



ALTER ELETTRONICA S.R.L.  
CASALE MONFERRATO (Italy)

THREE – PHASE THYRISTOR  
CONVERTER  
DC MOTOR DRIVER  
SERIE C  
MODELS  
**6AXC-6IC-12IRC-12SPC**

## GENERAL FEATURES

The series of thyristors drives, this book has been conceived for, is formed by the following types:

- 6AXC** Armature feed by double star bridge (4 quadrants)
- 6IC** Armature feed by total controlled Graetz bridge (1 quadrant)
- 12IRC** Armature feed by double Graetz bridge (4 quadrants)
- 12SPC** Armature feed by double Graetz bridge (4 quadrants)  
Field feed by half-controlled single-phase Graetz bridge.

The 6AXC drivers are suitable to control the N.C. machine-tool motors-axes and when is necessary to control accurately the motor speed (until motor stop) and have high response to the control.

The connection to three-phase mains is by  $\Delta Y$  transformer with accessible central tap.

The 6IC drivers allow a single direction of the motor with no possibility for load braking.

The 12IRC drivers are suitable for the applications where both senses of rotation of the motor are required, as well as load braking.

The 12SPC drivers are suitable to control machine-tools spindle motors and coilers or decoilers.

These drivers control both armature and field and the motor can work whether in constant torque and in constant power mode.

The drivers type 6IC-12IRC-12SPC are connected to three-phase mains by interposing a three-phase inductor (out of the driver) to reduce the spikes caused by the thyristors operation.

The drivers type 6AXC-12IRC-12SPC permit the motor and load braking with energy recovery to mains. So it is possible to let the motor work as a brake for as long as required.

The following features are the same for all types:

- Modular design and types interchangeability.
- Reduced number of spare parts for repair.
- Front accessibility to all electric and electronic parts.
- Protection of thyristors by follow:
  - thermomagnetic circuit breaker built-in the driver (MT Option)
  - ultrafast fuses built-in the driver (FI Option)
  - ultrafast fuses out of the driver (FE Option)
- Electronic control circuits on one mother board with plug-in cards.
- Easy visual diagnosis of the operations.
- Dinamic braking on the resistance for the types 6AXC-6IC-12IRC (Optional)
- Control circuits insulated from three-phase mains.
- Field supply for the types 6AXC-6IC-12IRC (Optional)

## TECHNICAL FEATURES

- Modular structure to vertical fixing on the panel board.
- Degree of protection: IP20.
- Power connections to terminal strip.
- Signal connections to screwed connector.
- Control circuits supply:  
220Vac  $\pm 10\%$  100mA max 50/60Hz (110Vac  $\pm 10\%$  200mA max OPTIONAL)
- Armature supply:
  - three-phase grounded neutral 380Vac  $\pm 10\%$  50/60Hz for types 6IC-12IRC-12SPC
  - by transformer  $\Delta Y$  with accessible star point for the type 6AXC.
- Field supply:
  - single-phase from mains or transformer
  - single-phase from insulation transformer only for the type 12SPC.
- Ventilation:
  - natural for armature rated current up to 50A
  - by built-in fan for armature rated current higher than 50A.
- Storage temperature:  $-20/+60^{\circ}\text{C}$  ( $-4/+140^{\circ}\text{F}$ )
- Operating temperature:  $0/+40^{\circ}\text{C}$
- Maximum altitude: 1000 m (3280 feet) a.s.l.
- Speed control by tachometer or by armature voltage with speed drop compensation (not for type 12SPC).
- Monitoring by:
  - RED LEDs** normally light for faults.
  - GREEN LEDs** normally off for logic signals
  - TEST POINTS** for analog signals.
- Output signal " **DRIVE O.K.**" by N.O. relay contact  
(breaking capacity: 110Vac 200mA max)
- Motor braking in case of driver faults (only with dynamic braking option).
- Internal protection against wrong command sequences.
- Differential input stage for analog speed reference  
(input resistance: 10Kohm).
- Outputs +10V  $\pm 5\%$  and -10V  $\pm 5\%$  5mA max.
- Output +24V  $\pm 20\%$  50mA max.
- Output for armature current indicator (+10Vmax 5mA max.) (OPTIONAL)
- Adjustments contained on the personalization card.  
If it is necessary to replace all the cards or the complete driver,  
is enough to shift this card. No further adjustments are necessary.
- Possibility to plug-in the acceleration and dec. ramp card (OPTIONAL)
- Possibility to plug-in a card with auxiliary functions to satisfy some  
special requirements, in such a way versatility of the driver is enlarged  
without introducing new elements in electrical cabine.

