APPLICATION MANUAL

• 15P0060B2 •

CTM90

FULL DIGITAL, FULL CONTROL UNIDIRECTIONAL
AC/DC THREEPHASE CONVERTERS

16/06/98
SOFTWARE VERS. C1.04÷1.16 R.01 English

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STARTUP BASE PROCEDURE

This section describes the main checkings and operations to be performed to obtain a proper adjustment of the CTM90 drive. The User is supposed to be familiar with the keypad: if not, refer to the section *KEYPAD AND ALPHANUMERIC DISPLAY* .
The aim of this section is just to give a track to be followed so as to perform a correct startup: for further details on the functions of the various hardware terminals or software parameters, etc., see the corresponding sections contained in this manual.
In particular, always refer to the sections *POWER AND SUPPLY CONNECTIONS* and *SIGNAL CONNECTIONS* for a proper use of hardware terminals, and to the section *PARAMETER LIST* for a correct setting of software parameters.

1. PRELIMINARY CHECKINGS

1.1 When installing, check that the mains rated voltage is included within the **preset supply voltage range**, which can be obtained from the document located inside the adhesive pocket on the drive side.
In the standard configuration, the drive can be supplied by a voltage included within 380÷415V_{ca} / 45÷65Hz.

⚠ If the three-phase supply is not delivered by the mains but through a **power unit**, it may be necessary to set **parameters #88** (max. allowed frequency change) and **#89** (delay in A03 alarm writing for unstable frequency), whose default values are 1Hz/s of alarm threshold and the immediate alarm tripping as well.

1.2 Check that the **drive size** is not oversized as regards the motor rated current: this current should not be lower than 70% approx. of the drive rated current.

1.3 Accurately check the wiring, always referring to the sections *POWER AND SUPPLY CONNECTIONS* and *SIGNAL CONNECTIONS*, contained in this manual.

⚠ If, for tacho generator feedback only, the **galvanic insulation of analog circuits** is required on the ES600 control board as regards the supply three-phase mains, remove the jumpers J1 and J2 located on this board (see section *ES600/3 CONTROL BOARD LAY-OUT*).

⚠ If the **galvanic insulation of digital inputs** is required on the ES600 control board, using an external supply voltage 0 - 24V_{CC}, remove the bridges BR2 and BR3 located on that board (see section *ES600/3 CONTROL BOARD LAY-OUT*).

1.4 According to the V_{EC} **direct voltage required for excitation**, check that the alternate voltage value available to supply terminals 39 and 40 is set to $V_{EA} = V_{EC} \cdot 1.11$.
This checking is not necessary if an **external field de-energizing unit** is used: the following refers to our type **DF2**.

1.5 Cut out the supply on the alternate side of the excitation circuit input to terminals 39/40 (removing the fuse of one phase at least), then disconnect and shortcircuit the cables previously connected to terminals 43/44, **so as to cut out the field lack alarm**.
If an **external field de-energizing unit** is used, just *remove the jumper SW2*, located on the ES536 board of DF2, if it is set to I, or keep the contact between terminals 10/11 open, if it is set to E.
In addition, disconnect and shortcircuit the cables that were previously connected with terminals 12/13.

1.6 Then, disconnect the cable previously available on terminal 28 (RUN / STAND-BY).

2. MAIN CHECKINGS AND CONFIGURATIONS

2.1 Supply the device, except for power section, and check on the ES600 control board if the following three LED's are lit:

LED1 **+15V**
LED2 **-15V**
LED3 **+5V**

If the display shows **an alarm**, reset it (e.g. simultaneously press the INC and DEC keys).
If the alarm does not disappear (i.e. if the alarm cause is still present), refer to the section *ALARM LIST*.
If the alarm that cannot be reset is **alarm A04** “**Mains out of tolerance**”, proceed as follows and then reset.

2.2 If necessary, set **parameter #17** - by saving on E^2PROM with ENTER key- to the correct rated value of the available supply three-phase voltage, whose factory setting is 380V.

To change this parameter, as any other one, first set the value of parameter #14 to 1.

Use E^2PROM to save all other settings mentioned in this procedure, otherwise the data entered will be lost at power off.

2.3 Check that the **ventilation unit**, if present, properly works by blowing air from bottom to top.

2.4 Go to **parameter #49** and set the percentage value of the motor rated current as regards the drive rated current (default value: 100%).
If necessary, set a proper thermal constant on **parameter #50**, according to the basic instructions contained in this manual (default value: 10 min).

2.5 Go to **parameter #73** and check that the preset speed feedback (default configuration: tacho generator feedback) is the desired type.

2.6 In case of tacho generator feedback, set on **parameter #12** (default value: $440V_{CC}$) the c.e.m.f. (*counter electromotive force*) that is available at n_{max} (max. speed to be actually adjusted), proportionally obtained from the armature voltage available at rated speed (for information, see section *APPENDIX: MANUAL CALIBRATION*).
If an **external field de-energizing unit** is used, set **parameter #12** to the rated armature voltage of the motor, then set the correct value of **parameter #79** (default value: 100%).

2.7 In case of armature feedback, set **parameter #12** to the max. armature voltage that must be calibrated when output (default value: $440V_{CC}$).

3. CURRENT AUTO-CALIBRATION

3.1 After checking that the contact on term. 15 (RUN/STOP) toward 0V is initially open, set **parameter #14** to **2** and start the current auto-calibration with the ENTER key, closing the KM remote control switch when required, and checking the contact closing on term. 15.

If **alarm A01** “**Wrong cyclic sequence**” trips, exchange the first and third phase on the supply three-poles **upstream the branching point** of the control and power supplies: then, when powering the drive again, reset this alarm.
Repeat the operations described in the previous paragraph, so as to obtain the same conditions.

3.2 Check that no alternate voltage is present between term. 36 and bar 46, and between term. 38 and bar 48. Therefore, check that there is **phase identity** at points 36 and 46 and at points 38 and 48, otherwise connect these terminals with the correct phases.

3.3 At this point, reconnect the cable previously available at term. 28 and through the ENTER key execute the current autocalibration.

⚠ At the end of auto-calibration, the four parameters calculated in this phase (parameters #18, #19, #45, #46) should have values different from the default ones, and different from the allowed limits: particularly, they have to be **#45 ≠ 0.05** e **#46 ≠ 50**. If not, check that the mains is not excessively unbalanced in the three phase voltages. Then, after checking, restart the current auto-calibration.

3.4 Turn the device off and restore the original excitation connections (see paragraph 1.5).
In particular, if an **external field de-energizing unit** is available, reset jumper SW2 to I, or restore the contact between term. 10/11 if the jumper is set to E and keep disconnected and shorcircuited the cables originally connected with term. 12/13.

