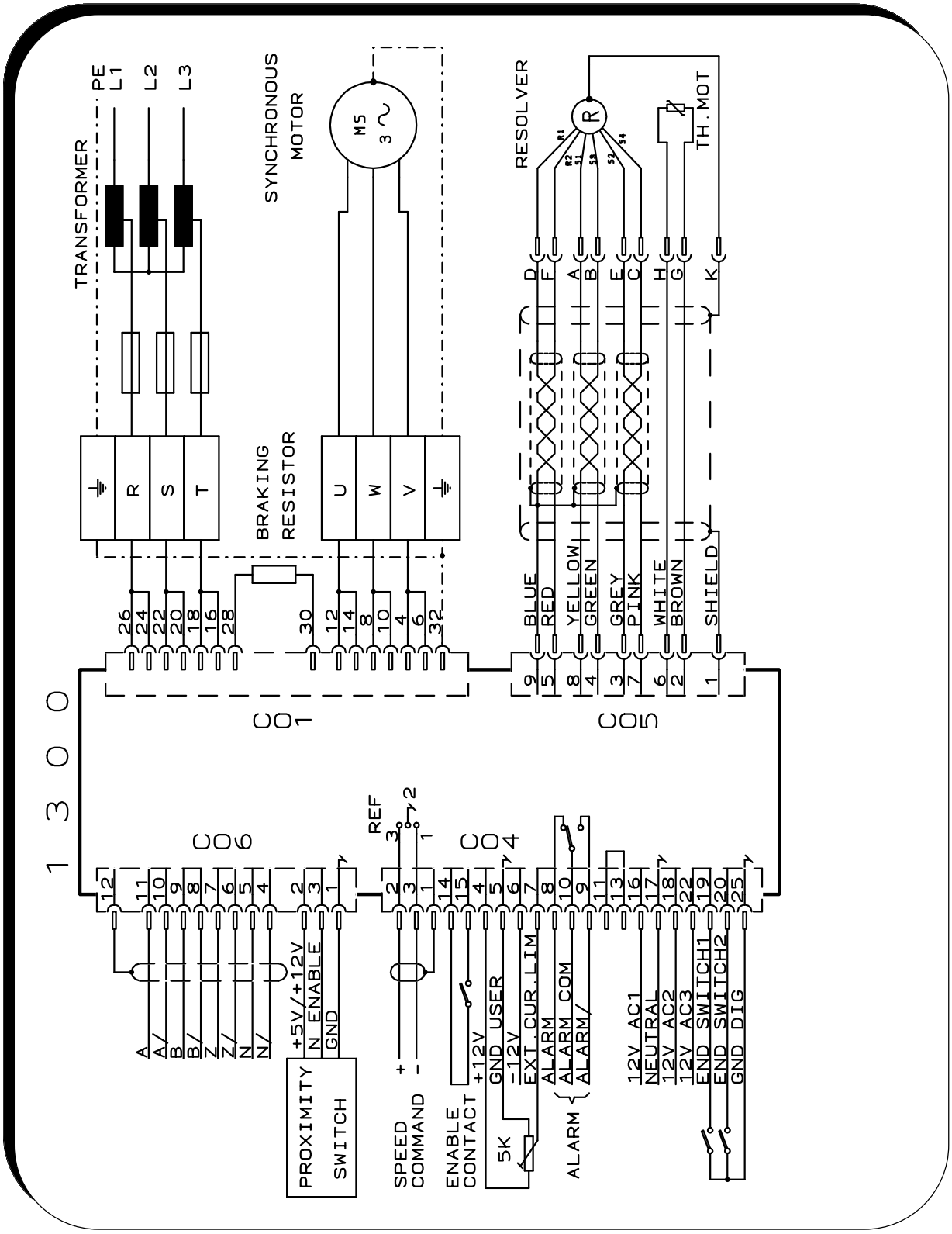


Fig. 1 : Wiring plan of servo-amplifier series 1300

C.1.2.2 Power connection

The wiring of the supply voltage, motor, braking resistor and earth is done through a socket connector DIN 41612 form H, female with faston.

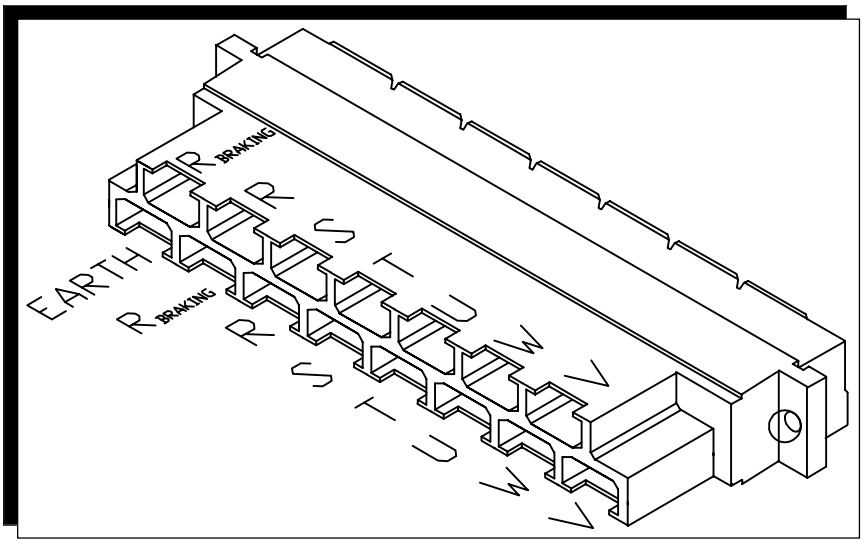


***Fig 2**:* Power connector

C.1.2.2.1 Monobloc version

The wiring of the supply voltage, motor and earth are made through fixed terminal blocks. These terminal blocks can accommodate wires up to 4 mm^2.