## OPTIONAL CARDS

**01/092** Ramp speed reference generator with separate setting of acceleration and deceleration times.

The enabling is made by outside control RA.EN.

The acceleration/deceleration times are setted by the R.T.AD. and F.T.AD. trimmers.

NOTE: To use the card is important that the X12 jumper on the 01/095 card (PERSONALIZATION) is not mounted.

**AUX** Are cards with particulars functions.

To use these cards please see the respective instruction books.

## OPTIONS

**CAR** Voltage output proportional to the armature current.  
(Max.output voltage 10Vdc, max.current 5mA)

## ELECTRONIC CIRCUITS PROTECTION FUSES

They are placed on the higher left side of the card 01/100.

FUSE CODE	PROTECTION	SIZE	CURRENT
F1 F2	INPUT 110Vac 222Vac	5 X 20	1 A 500 mA
F3	+15V SUPPLY	5 X 20	500 mA
F4	-15V SUPPLY	5 X 20	500 mA

## ARMATURE SUPPLY THREE-PHASE BRIDGE PROTECTION FUSES

CONVERTER RATED CURRENT	FUSES RATED CURRENT	ULTRA FAST FUSES Max $I^2t$ at 25°C 10ms [ $A^2s$ ]
15 A	25 A	1,100
30 A	40 A	1,100
50 A	63 A	5,000
80 A	100 A	13,000
110 A	160 A	20,000
160 A	250 A	20,000
250 A	350 A	145,000

## FIELD SUPPLY SINGLE-PHASE BRIDGE PROTECTION FUSES

CONVERTER RATED CURRENT	FUSES RATED CURRENT	SIZE
UP TO 15 A	15 A	5 X 20
FROM 15 TO 20 A	25 A	10.3 X 38

## SETTING AT WORK

Accurately check that:

- The driver underwent no damage while the transport or the set up.
- The supply voltages correspond to that indicated on the motor plate.
- The connections correspond to that indicated in this instruction book.
- The ground connections not form closed loops.
- Spykes suppressors (RC snubber for ac supply and diodes for dc) are mounted in parallel to the coils of: remote control switches, relays, selenoid valves, clutches, brakes, and single or three-phase ac motors.
- There is an enough room for a good vertical air circulation.

Carry out the following setting:

- Mains frequency 50/60Hz.  
The driver is setted by the manufacturer for 50Hz.  
The setting to 60Hz may be made cutting:  
the X1-X2-X3-X13 jumpers on 01/095 (personalization) card.  
the X31-X32 jumpers on 01/101A card (for 12SPC model only).  
NOTE: Be careful during the taking out or the plugging-in of the cards on the connectors of the mother card 01/100.

## STARTING PROCEDURE

- **Switch on the service supply** and check that the fun running (if mounted).  
All red leds must be light apart from:  

3 PHASE LINE      BRAKE DISABLE      DRIVE OK
- **Connect to mains** checking the ignition of red leds previously off.  
NOTE: The DRIVE OK led must be on 1 sec. after the other two.
- **Close the COEN outside contact** (converter enable) making sure that the speed reference is zero and the motor is stopped.
- **Give a low value speed reference** and check that the rotation sense of the motor is those that you want.  
If the rotation sense is opposed to those wanted, must reverse the armature or motor field and the T.G.connections.  
In the case of stopping of the driver (TACHO OK led out) check the connection and the polarity of the T.G. signal.  
NOTE: The modification of the connections must be made always without any supply to the converter.

## STOPPING PROCEDURE

- **Open the COEN outside contact.**
- **Disconnect the converter from mains.**
- **Switch off the service supply.**

**NOTE:** The starting and stopping procedures must be always respected also during the normal operation of the converter.

## ADJUSTMENTS

For better understand the operations to follow, is necessary do reference always to the speed and current loops diagram.

The follow adjustments must be effectued if the driver is regulary working and after the SETTING AT WORK operations.

The regulation trimmers and test points are mounted on the 01/093A and 01/095 cards and are accessible through the fissure on the driver frontal panel.

The CLOCKWISE rotation of the trimmer's regulation screw correspond to the increase of a correspondant function.

The negative probe of the voltmeter and the oscilloscope ground must be connected to the test point indicated by  $\perp$  mounted on the 01/093A card.

### NOTE:

- Regulations and measures must be made without removing the frontal panel of the driver.
- Make use of totally insulated screwdriver for the trimmer's regulation.
- The trimmer's regulation screw sealed with enamel mustn't be moved.
  