4. SPEED AUTO-CALIBRATION

4.1 Supply the device and check the presence of the direct voltage rated value for the field at term. 41 and 42.
If an **external field de-energizing unit** is available, supply it by adjusting the RV5 multirev. trimmer (that firstly must be in CCW position) so as to measure a direct current for the field equal to the rated value.

4.2 After checking that the contact on term. 15 toward 0V is initially open, set **parameter #14** to **3** and start the speed auto-calibration through the ENTER key, close the KM remote control switch (and therefore all the contacts on term. 15 and 28 toward 0V) when required, then definitely execute the auto-calibration through the ENTER key again: in this phase, the **parameters #28** and **#29** will be calculated.

⚠ In case of tacho generator feedback, if **alarm A11** "**Tacho generator failure**" trips, exchange the two cables of the tacho generator, unless the connection itself has interruptions on one or both cables: then, after supplying the drive again, reset this alarm.

⚠ When the speed autocalibration is over, the two parameters here calculated (parameter #28 and #29) should have values different from the default ones, and from the allowed limits.

5. OPERATION AS SPEED CONTROL

5.1 If a speed control is required, first **adjust the max. speed** (see next step).
If an **external field de-energizing unit** is available, during this adjustment the remaining trimmers RV2, RV1, RV4 (refer to OPERATION MANUAL of DF2) will have to be calibrated too. At the end of the adjustment, the original connections to term. 12/13 will be restored.

5.2 The max. speed adjustment is obtained by gradually increasing the speed reference toward the max. value, and by fixing the desired speed: in case of tacho generator feedback, through the **RV5 multirev. trimmer** on the ES602 board (installed on connectors), otherwise, in case of armature feedback, through **parameter #12**.
When term. 2 and/or 3 is set to the max. speed reference, parameter #01 will display a value of approx. 100%. When the max. speed reference is set to term. 4, parameter #09 will display a value of approx. 100%.
The values displayed for these two parameters also take into consideration the possible internal gain applied through parameters #15 and #16 (see below) respectively.

⚠ Make sure that, at max. speed, the direct voltage at output does not exceed the armature rated value of the motor (usually $440V_{CC}$ for three-phase supply at $380V_{CA}$).

⚠ The operation stability usually becomes more critical when the max. value adjusted for the speed decreases a lot (by CCW rotating the trimmer or by decreasing the value of the a.m.).

5.3 In addition to the feedback adjustment, an input **reference adjustment** to term. 2/3/4 can be performed through **parameters #15** and **#16** (default values: 1).
According to what mentioned in step 5.2, to adjust max. rotation speeds with very low values, do not adjust the feedback, but de-amplify the reference through the two a.m. parameters.

5.4 The **reference value for jog run** must be set on **parameters #21** and **#22** (default value: +5% for both).

5.5 To avoid any speed overshoot, you may apply the **parameters automatic matching** (excluded, by default) through **parameters #81÷85**, so as to face quick reference changes at constant load, e.g. if ramps are not used.
This matching is useful also in case of quick load changes at constant reference: in the two cases the setting of **parameter #85** is different, as shown in section *APPENDIX: MANUAL CALIBRATION*.

6. RAMPS HANDLING IN SPEED CONTROL

6.1 You can apply **ramps for speed references at term. 2/3** by properly setting **parameters #23**, **#24** and **#25** (default values: 0s), or insert some rounding-offs through **parameters #26** and **#27** (default values: 0s).

⚠ Between the ramp and rounding-off times, a given inequality should be verified, as described in this manual in the section *PARAMETER LIST*, as a comment to the figure showing the meaning of parameters #23÷27.

6.2 The **ramp times** can also be continuously changed from outside by means of the analog input, by properly configuring it through **parameter #57** (default setting: excluded), or they can be set to zero through the digital input by properly configuring it through **parameter #74** (default meaning: CLIM).

6.3 The **ramps for jog run** are defined by **parameter #20** (by default, the same applied to term. 2 and 3), and according to its setting, through **parameters #23**, **#25**, **#26** and **#27**, or through **parameters #75** and **#76** (default values: 0s).

6.4 With average length ramps, it may be useful to perform the **automatic increase of the integral time** through **parameter #80** (excluded by default).

7. OPTIONS FOR SPEED CONTROL

7.1 You can select a unique **polarity for speed reference** input on term. 2/3 (and for the global internal one) through **parameter #54** (only positive by default).
The **min. reference** can be set, provided that parameter #54 has been configured to the default value, through **parameter #55** (default value: 0%), while the **max. limit reference** can be set on **parameter #56** (default value: 100%).
If a min. speed reference is not set and with a zero reference the motor rotates slowly, the **speed drift** can be corrected by means of **parameter #30** (default value: 0%).

⚠ If this correction exceeds the expected result, a *min. reference threshold* should be defined to set the motor in rotation state.

7.2 To **invert the polarity of the speed reference**, you may use the digital input that can be configured through the corresponding setting on **parameter #74** (default meaning: CLIM).

7.3 The **compensation for R•I resistive drop** is performed through **parameter #78**, whose default value is 100%.

7.4 Then, to select the **operation quadrants,** use **parameter #47** (by default: both enabled).

8. CURRENT CONTROL (TORQUE)

8.1 Perform a current control (torque) for example when controlling the traction on an unwinding or winding material, or when controlling machines that are mechanically connected to others, for which you must define a correct torque sharing.

8.2 In the first case, a simple **external adjustment of the current limit** is normally performed, by properly selecting the analog input that can be configured on term. 4 through **parameter #57** (excluded by default), where the used signal polarity can be selected through **parameter #77** (positive by default) and the sent signal level can be internally adjusted through **parameter #16** (default value: 1).

⚠ In this operation mode, the speed reference should always keep the drive in current limit state.

8.3 In the second case, the a.m. solution can be used, otherwise you can perform a direct **setting of current reference**: use **parameter #61**, to get a permanent configuration, or **parameter #74** (default meaning: CLIM) to obtain the enabling through a control of the digital input, where the sent signal level can be internally adjusted through **parameter #15** (default value: 1).

9. OPTIONS FOR CURRENT LIMIT CONTROL

9.1 Both in the speed and current control, the current **internal limitation** is kept active, generally set to a unique level on **parameter #32** (default value: 100%), always as percentage of the motor current rated value set on **parameter #49** (default value: 100%). In particular, if a two-level adjustment is required, use **parameters #34** and **#36** too (default: values: 100%), while for a hyperbolic adjustment use **parameters #37** and **#38** (default value: 100%).

9.2 With a given max. duty-cycle, you can have a **current overlimit** due to heavy torque requirements by **parameters #39** (default value: 2s) and **#41** (default value: 100%).

9.3 By properly configuring the digital input through **parameter #74** (by default with CLIM meaning), you can also have a **current limit decrease**, which can be defined through **parameter #43** (default value: 50%).