The earth connection must be done to terminals	**yellow / green**
The terminals for the supply voltage are marked	**R, S, T** or **L1, L2, L3**
The motor terminals are marked	**U, W, V**

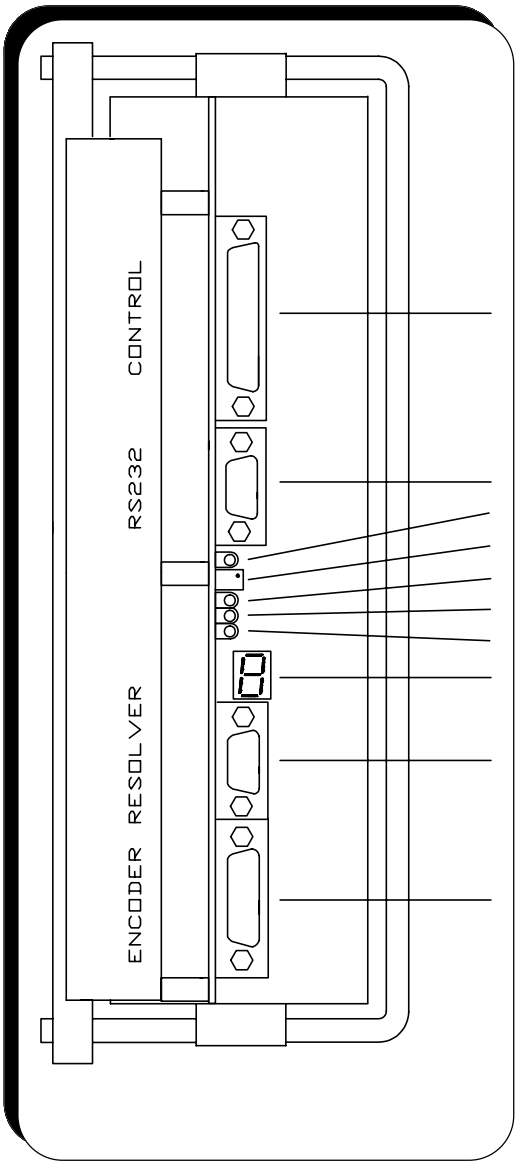
C.1.2.2.2 Rack version

The wiring of the supply voltage, motor and earth are made through fixed terminal blocks. These terminal blocks can accommodate wires up to 10 mm^2.

Each motherboard has in addition of the power connector 3 fixed terminal blocks :

2 motor terminal blocks, each block marked by	:	**"Earth"**, **U**, **W** and **V**
1 terminal block for the supply voltage marked by	:	**"Earth"**, **R**, **S** and **T** or **L1**, **L2**, **L3**

C.1.2.3 Connection of the command signals



Connector CO4-25 poles SUB-D
Control signals (female)

RS 232 serial port (male)
Current command
Offset potentiometer
Speed command
Speed
0V
7 segments display

Connector CO5-9 poles SUB-D
Resolver feedback (female)

Connector CO6-15 poles SUB-D
Simulated encoder ouputs (female)

Fig. 3 : Connectors, display and test points

The following cable connectors are delivered with each unit of the series 1300.

Resolver feedback connector	(CO5)	SUB-D 9 poles
Encoder outputs connector	(CO6)	SUB-D 15 poles
Control signals connector	(CO4)	SUB-D 25 poles

C.1.2.3.1 Wiring of the resolver and motor thermal switch

Correct wiring of the resolver is the **precondition** for good and reliable operation of the servo-amplifiers series 1300. The non-respect of the described operations in this manual will obligatory bring **a deterioration of the announced performances**.

A cable with the following characteristics is needed :

- 3 pairs of conductors 0,14 mm^2 twisted in pairs and shielded separately.
- 2 conductors of 0,5 mm^2 shielded separately.
- an overall shield not connected to the previous shields.

*(It is recommanded to use **HEIDENHAIN** cable reference 200 775 02)*

The cable wiring should be done as **fig.4**.

The 3 internal shields should be connected only on the servo-amplifier side. The external shield should be rather on both sides (amplifier side and motor side) but **imperatively on the amplifier side.** It is recommended to follow the convention (signal / conductor colour) used in this manual.

Contacts 2 and 6 are intended for the motor thermal switch wiring. The contact should be either of type normally closed, or of type normally open.

It should have the following characteristics :

contact closed : 1 k ohm
contact opened : 10 k ohm

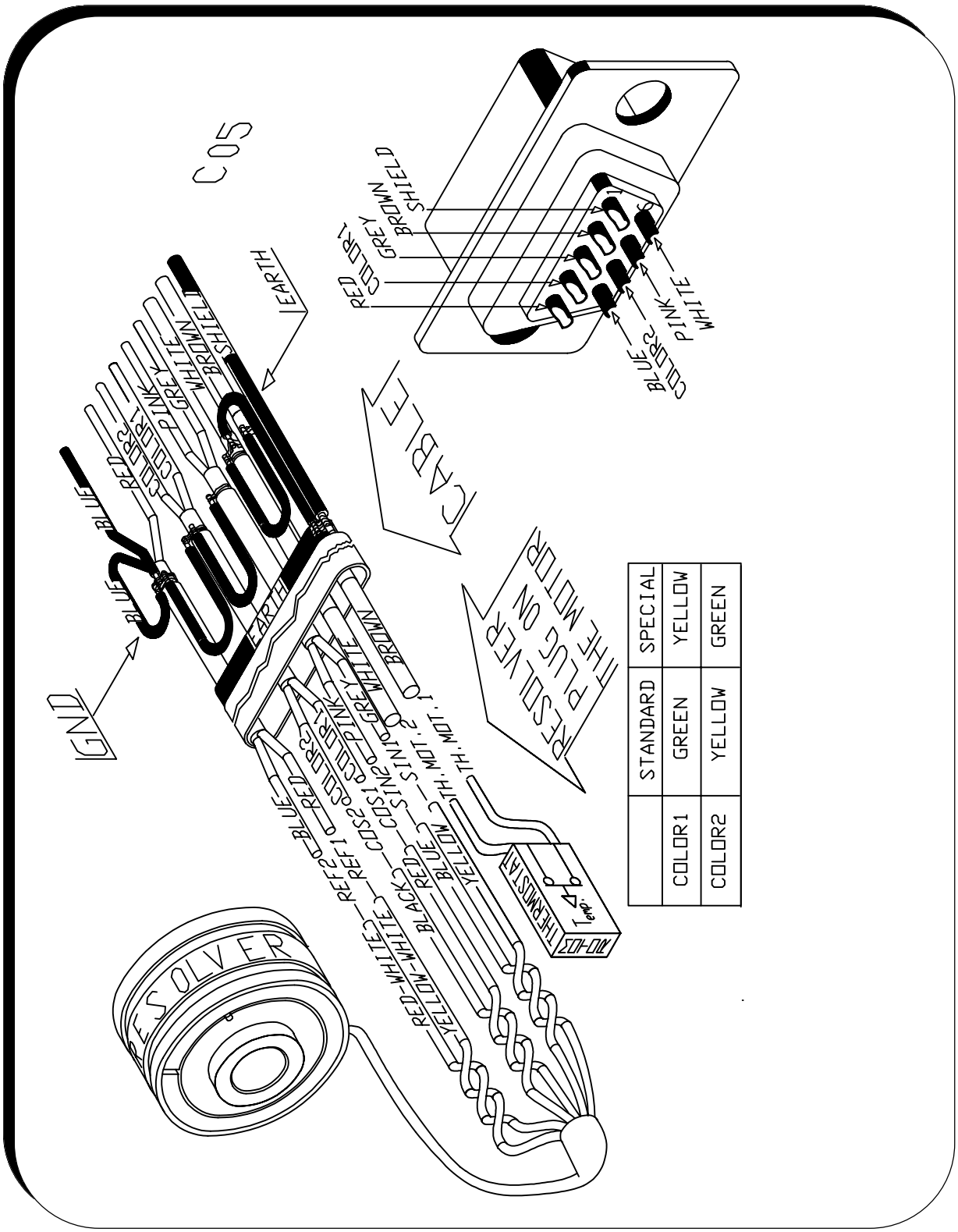


Fig 4 *:* Resolver and thermostat motor wiring

C.1.2.3.2 Control signal wiring

The signals necessary for the control of the servo-amplifier 1300 are assembled together on the connector CO4 :