- Setting of the MAX ARMATURE CURRENT delivered by the driver:  
Adjust the C.L.AD. trimmer and check the voltage on CU.RE. test point.  
10V on CU.RE. test point correspond to the rated current of the driver.
- Setting of the OUTSIDE INDICATOR OF THE ARMATURE CURRENT:  
Adjust the CM.AD. trimmer to obtain the required value on the measuring instrument.
- Zero setting of the SPEED OFFSET:  
Adjust the  $\emptyset$  SPE trimmer to stop the slow rotation of the motor shaft with zero speed reference.
- Setting of the MAX SPEED:  
Adjust the SP.AD. trimmer to obtain the speed wanted with a max.input speed reference.
- Adjustment of the ROTATION STABILITY:  
Adjust the STAB. trimmer to obtain from the motor a prompt reply without overshoot to a step speed reference.
- Adjustment of the COMPENSATION OF THE SPEED DROOP:  
Adjust the AR.CO. trimmer to compensate the speed droop from loadless to full load at the operation with armature voltage feedback.
- Setting of the RISE AND FALL TIMES:  
Adjust the rise time by the trimmer R.T.AD.  
Adjust the fall time by the trimmer F.T.AD.  
A checking of the speed ramps is possible on the TP RAMP OUT.  
The reference voltages for the rise and fall ramps generator are respectively on TP A.REF. and D.REF.

## SIGNALS ON TEST POINT (T.P.)

### CARD 01/092

FT.REF. Deceleration reference for the speed ramp generator.  
RT.REF. Acceleration reference for the speed ramp generator.  
RAMP OUT Speed ramp output signal 10V max.

### CARD 01/093A

⊥ Zero volt.  
+24V Inside supply +24Vdc  
+15V Stabilized inside supply +15Vdc  
-15V Stabilized inside supply -15Vdc  
CU.MO. Signal for armature current indicator  
SP.RE. Speed reference differential amplifier output 10V max.  
CU.RE. Reference for armature current limiter  
(+10V corresponds to the rated current of the driver).

### CARD 01/095

TACH. Voltage supplied from the tachogenerator.  
AR.VO. Voltage proportional to the motor armature voltage.  
100V on the armature correspond to 1V on T.P.  
(50V on the armature correspond to 1V on T.P. for type 6AXC only).  
AR.CU. Voltage proportional to the armature current.  
1V correspond to the driver rated current for current up to 110A.  
0.6V correspond to the driver rated current for current more than 110A.

### CARD 01/101A

FL.CU. Voltage proportional to the field current of the motor.  
Voltage on T.P. for different rated current of the drivers:  
40mV/A for field rated current 2,5A  
20mV/A for field rated current 5A  
10mV/A for field rated current 10A  
5mV/A for field rated current 20A

## REGULATION TRIMMERS

### CARD 01/093A

∅ SPE ZERO SPEED Zero setting of the speed offset.

### CARD 01/095

R.T.AD. RAMP TIME ADJ RISE. Adjustment of rise time of speed ramp.  
F.T.AD. RAMP TIME ADJ FALL. Adjustment of fall time of speed ramp.  
SP.AD. SPEED ADJ. Adjustment of max speed.  
CL.AD. CURRENT LIMIT ADJ. Adjustment of max. armature current.  
C.M.AD. CURRENT MONITOR ADJ. Adjustment of the armature current output.  
AR.CO. ARMATURE COMPENSATION. Compensation of the speed droop from loadless to full load at the operation with armature voltage feedback.  
STAB. STABILITY Stability adjustment of the speed loop.

## WARNING LEDS

NOTE: These leds (red) are off only in fault condition.

### CARD 01/097

3 PHA. 3 PHASE LINE  
Presence of the three-phase mains.  
(it is OFF when one or more mains phases are out).

TA.OK. TACHO. OK.  
Presence and right polarity of the T.G. signal. (STORED)  
To reset this signal take off the services supply.

BR.TE. BRIDGE TEMPERATURE OK.  
Armature bridge temperature under the highest allowable value.

BR.DI. BRAKE DISABLE.  
Disabling of the DYNAMIC BRAKING circuit.

± 15V Presence of stabilized supplies +15V and -15V.

DR.OK. DRIVE OK.  
No fault in the driver.  
This led is ON about one sec. after the ignition of all other  
warning leds and it turns off when turning off one or more warning  
leds.  
Only when this led is ON, the outlet contact OKD1-OKD2 is closed.  
When this led is OFF, the driver is disabled and the motor is  
not controlled.