10. ANALOG AND DIGITAL I/O

10.1 The **programmable analog input** is set through **parameter #57** (excluded by default), while the **programmable analog output** is set through **parameter #58** (by default 0V).

10.2 The **programmable digital input** is set through **parameter #74** (by default with CLIM meaning), while the **programmable digital output** is set through **parameter #86** (by default set as speed threshold ST), with threshold and hysteresis values set through **parameters #31** and **#87** (default values: 25 (2.5) % and 5%, respectively).

10.3 Two are the **preset analog outputs**: **OUT V** and **OUT I**.

11. BACK-UP AND RESTORE OF CURRENT PARAMETERS

11.1 After setting up the machine, when all settings are correct, perform a **back-up** of current parameters by setting **parameter #14** to **6**, so as to make the **back-up parameters restore** command available (by setting **parameter #14** to **7)**.

11.2 You should always **keep track** of those parameters whose values have been changed as regards the default ones, using the proper shedule mentioned al the end of the OPERATION MANUAL.

STANDARD FEATURES

Application: THE CTM90 IS A FULL DIGITAL, THREE-PHASE AC/DC DRIVE, USED TO SUPPLY DC MOTORS ARMATURE CIRCUIT SO AS TO PERFORM A TWO QUADRANTS SPEED OR TORQUE CONTROL. IN ALTERNATIVE, IT CAN BE CONFIGURED TO SUPPLY ELECTROMAGNETS OR INDUCTIVE LOADS.

Supply: From three phase mains (or from generator unit, see par. # 88 and 89), 380...415 Vac +10/-15% (for modules with V_R = 1400V), 45÷65 Hz (with automatic adjustment). Presetting for other supply voltages, only if required. On request, presetting for different supply voltages for control and power.

Output voltage: 440 Vdc for 380 Vac mains (400 Vdc max in regeneration)

Conversion bridge: Three-phase, full controlled bridge, made up of module thyristors.

Cooling: Natural with vertical air flow up to .70; forced from .100 up.
Possibility of **THROUGH PANEL** assembly for biggest sizes.

Capability of overloads: +30% of rated current for 20 s with automatic reduction to the current limit value if the overload lasts more than allowed. Capability of overload up to 200% max starting from lower currents. This function can be repeated with a duty cycle of 13,5%.

Field winding power supply: Internal rectifier protected by a fast acting fuse, for CTM90.330 max. only, to power the field winding of the D.C. motor, with signal of field loss by means of an insulated relay contact.

Controlling: By double feedback loop, completely digital, internal for the armature current control and external for speed control. Adaptive speed controller, with automatically variable parameters depending from speed error.

Speed feedback: From tacho generator or from armature voltage with RxI armature drop compensation: see parameter #73.

Operation features: Operation as motor in the first quadrant (motive torque with forward rotation) with speed or torque control. Operation as brake with mains regeneration in the second quadrant (braking torque with backward rotation) with speed or torque control, for example, for an unwinder in traction state. Possibility of cut out of one of the 2 quadrants (see par. #47). Possibility of operation with constant power (see par. #37/#38), through armature weakening. Possible operation with external field weakening (see par. #79).

Automatic calibration: The drive automatically calculates the ideal gain parameters to be input in the current and speed loops and it recognizes the basic characteristics of motor (armature resistance and inductance, ratio between the counter-EMF and the angular speed) and load.

Standard serial interface: A serial interface is standard delivered, for remote communication and parameter input. Its electric standard is RS485; the used protocol is ANSI X3.28, for multidrop connection between a master (typically a PC) and a number of drives up to 32 (slave).
On request, an optoinsulated conversion modem RS485/RS232-C is available, for the direct connection to a PC.

Accuracy: ± 0.1% of the rated speed for:
- load change up to 100% of the rated torque;
- mains voltage change of +10/-15% as regard its rated value;
- temperature changes of ±10°C.

Resolution: 0.01% of the rated speed.

External speed references: Voltage inputs ± 10 Vdc (input impedance 20 kΩ).Possibility to change the inputs gain (see par. #15 and #16). Electronic inversion of polarity (see par. #74). Possibility of min (see par. #55) or max (see par. #56) speed enabling.

Ramp function: Completely digital with independent adjustment (also external) of the acceleration or deceleration time. External control for ramp times zeroing. Possibility of starting and ending rounding of the ramps, with 2nd order function ("S" curve). Automatic increase of acceleration ramp if the load requires a torque near to the maximum one, or of deceleration ramp if this is shorter than idle stop time. If the load torque becomes equal than the maximum motor torque, then the speed reference in the ramp is stopped to the actual value: this avoids large increase of speed error and minimizes the time in which the drive remains in limit current. For this reason the internal ramp of the drive always tracks motor real speed.

Analog Output signals: Voltage signal OUT V with double polarity, proportional to the motor rotational speed. Current signal OUT I, also filtered, proportional to the armature current delivered. Auxiliary signal OUT AUX that can be configured through keyboard (see param. #58), for example as ramps output, current reference (for SLAVE operation), absorbed active power, synchronizer for inertia compensations.

Inner relay for speed or current threshold, and for set speed reached: Keyboard configurable relay (see par. # 86) with adjustable threshold and hysteresis.

Inner relay for electro-mechanical switchings: To signal the motor has stopped.

Inner Alarm relay: For alarm intervention signaling. Indicates drive fault.

ES600 control board interchangeability: An EEPROM (non-volatile memory) is installed on the board ES600 where (after the automatic or custom calibrations) the characteristic parameters of the drive and of the different adjustments are stored, except for the calibration of the max. speed and the current and speed output signals, which are located on theES602 board (together with the ES600/3 printed circuit). The ES602 and the EEPROM can be easily removed and installed on a possible replacement board, thus ensuring the complete drive interchangeability in case of fault, without having to repeat the start-up operations. The EEPROM can be used to reset the default parameter or a given configuration, for which a BACK-UP has been previously made.

Digital inputs: They can be controlled by a PLC with static outputs (open collector NPN). These inputs can be galvanic separated from the field.

Protections:
- To limit the short-circuit curr., to reduce any deformation of the mains voltage and the dI/dt of the line current: switching reactances separately delivered, to be installed by the user;
- To reduce the excessive dV/dt on the thyristors: single RC filters;
- Against short-circuits: fast acting fuses, to be externally installed;
- Against overloads: current limit that can be adjusted in different ways (see par. #32...43);
- Against wrong phase rotation and/or phase mismatching between control mod. and power section: alarm A01;
- Against unstable mains frequency or frequency out of tolerance: alarms A02 and A03;
- Against mains voltage out of tolerance: alarm A04;
- Against phase loss: alarm A05;
- Against break or faulty connection of the tacho generator: alarm A11;
- Against overheating of the motor, through a thermal image of it: alarm A14.
- Against no or poor ventilation, by means of thermostat on the heatsink: alarm A31.