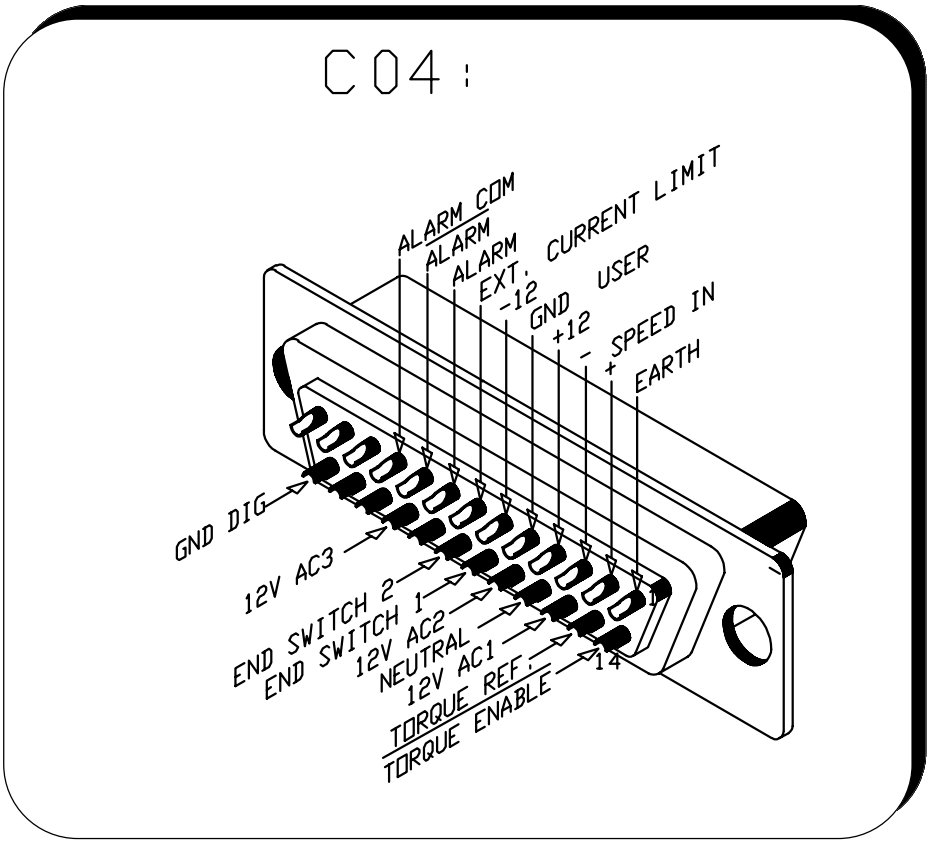


Fig 5 *:* Connector of the control signals

The relay "ALARM" of the servo-amplifier series 1300 is of type change-over contact. The breaking power of his contact is the following : **100 V - 0,5 A - 10 V A**

The relay state is given as follows :

State of the servo-amplifier	State of contact **ALARM - ALARM COM - ALARM/**	
not supplied	closed	open
supplied, operate normally	open	closed
supplied, malfunction	closed	open

PIN-OUT OF CONNECTOR CO4 (SUB-D 25 POLES)

Pin Nr.	Designation	Function
1	EARTH	speed command shield
2	SPEED IN +	input of non-inverted analogic speed command. level -10 V to +10 V
3	SPEED IN -	input of inverted analogic speed command. level -10 V to +10 V
4	+12 V	provided as a voltage source for use as a command reference (20 mA max.)
5	GND USER	common reference terminal for the +/- 12Vdc supply provided on Pins 4 and 6
6	- 12 V	provided as a voltage source for use as a command reference (20 mA max.)
7	EXT.CUR.LIMIT	external current limit, +10V corresponds to the peak current of the amplifier
8	ALARM	normally open contact when no faults are active
9	ALARM/	normally closed contact when no faults are active
10	ALARM COM	common point of the change-over contact
11		internal connected to the pin Nr. 13
12	N.C.	no connection
13		internal connected to the pin Nr. 11
14	TORQUE ENABLE/	contact closure between pins 14 and 15 will enable the amplifier transistor bridge
15	TORQUE REF	same as above
16	12 V AC1	external supply of the control board
17	NEUTRAL	external supply of the control board
18	12 V AC2	external supply of the control board
19	END SWITCH 1	end switch 1 in relation to pin Nr. 25
20	END SWITCH 2	end switch 2 in relation to pin Nr. 25
21	N.C.	no connection
22	12 V AC3	external supply of the control board
23	N.C.	no connection
24	N.C.	no connection
25	GND DIG	potential of digital reference (0V)

C.1.2.3.3 Incremental encoder signal wiring

The servo-amplifier provides simulated encoder outputs on connector CO6 :