### CARDS 01/101 AND 01/107

FIELD OK. Presence of the motor field current.

## SIGNALING LEDS

NOTE: These leds (green) are ON when the correspondant signal is ON.

### CARD 01/092

RA.EN. RAMP ENABLE  
Enabling of the speed ramp.

### CARD 01/097

CO.EN. CONVERTER ENABLE  
External enabling control of the driver.

BR.EN. BRIDGE ENABLE  
Enabling of thyristors firing.

### CARD 01/098

BRIDGE BRIDGE ON  
ON Presence of firing of thyristors.

### CARD 01/101

RE.MO. REGENERATIVE MODE  
Regenerative operation of the driver.

BRID.OFF BRIDGE OFF  
Disable of the braking bridge.

CO.P.R. CONSTANT POWER RANGE  
Operation of the motor at the constant power range.



## INPUT/OUTPUT CONNECTORS

The connectors are on the upper side of the mother card 01/100.  
To use them see the connection diagrams.

ACS 1-2	Input services supply 110/220Vac $\pm 10\%$ 200/100mA 50/60 Hz.
GND.	Common of all supplies.
OKD.1-2	Relay contact which is closed when the driver regularly working. (NO ALARM)
COEN	Driver enable. (It is ON if connected to GND)
RAEN	Enabling of rise and fall ramp. (It is ON if connected to GND)
+24V	Output + 24V 50mA max.
TAKO	Input T.G. signal. (Connected only to control the speed by T.G.)
+10V	Output + 10V 5mA max.
-10V	Output - 10V 5mA max.
REFL	Cold input for the speed reference (10V max).
REFH	Hot input for the speed reference (10V max).
CUMO	Output for armature current indicator (+10V max. 5mA max.).

## REPLACEMENT OF THE ELECTRONIC CARDS

All drivers with rated current up to 110A utilize the mother card 01/100.  
All drivers with rated current more than 110A utilize the mother card 01/100B.  
The mother card must be replaced with another of the same type.  
The card's number is on the right lower corner of the same card.

All adjustments for the normal working of the driver (without cards AUX), are contained on the card 01/095.

To replace the mother card or the driver, is enough to plug-in the card 01/095 (taken out from the mother card replaced) on the connector of the new mother card.

No adjustments or settings on the cards are necessary, except on the card 01/098 when it is used on the driver type 6AXC.

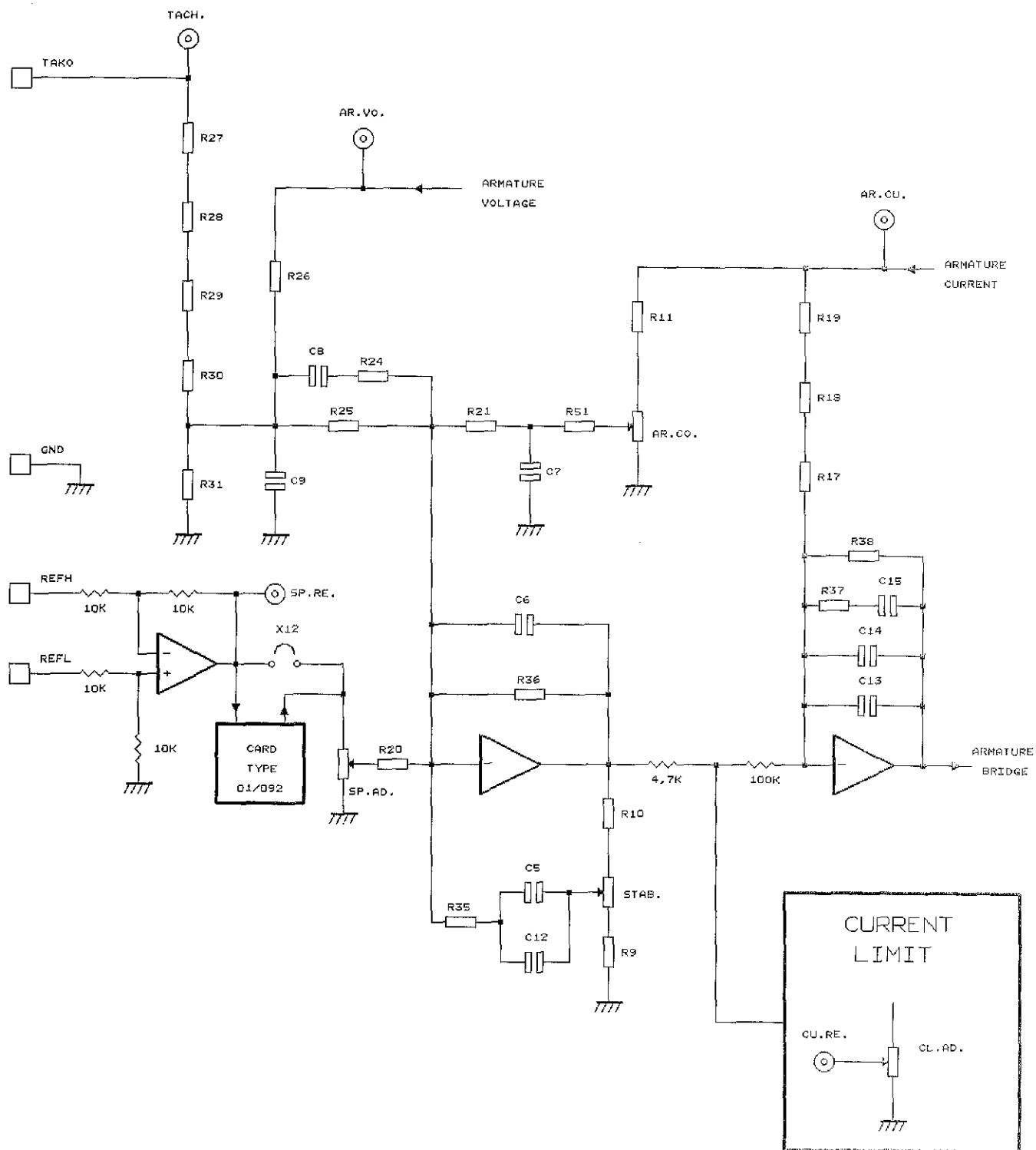
In this case on the card mustn't be mounted the IC coded M1  
(if it is mounted take it out from the socket).