Operation temperature: Ambient, 0 to 40°C. 4% decrease for each degree increase.
Relative humidity: 20 ... 90% (non-condensing).
Max. operation height without derating: 1000m (above sea-level). 1% decrease for each 100m increase.

Weight:

11	kg for	CTM90	.10, 20 and .40
13	" "	"	.70
14	" "	"	.100 180
16	" "	"	.250 and .330
39	" "	"	.410 600
45	" "	"	.900
48.5	" "	"	.1200

DRIVE RATING TABLE AND ACCESSORIES

FOR 380...415Vac SUPPLY (for modules with V_R=1400V)

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SIZE 1	CTM90.10	10A	13A	—	40mm	M 6	35/40A 00T/80	35/40A 00T/80	30W
	" .20	20A	26A	—	40mm	M 6	35/40A 00T/80	35/40A 00T/80	60W
	" .40	40A	52A	—	40mm	M 6	35/40A 00T/80	50A 00T/80	120W
	" .70	70A	91A	—	72mm	M 6	100A 00T/80	100A 00T/80	210W
	" .100	100A	130A	220V 100mA	72mm	M 6	100A 00T/80	125A 00T/80	300W
	" .150	150A	195A	220V 100mA	72mm	M 8	160A 00T/80	200A 00T/80	450W
	" .180	180A	234A	220V 100mA	72mm	M 8	160A 00T/80	200A 00T/80	540W
	" .250	250A	325A	220V 200mA	72mm	M 8	250A 00T/80	315A 00T/80	750W
	" .330	330A	429A	220V 200mA	72mm	M 8	315A 00T/80	375/400A 00T/80	990W
SIZE 2	CTM90.410	410	533A	220V 600mA	84mm	M 10	450A 2T/80	550A 2T/80	1230W
	" .500	500A	650A	220V 600mA	84mm	M 10	550A 2T/80	700A 3T/80	1500W
	" .600	600A	780A	220V 600mA	84mm	M 10	550A 2T/80	700A 3T/80	1800W
	" .900	900A	1170A	220V 600mA	84mm	M 10	800A 3T/80	1000A 3T/80	2700W
SIZE 2A	CTM90.1200	1200A	1560A	220V 2A	84mm	M 12	1000A 3T/80	1250A 3T/80	3600W

NOTE: DO NOT OVERSIZE the drive as regard the motor, otherwise control performances will get worse, till the auto-tuning procedures block. We recommend to choose the drive size so as it is comparable or directly higher than the rated motor current.
Note: On the A.C. and D.C sides, the use of fast-acting fuses (values shown in the table) is recommended, so as to avoid possible failures to the power section.

(1) Continuously delivered max. current (max. limit current).
(2) Max. overlimit current that can be delivered, for the time preset through param. #39, equal to 130% of the max. current that can be continuously delivered.
(3) RMS power supply values for cooling fan (if present).
(4) Heatsink height.
(5) Size of power terminals thread: 46 ... 50.
(6) Fast acting fuses size, A.C. side (660V).
(7) Fast acting fuse size, D.C. side (660V), for regenerative operation only.
(8) Losses due to drive heating.

THREE-PHASE SWITCHING INDUCTANCE

A three-phase inductance has to be applied to the supply line. It offers the following advantages:

- Reduction of sinusoidal mains voltage distorsions, in the connection area of the converter.
- Reduction of line current gradients which may cause radio interferences and other inducted noises on adjacent lines (see also section EMC featues and input filter).

Two three-phase inductance series are available, L2 and L4, having identical current rated values but differing in inductance values and phase drop (approx. 6V for L2 and 1V for L4).
The following is a list of inductance characteristics according to the converter size.

	Converter	Inductance rated current	L2 INDUCTANCE		L4 INDUCTANCE	
			Code	Inductive value	Code	Inductive value
SIZE 1	CTM90.10	10A	IM0120104	2.1mH	3x IM0100354	150µH
SIZE 1	" .20	18A	IM0120154	1.1mH	3x IM0100354	150µH
SIZE 1	" .40	35A	IM0120204	0.6mH	3x IM0100354	150µH
SIZE 1	" .70	70A	IM0120254	0.3mH	IM0122104	45µH
SIZE 1	" .100	120A	IM0120304	0.18mH	IM0122154	30µH
SIZE 1	" .150	120A	IM0120304	0.18mH	IM0122154	30µH
SIZE 1	" .180	170A	IM0120354	0.12mH	IM0122204	20µH
SIZE 1	" .250	235A	IM0120404	0.09mH	IM0122254	15µH
SIZE 1	" .330	335A	IM0120504	0.062mH	IM0122304	10µH
SIZE 2	CTM90.410	335A	IM0120504	0.062mH	IM0122304	10µH
SIZE 2	" .500	520A	IM0120604	0.040mH	IM0122404	6.2µH
SIZE 2	" .600	520A	IM0120604	0.040mH	IM0122404	6.2µH
SIZE 2	" .900	780A	IM0120704	0.025mH	IM0122504	4.5µH
SIZE 2A	CTM90.1200	1100A	-	-	IM0122604	3µH

CTM90 - EXTERNAL AND FIXING DIMENSIONS 10...330A

See fig.1

1	Earthing screw (thread size: M6).
2	Faston type terminals V1 and V2, for cooling fan power supply (fitted for CTM90.≥100). During wiring, use the appropriate insulated Faston terminals, delivered with the equipment.
3	ES600 Control board terminal.
4	ES630 Firing board terminal.
5	Power terminal.
6	Cooling air flow direction.
7	Fastening on vertical panel through 4 M5 screws.
8	Leave a free space, in the upper and lower side of the drive, to grant correct cooling air circulation.
9	Heatsink.
10	Fan (assembled for CTM90.≥100).
A-B	NOTE:To reach the drive inside, loosen the two screws A and the two screws B, slide the upper frame upwards till the screws B are free from their fastening holes, then tilt the frame outwards

CTM90 - POWER AND SUPPLY CONNECTIONS 10...330A

See fig.2

L1/L2/L3	50/60Hz power supply threephase mains (standard 380...415Vac, for modules with V_R=1400V).
FU1/FU2/FU3	Fast acting fuses, A.C. side, for AC/DC bridge protection.
FU4	Fast acting fuse, D.C. side, for AC/DC bridge protection. **Note: Necessary for regenerative operation only.**
FU5/FU6	Delayed fuses for TC auto-transformer primary protection.
FU7	Delayed fuse for cooling electro-fan protection.
FU8/FU9	Fuses 500mA min, protecting the connection to terminals 36/38 of the threephase mains.
KM	AC/DC bridge supply remote control switch.
L	Threephase switching impedance.
RL1	Inner relay for field current loss signaling.
TC	Auto-transformer for D.C. motor field power supply. The alternate voltage V_{EA} on the secondary, is obtained from the required direct voltage V_{EC} through the following formula: $V_{EA} = V_{EC} \cdot 1{,}11$
M	Direct current motor. **Note: To optimize stability, connect the STABILIZING SERIES in phase with the independent excitation.**
A	AC/DC conversion bridge. For further information about bridge A, electric diagram and physical position, see fig.3, fig.4, fig.5. NOTE: The polarities included in brackets for term. 49 and 50 refer to the regenerative operation.
EF	Three-phase filter against electromagnetic interference (EMI). See section EMC FEATURES AND INPUT FILTER.