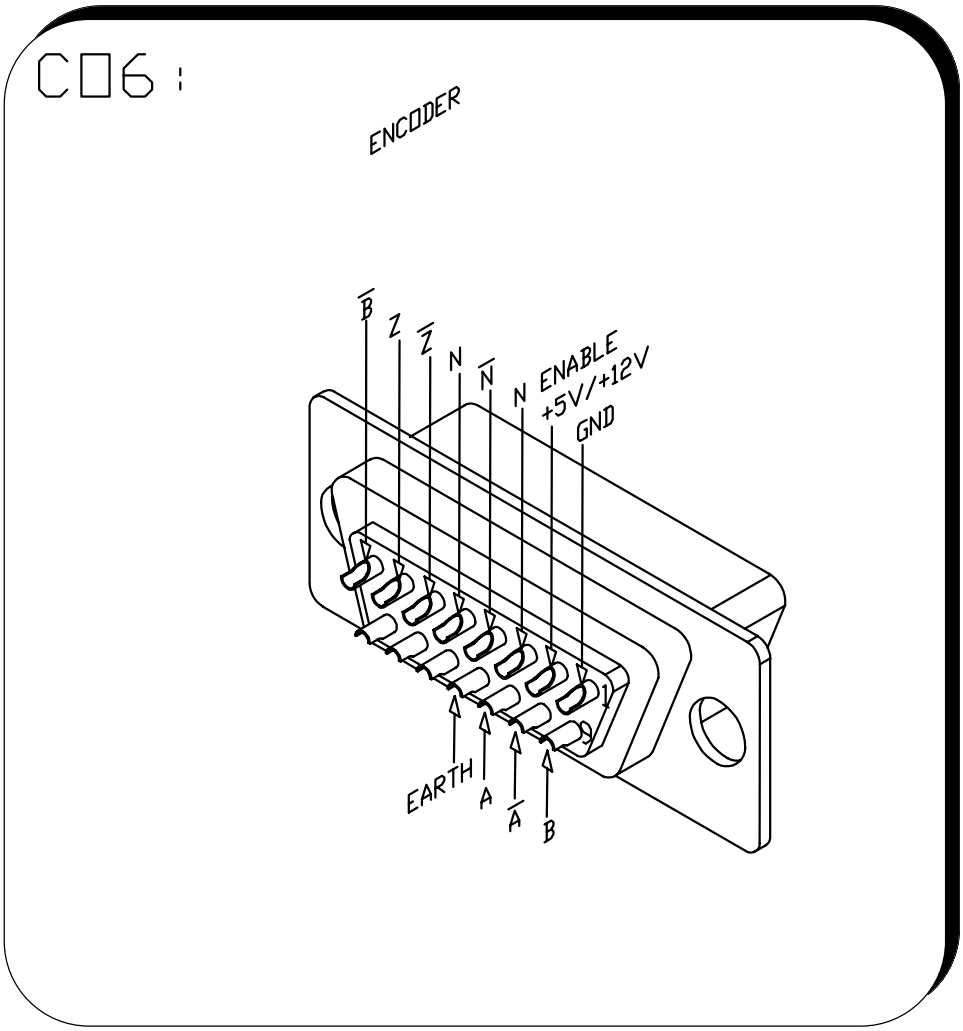


Fig 6: Connector of the simulated encoder outputs

The signals **A, A / B, B / Z, Z /** and **GND** are similar to the signals of an incremental encoder signal with differential outputs. The line driver used is type 75172. The line receiver of the position controller should be type **75175**.

These signals are always present and do not require any external supply.

The **GND** signal should be common to the position controller and to the servo-amplifier. The cable connecting the position controller to the servo-amplifier should be shielded with twisted pairs. The shield can be connected to the **EARTH**-Pin of the servo-amplifier.

The signals **N, N /, N enable** and **+5 V / + 12 V** supply are used to produce the zero pulse (N and N /) when a proximity switch is activated (coarse and fine zero functions).

Optical, inductive or Hall effect sensors can be used. The supply voltage is provided from the servo-amplifier (+12 V or + 5 V). The required voltage is selected by the jumper **"+12 V / +5 V USER"**.

Reference drawing is as follows :

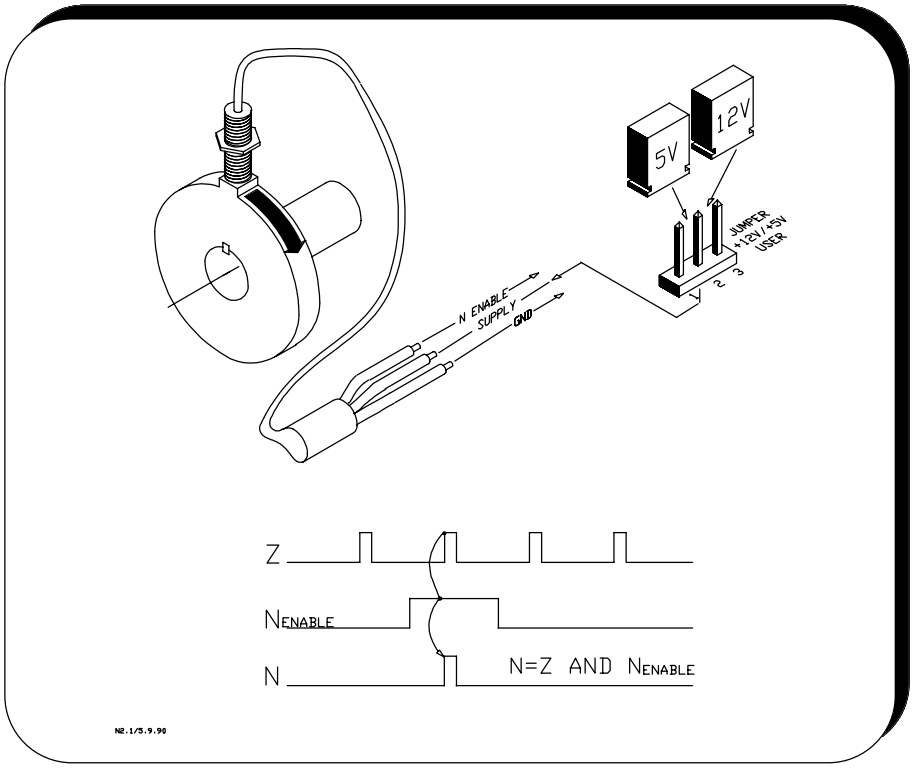


***Fig 7**:* Signals N, N/ and N ENABLE

PIN-OUT OF CONNECTOR CO6 (SUB-D 15 POLES)

Pin Nr.	Designation	Function
1	GND	0V for proximity sensor
2	+5 V / +12 V	proximity sensor supply, selection of the supply by jumper USER
3	N ENABLE	signal of the proximity sensor when the position is reached (input)
4	N/	output active at low level when the proximity sensor is active and when the zero impulse appears
5	N	reversed signal output of the pin Nr. 4
6	Z/	reversed zero impulse output, one impulse per motor turn.
7	Z	zero impulse output, one impulse per motor turn
8	B/	reversed impulse B output
9	B	impulse B output
10	A/	reversed impulse A output
11	A	impulse A output
12	EARTH	cable shield
13	N.C.	no connection
14	N.C.	special application
15	N.C.	special application

C.1.3 Transformer choice

The servo-amplifiers of the series 1300 are supplied either by :

- a 220V three-phase supply
- an isolating transformer
- an autotransformer

A dispositif in series with the supply lines has the function to limit the peak switching current and protect the rectifier bridge.

If the equipment is to be operated directly from the 220 V supply, it is necessary to insert a 4 mH three-phase choke between the network and the servo-amplifier.