The settings of the cards AUX are on the same cards so, in case of replacement, they must set again.

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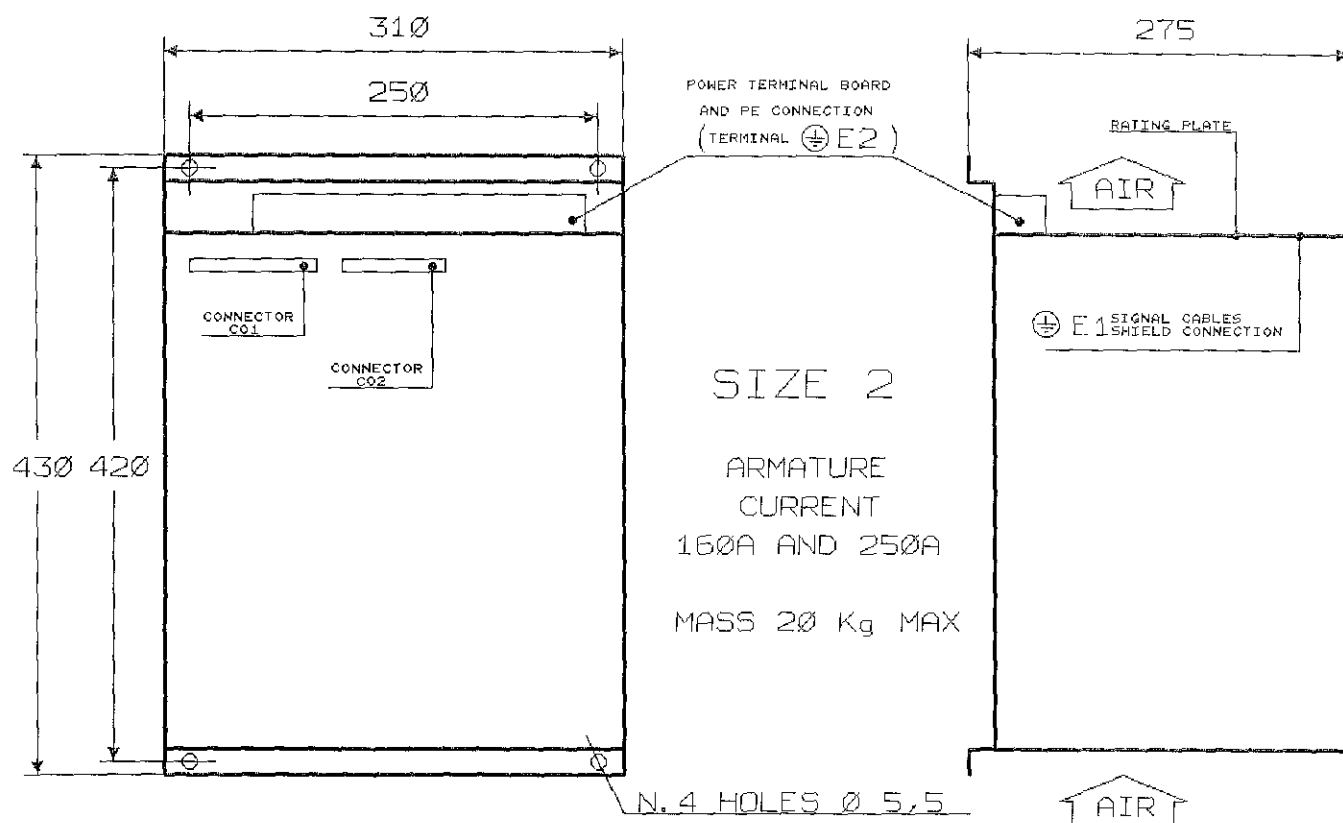
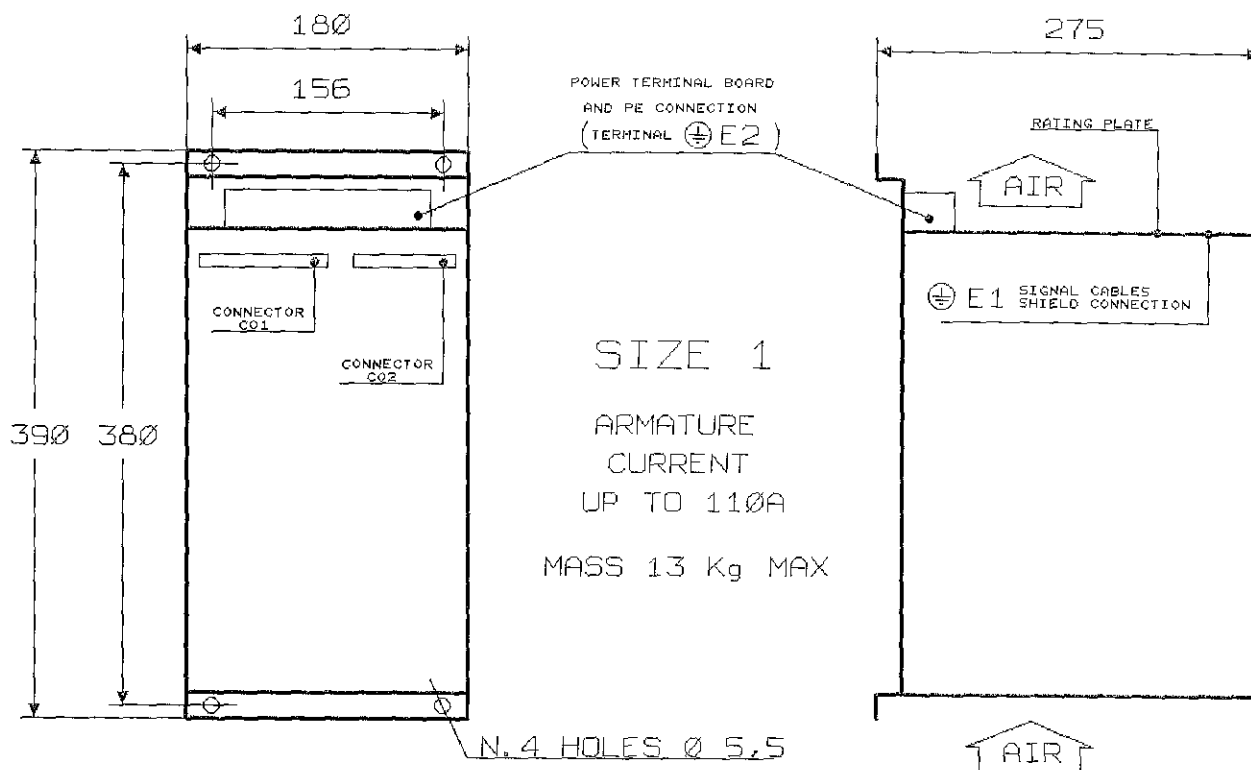
**The contents of this book are subject to modifications without notice.**