Fig.1 - CTM90.10...330 - External and fixing dimensions .

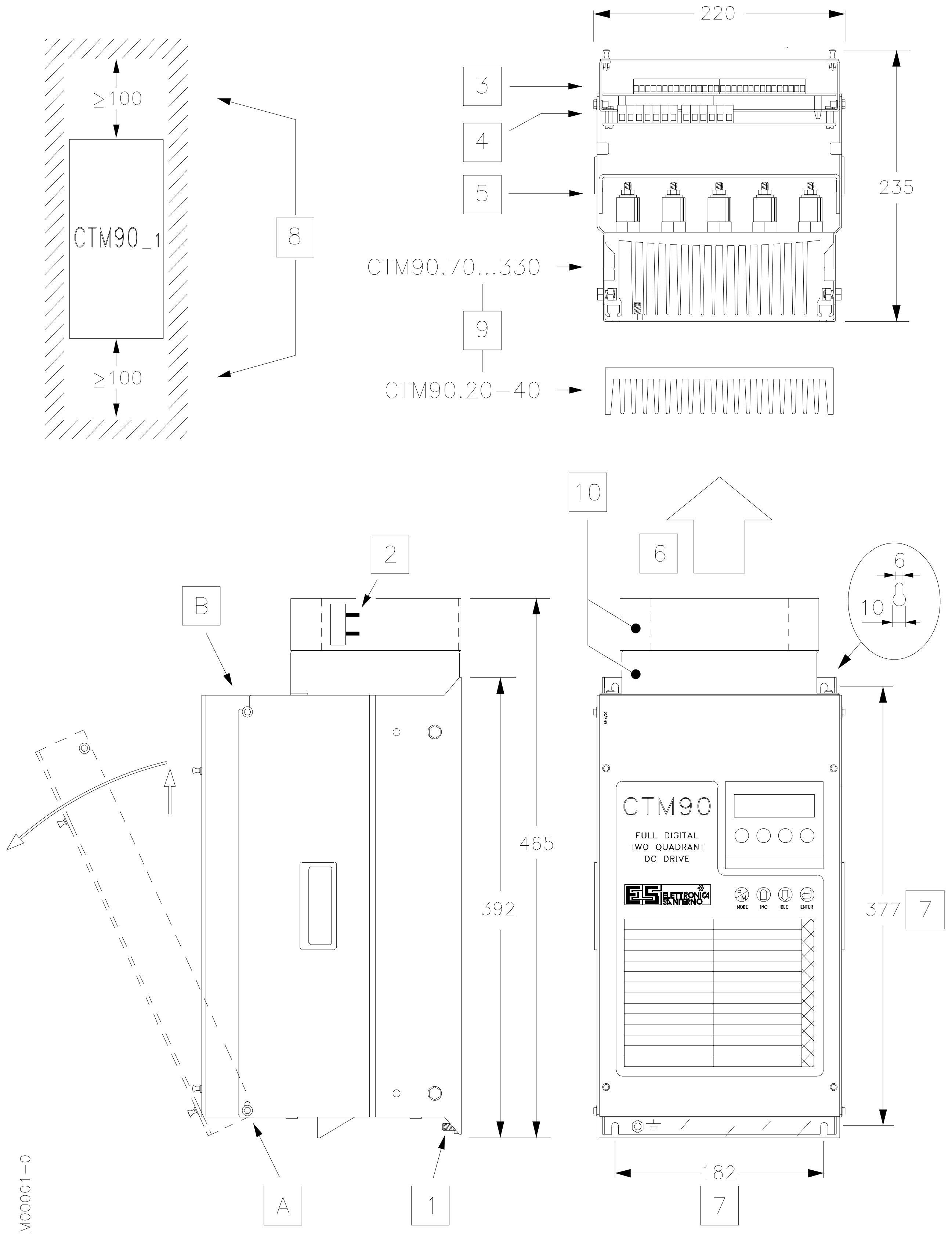


Fig.2 - CTM90.10...330 - Power connections and power supply -

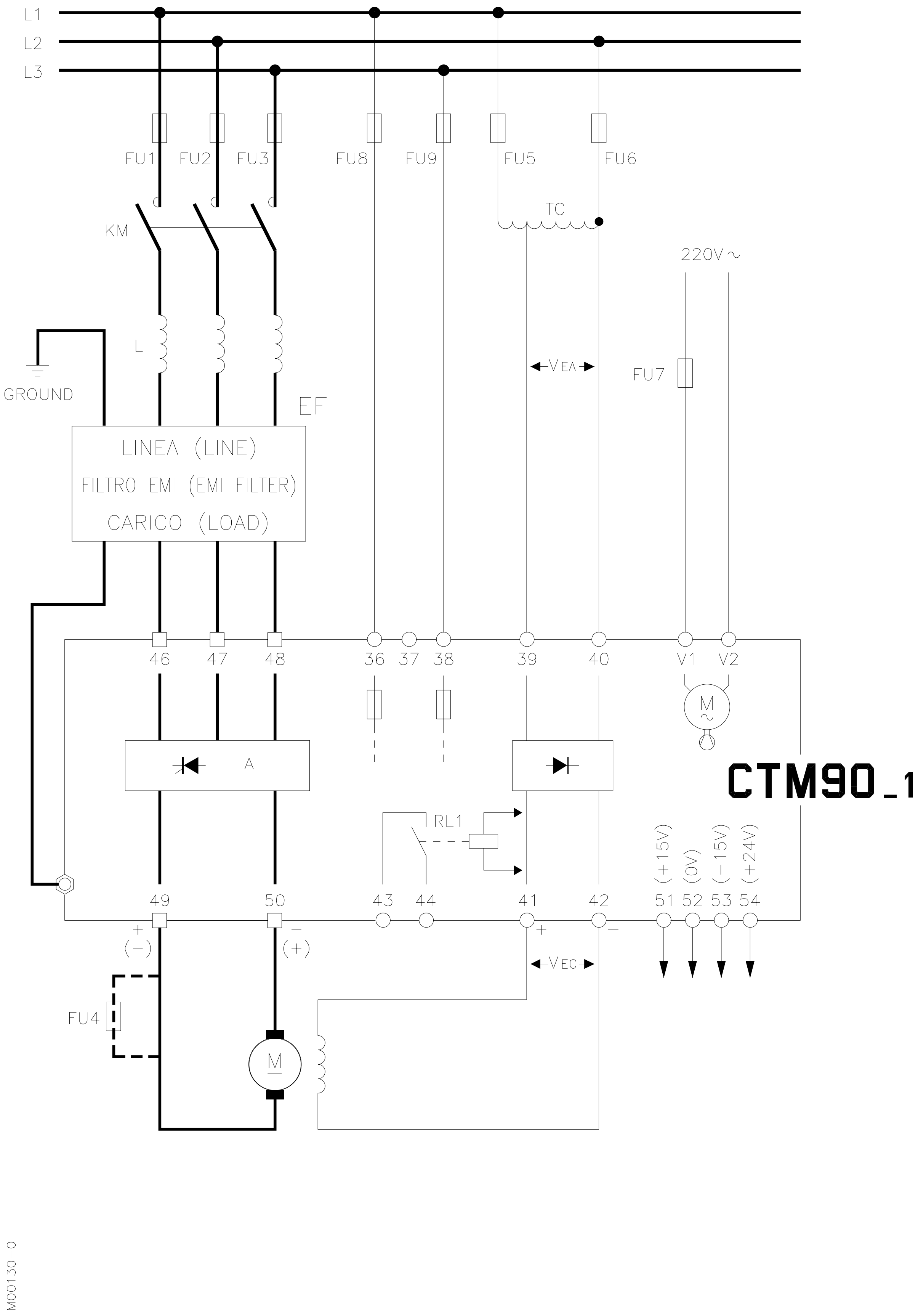