The size of the mains transformer is approximatively calculated from the incoming power per axis.

Mechanical power :

$$P \text{ mech. (kW)} = \frac{\text{motor torque (Nm) x motor speed (rpm)}}{9550}$$

The power of the transformer in kVA should be about equal to the mechanical power if you leave out the motor efficiency.

C.2 SWITCHING THE SERVO-AMPLIFIER ON WITHOUT MOTOR

This first switching on should be done with the enable contact open (connector CO4, terminals 14 and 15), it means without active power stages. The resolver should be connected to the servo-amplifier.

The 3 phase motor must not be connected to the servo-amplifier.

C.2.1 Checking LEDS and 7 segment display

C.2.1.1 LED

"OVER I" red LED	normally off. This LED lights up during a short-circuit between two motor phases or a power stage fault.

The state of LED and the output stage inhibit are latched.

"Braking" yellow LED	normally off. This LED lights up when the braking module operate.

C.2.1.2 7 segment display on the front place

This display shows the state of the servo-amplifier and motor. The alarm C has the most priority (following 7,6,5 etc). If some alarms take place simultaneously, only the one with the higher priority will be displayed. A alarm reset is only possible by switching off the servo-amplifier supply.

servo-amplifier in function
enable contact closed

servo-amplifier in function
enable contact closed and zero position

servo-amplifier in function
enable contact open

servo-amplifier in function
enable contact open and zero position

continuous current limit reached

motor over temperature fault (alarm latched)

amplifier heatsink over temperature fault
(alarm latched)

resolver digital converter
out of function (alarm latched)

resolver feedback fault (alarm latched)

alarm indicated by the
power part

display of the point when the
motor turns clockwise

motor connection failure

C.2.2 Checking the electrical rotation sens of the resolver

The decimal point of the 7 segment display lights up when the motor shaft is turned clockwise.

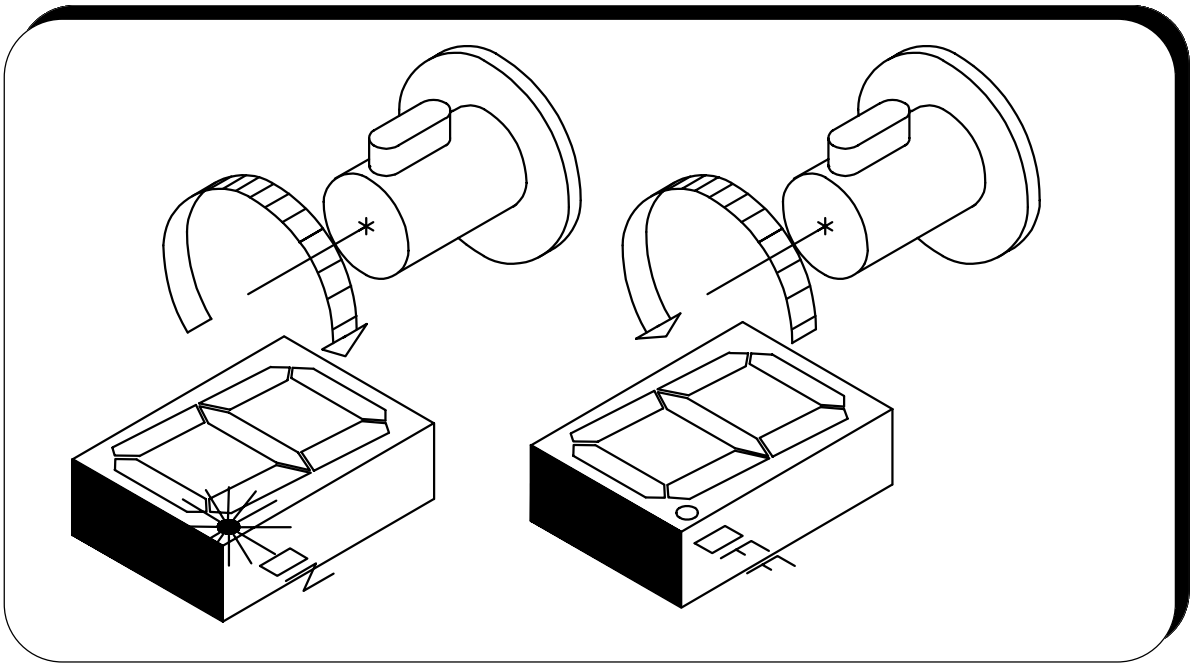


***Fig.8** :* electrical rotation sens of the resolver

If the decimal point lights up during anti-clockwise rotation, connections to CO5 connector Pin 4 (COS1) and 8 (COS2) must be reversed.

C.2.3 Determining the motor phases

This operation must be done only when the three-phase motor order is unknown (motor prototype or no documentation).

It is necessary to have a DC supply of about 3A.

The procedure is as follows :

1. Define arbitrarily the Phase **U** as one of the 3 motor phases.

2. Connect **U** to **"+"** and a **2nd phase** motor to **"-"** of the DC supply.

3. Switch supply on. The shaft will move to a stable position.

4. Mark the new shaft position with a pencil, at top dead center.

5. Disconnect the **"-"** of the supply from the **2nd phase** of the motor and connect the **"-"** to the **3rd phase** motor. Observe the axis rotation direction.

6. Mark with a pencil the new shaft axis position.

7. With the help of the table below, determine the 2 unknown motor phases :

sens of axis rotation	2nd phase	3rd phase
clockwise	V	W
anti-clockwise	W	V

C.3 SWITCHING THE SERVO-AMPLIFIER ON WITH MOTOR AND OPTIMIZATION

C.3.1 Preparation before switching the mains voltage on

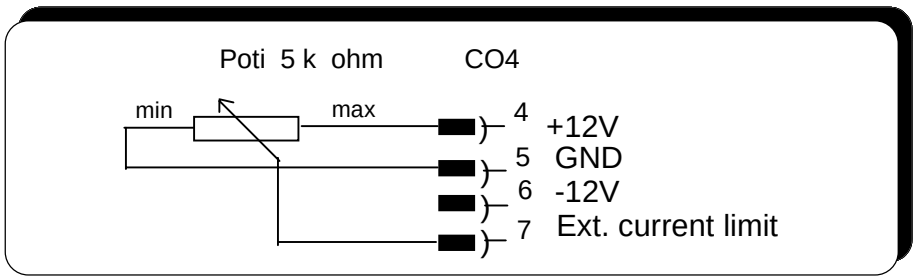
a) Disconnect motor from the machine.
The 3 phases motor should be again connected to the servo-amplifier.
Check if the axis is stopped and release the motor brake.

b) Check the following connections :

- motor cable / CO 1
- resolver cable / CO 5
- control signals cable / CO 4
- If used :
  cable for encoder simulation / CO 6

c) Reduce the max. current of the servo-amplifier using one of these two methods :

1) Input current limitation.
Construct the following circuit :



Set potentiometer in min. position.