## SPEED AND CURRENT LOOPS



RESISTORS, CAPACITORS AND TRIMMERS ARE LOCATED ON THE CARD TYPE 01/095

## DIMENSION AND WEIGHT

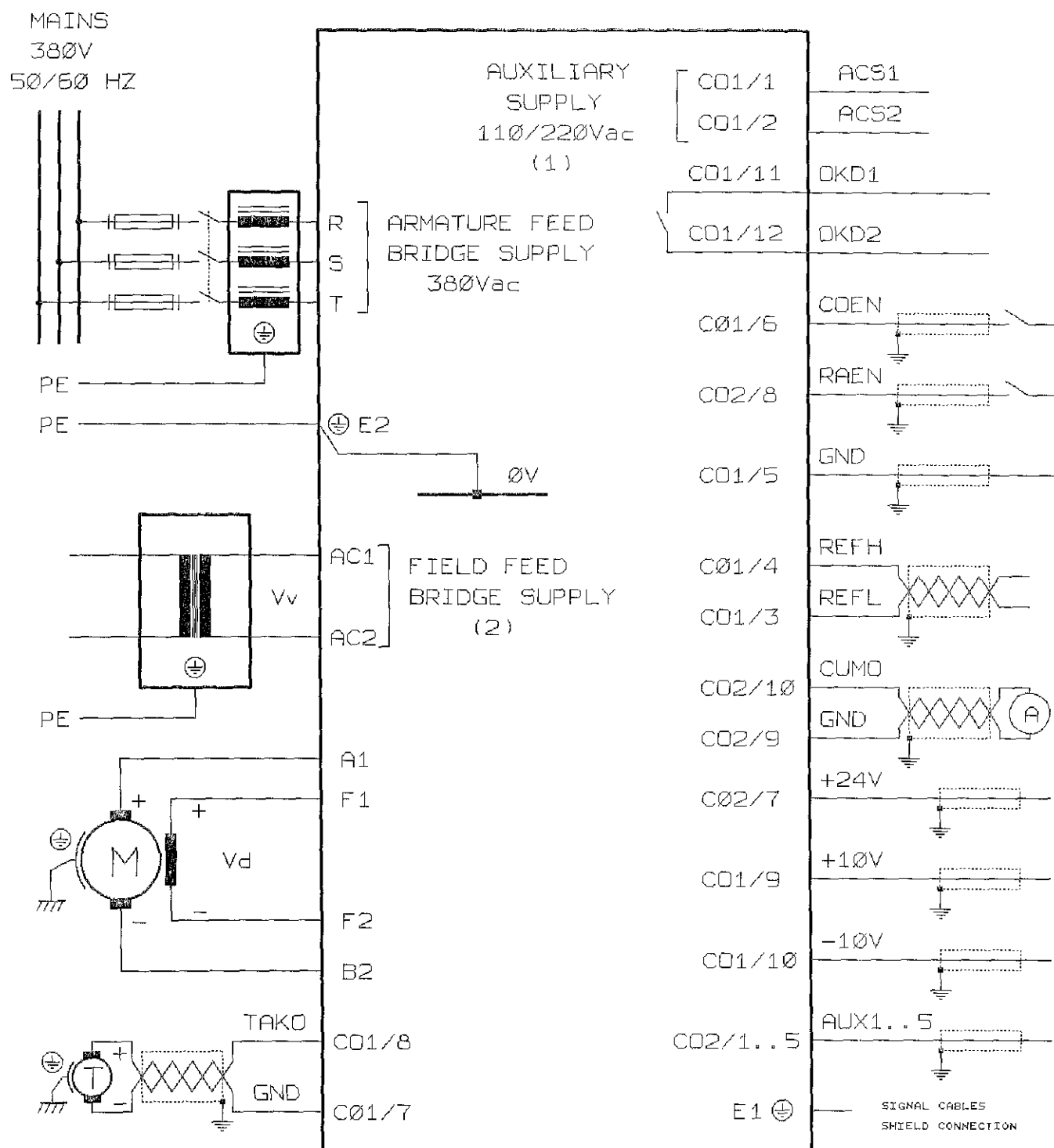


DIMENSION [mm]