Fig.3 - CTM90.10...330 - Block diagram -

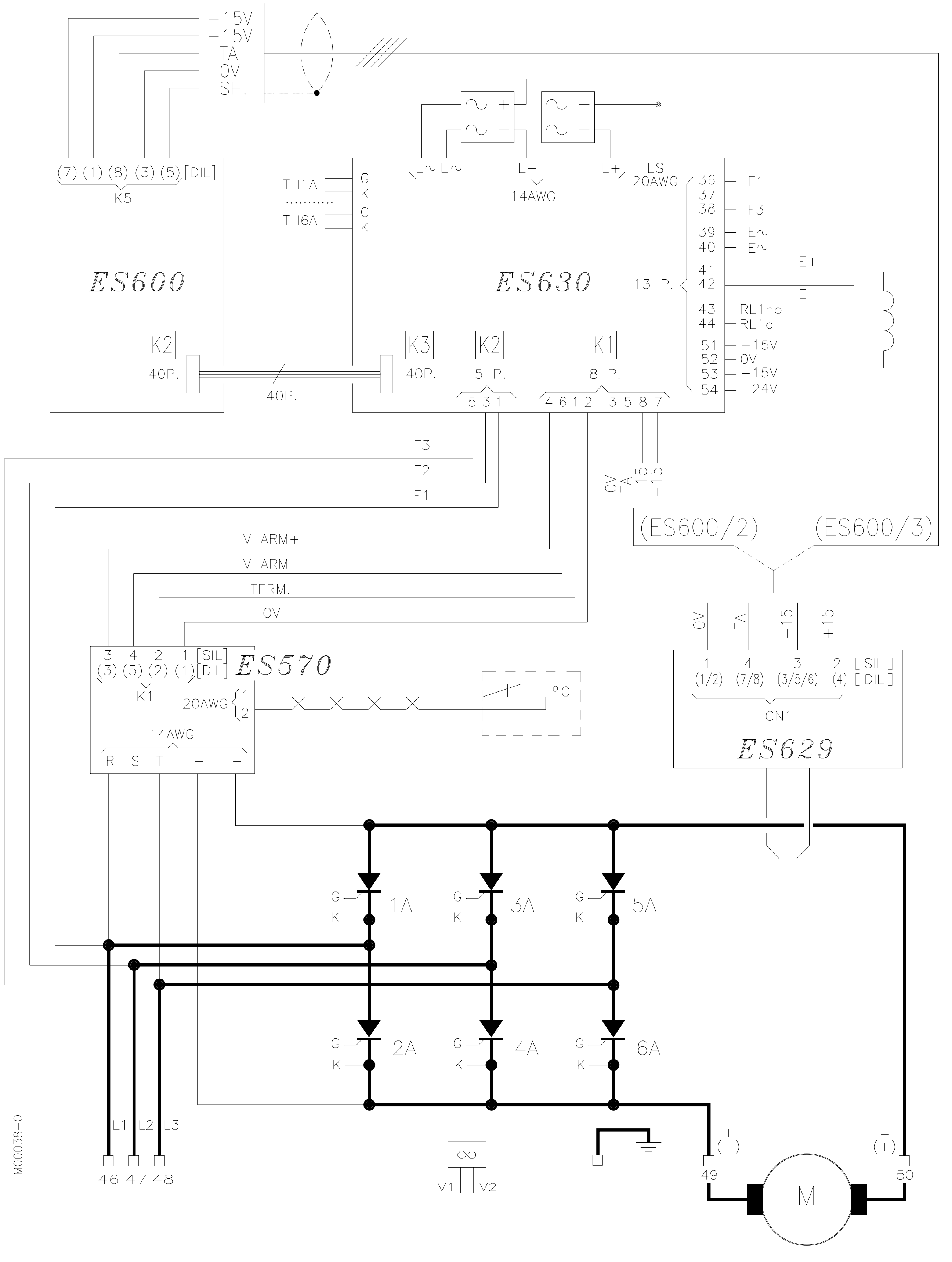


Fig.4 - CTM90 size 1 180A max. - Power Section lay-out

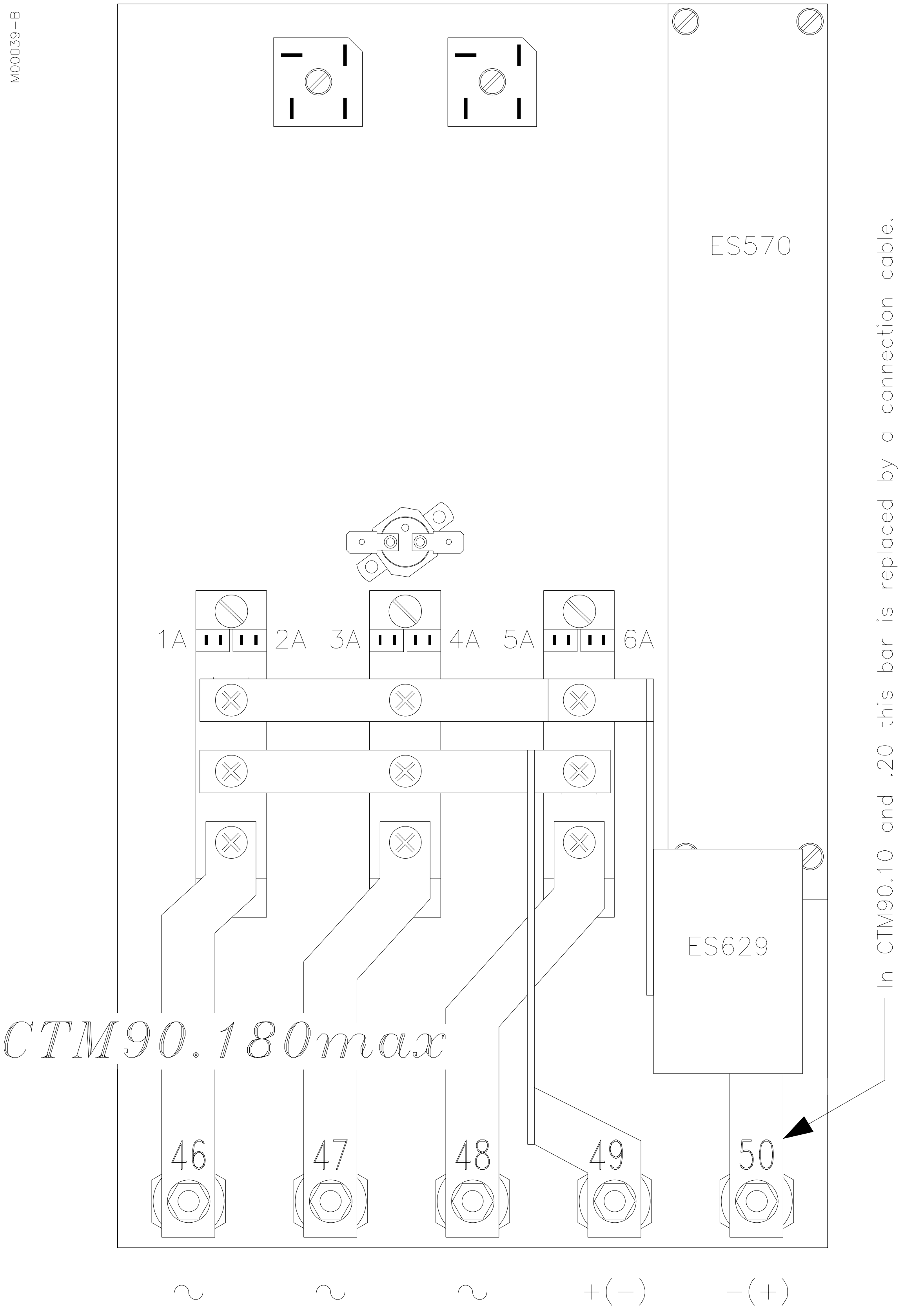
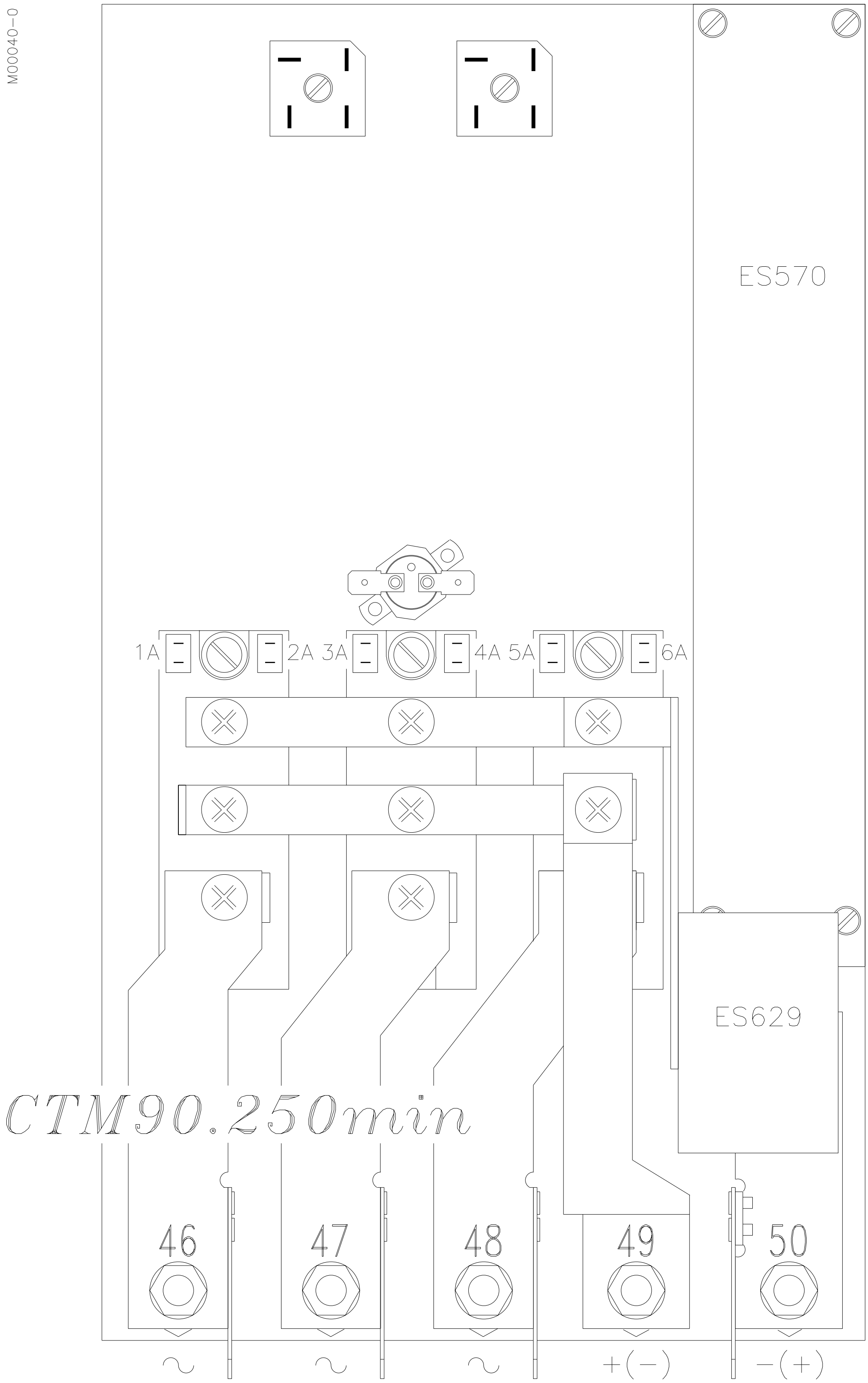


Fig.5 - CTM90 size 1 250A min. - Power Section lay out -



CTM90 - EXTERNAL AND FIXING DIMENSIONS 410...1200A

See fig.6a (CTM90 410...300A) and fig. 6c (CTM90...1200A) for external dimensions.