2) Parameter **"Max. current"**

Program this parameter to 3.

d) Open the enable contact connected on CO4 between the pin 14 (TORQUE ENABLE) and 15 (TORQUE REF)

C.3.2 Switching the mains voltage on

a) Switch on the amplifier.

b) The 7 segment display should indicate "1".

c) Set a positive command speed voltage (about 1 V) to the servo-amplifier and close the enable contact. The 7 segment display shows "0".

d) If the current limitation is used, adjust the potentiometer in direction of the max. position or increase the **max. current** parameter untill the motor starts running.

If the motor doesn't turn or very slowly, check the two endswitch contacts.

e) Reverse speed command.
Check that the motor turns in the reverse direction.

f) Set the input current limit or **max. current** parameter to the initial state.
Save the **max. current** using the key <F2>.

C.3.3 Optimising

C.3.3.1 Compensating the speed controller

A correct operation of the motor over the whole speed range can be obtained by the optimising the **Proportional Gain** and **Integral Gain** parameters.

Connect the P.C. to the amplifier. Start the configuration program :

1. Program the 2 gains at 10 (low gains).

2. Connect an oscilloscope between measuring points **"SPEED MONITOR"** and **"GND"**.

3. Switch on the servo-amplifier and close the enable contact.

4. Apply a low command speed voltage (<100 m V)

5. Increase the value of the **Integral Gain** parameter in view to answer to the following requirements :

a) good static torque
b) smooth shaft rotation

6. Check the oscilloscope signal after reference step of about 2V. Several results can occur :

a) The signal shows several oscillations	:	in this case, increase **Proportional Gain** value
b) The motor is noisy	:	in this case, decrease **Proportional Gain** value
c) The signal shows only one small overshoot	:	in this case, the speed loop is optimized

7. When the condition **6 c)** is achieved, save the gains obtained with key <**F2**>.

C.3.3.2 Offset and speed compensation

a) Offset compensation

The offset is compensated with the potentiometer **"OFFSET"**.

The setting of the offset should be done without the position controller, **Automatic Offset Control** parameter switched off (OFF).

If the offset correction must only support the whole CNC and the servo-amplifier, assign a zero command speed from the CNC and adjust potentiometer **"OFFSET"** to obtain a zero speed on the motor.

b) Speed compensation

The **Speed factor** parameter allows adjustment of the motor speed from - 6000 t/mn to + 6000 t/mn.

Press the <F2> key to save the **Speed factor** parameter.

C.4 TROUBLE SHOOTING

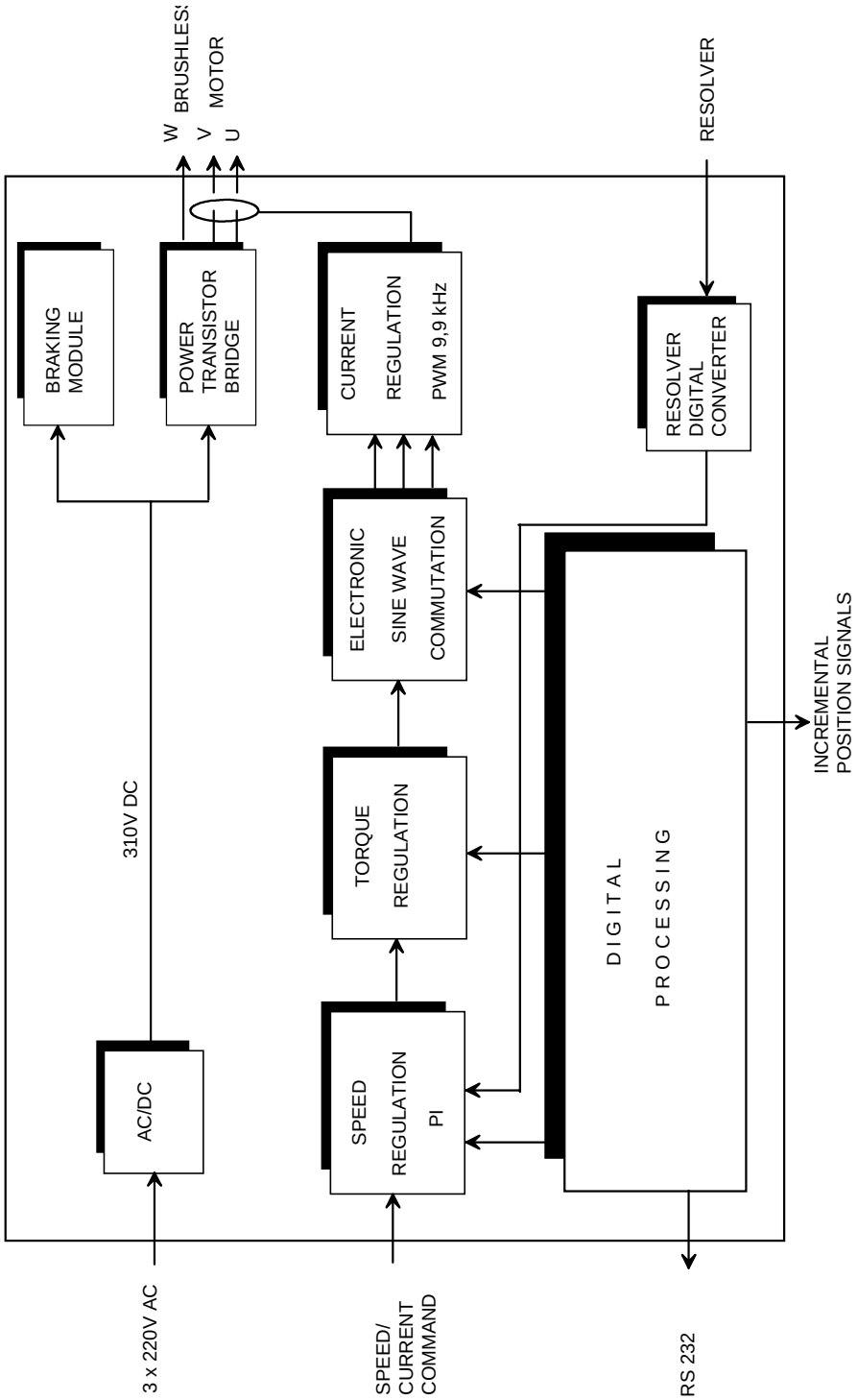
The following table shows the most frequent troubles and their causes.