# OUTSIDE CONNECTIONS FOR MODEL

6IC - 12IRC - 12SPC

WITH POSITIVE SPEED REFERENCE AT INPUT REFH  
MOTOR AND TACHOGENERATOR POLARITY ARE THAT SHOWN IN THE DIAGRAM



## NOTE

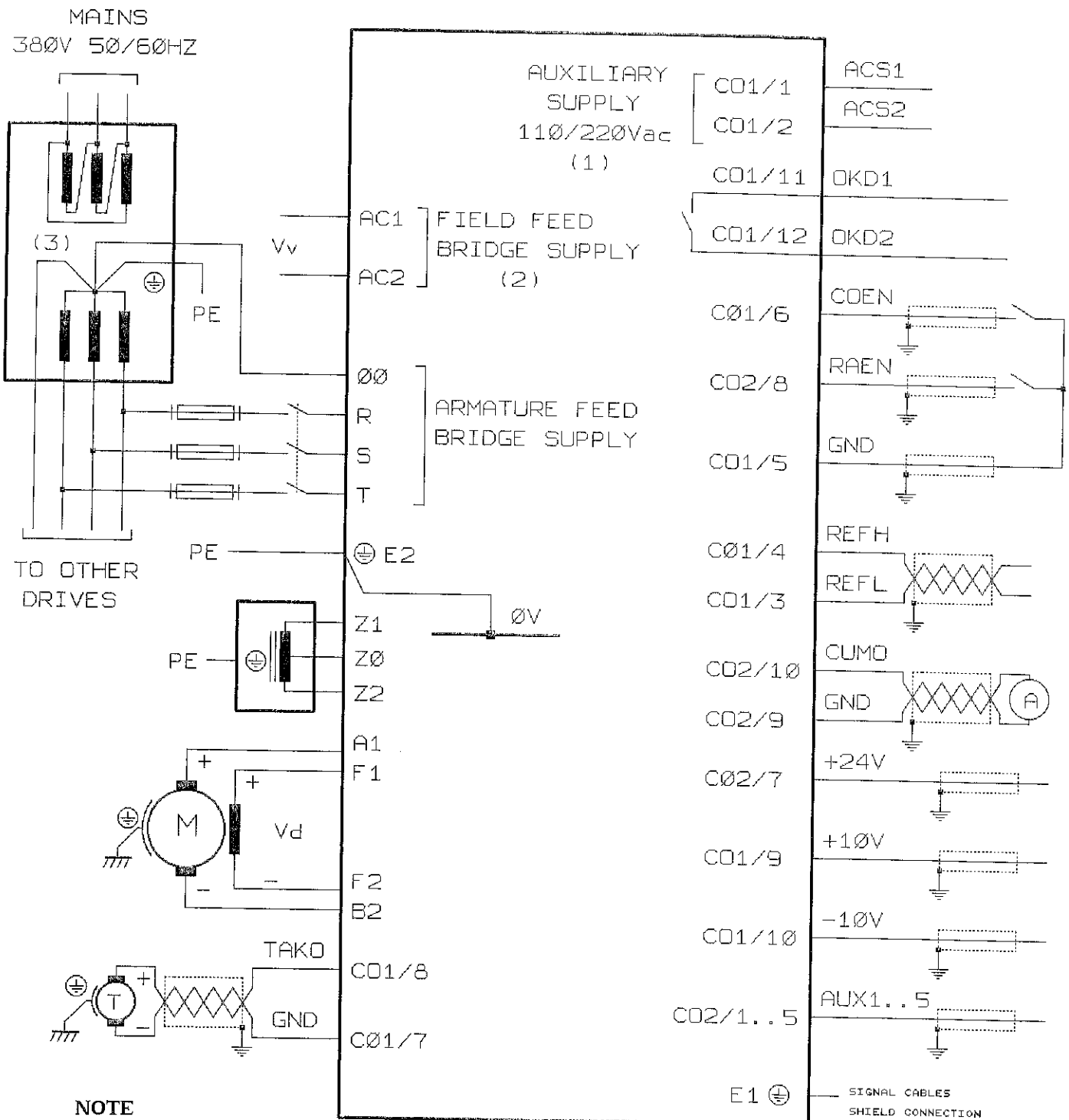
- (1) please see page 2
- (2)  $V_v = 1.1 \times V_d$  (380Vac max)

FOR DRIVE MODEL 12SPC THE FIELD FEED BRIDGE SUPPLY MUST BE MADE ONLY BY TRASFORMER

# OUTSIDE CONNECTIONS FOR MODEL

6AXC

WITH POSITIVE SPEED REFERENCE AT INPUT REFH  
MOTOR AND TACHOGENERATOR POLARITY ARE THAT SHOWN IN THE DIAGRAM



## NOTE

- (1) please see page 2
- (2)  $V_v = 1.1 \times V_d$  (380Vac max)
- (3) THE CONNECTION TO GROUND OF THE STAR POINT IS ESSENTIAL FOR DRIVE OPERATION

# ANALOG CONNECTION EXAMPLES