No	Trouble	Possible cause
1	LED "OVER I" switched on	- short-circuit between 2 motor terminals
2	Display 2	- limit of continuous current reached - **Resolver Shift Angl**e parameter misadjusted
3	Display 3	- motor overloaded - miswired or loose connection of wires for motor thermal switch
4	Display 4	- servo-amplifier overloaded - cooling fan failure
5	Display 5	- resolver conversion circuit failure - **Resolver Shift Angle** parameter misadjusted
6	Display 6	- resolver failure - resolver wiring failure
7	Display 7	- appears with OVER I LED - brake fuse failure or missing - appears in case of overvoltage or supply missing

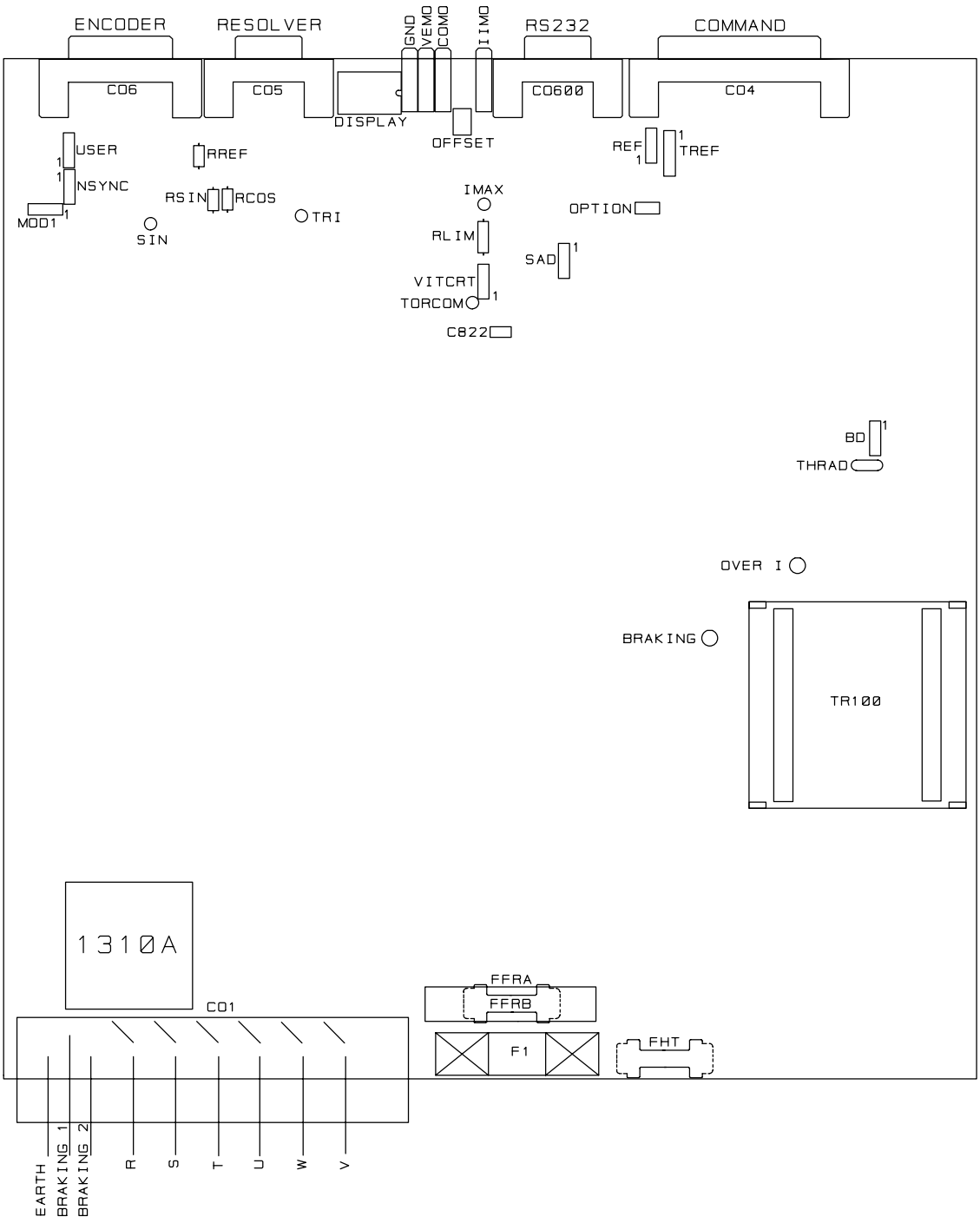
C.4 TROUBLE SHOOTING

No	Trouble	Possible cause
8	Display C	- motor connection failure
9	Motor doesn't turn in display 0 when speed command is applied	- endswitch enabled - max. current of servo-amplifier limited too low - motor brake engaged - speed reference short-circuited by **REF** jumper
10	motor rotation is not smooth	- **Motor pole pairs** parameter misadjusted - Motor wiring on terminal U, V, W not in the correct sequence
11	motor turns in wrong direction	- wrong polarity of the speed reference Reverse wiring of CO4-2 and CO4-3 and move jumper REF or reverse **Speed factor** parameter

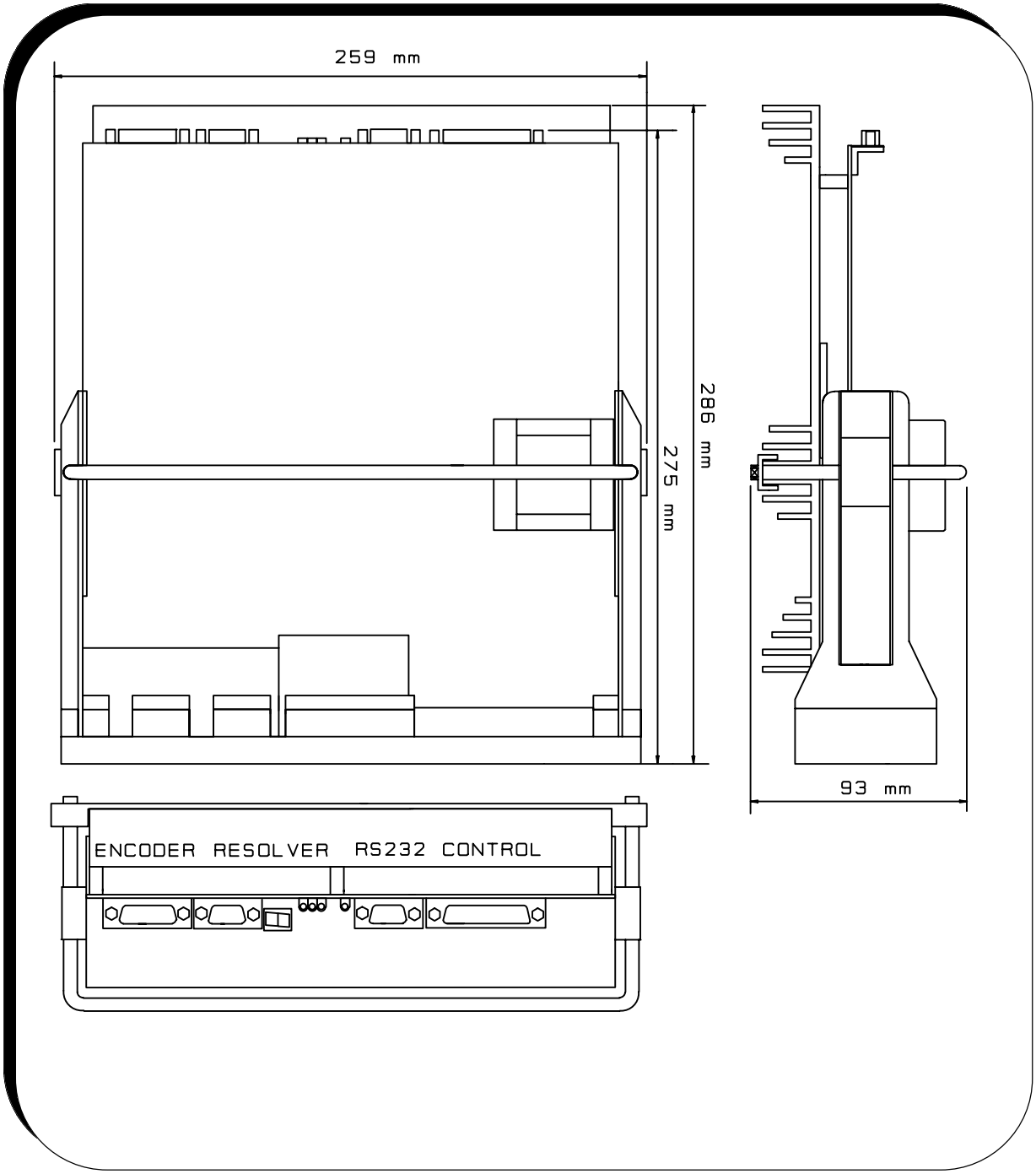
D.1 BLOCK DIAGRAM



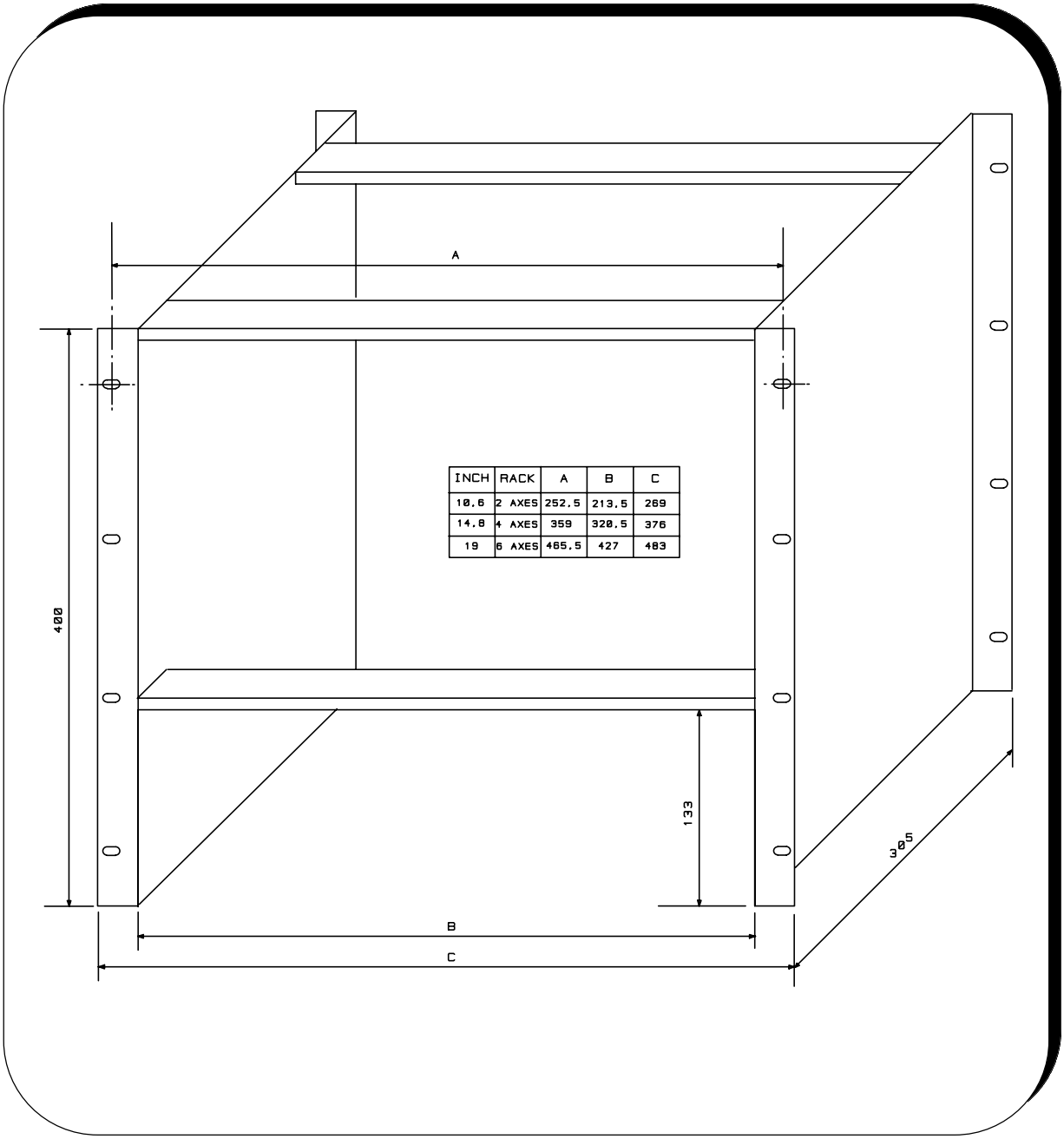
D.2 LAYOUT OF CONTROL BOARD



D.3 DIMENSIONS OF MONOBLOC VERSION



D.4 DIMENSIONS OF RACK VERSION



INCH	RACK	A	B	C
10.6	2 AXES	252.5	213.5	269
14.8	4 AXES	359	320.5	376
19	6 AXES	465.5	427	483