1	Earthing screw (thread size: M8).
2	ES600 Control board terminal.
3	ES630 Firing board terminal.
4	Excitation supply terminal board.
5	Power connections (bars).
6A	Direction of the main cooling air flow.
6B	Direction of the secondary cooling air flow.
7	Fastening on vertical panel by means of 4 screws M6 (to position the 4 holes, see fig. 6b).
8	Leave a free space, in the upper and lower side of the drive, to grant correct cooling air circulation.
9	Side supports (n.2).
10	Fans (3 for CTM90 900A max, 2 for CTM90 1200A).
A B	NOTE:To reach the drive inside, turn the four screws A counterclockwise and completely loosen the screw B, then open the frame.
	For fastening and **"THROUGH PANEL"** assembly , see fig. 6b.
11	Opening to be made on the support vertical panel for THROUGH PANEL assembly. To this purpose, remove the 6 screws C (see fig. 6a and 6c) so as to remove the two side supports.
12	Positioning side view for THROUGH PANEL assembly: this assembly is recommended when a forced air duct already exists with which the main flow 6A can be aligned, or when it is more convenient to condition the cabinet rear side instead of the whole volume in which the drive is installed.

CTM90 - POWER AND SUPPLY CONNECTIONS 410...1200A

See fig. 7

L1/L2/L3	50/60Hz power supply threephase mains (standard 380...415Vac, for modules with V_R=1400V).
FU1/FU2/FU3	Fast acting fuses, A.C. side, for AC/DC bridge protection.
FU4	Fast acting fuse, D.C. side, for AC/DC bridge protection. **Note: Necessary for regenerative operation only.**
FU5/FU6	Delayed fuses for TC auto-transformer primary protection.
FU7	Fast acting fuse for rectifier bridge protection for D.C. motor field power supply.
FU8/FU9	Fuses 500mA min, protecting the connection to terminals 36/38 of the threephase mains.
FU10	Fuse 2A min. for CTM90 900A max (2.5A min for CTM90 1200A) protecting the connection to terminals 55/56 of the threephase mains.
KM	AC/DC bridge supply remote control switch.
L	Threephase switching impedance.
TC	Auto-transformer for D.C. motor field power supply. The alternate voltage V_{EA} on the secondary, is obtained from the required direct voltage V_{EC} through the following formula: $V_{EA} = V_{EC} \cdot 1,11$
M	D.C. motor (armature circuit + field circuit).
A	AC/DC operating bridge. For further information about bridge A, electric diagram and physical position, see fig.8, fig.9a and fig. 9b.
NOTE:	The polarities included within brackets for terminals 49 and 50 refer to the regenerative operation.
EF	Three-phase filter against electromagnetic interference (EMI). See section EMC FEATURES AND INPUT FILTER.

Fig.6a - External dimensions CTM90. 410...900A

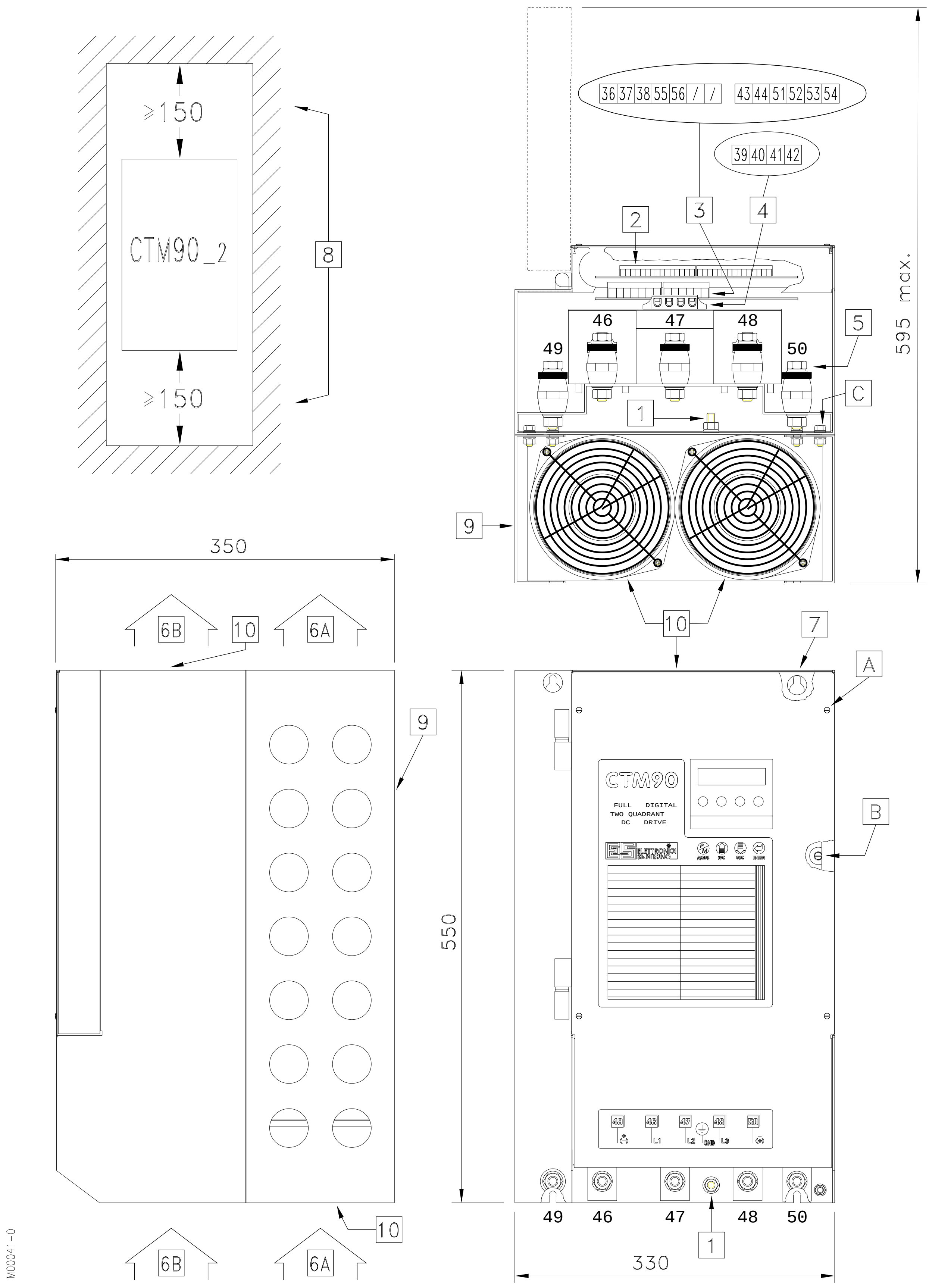
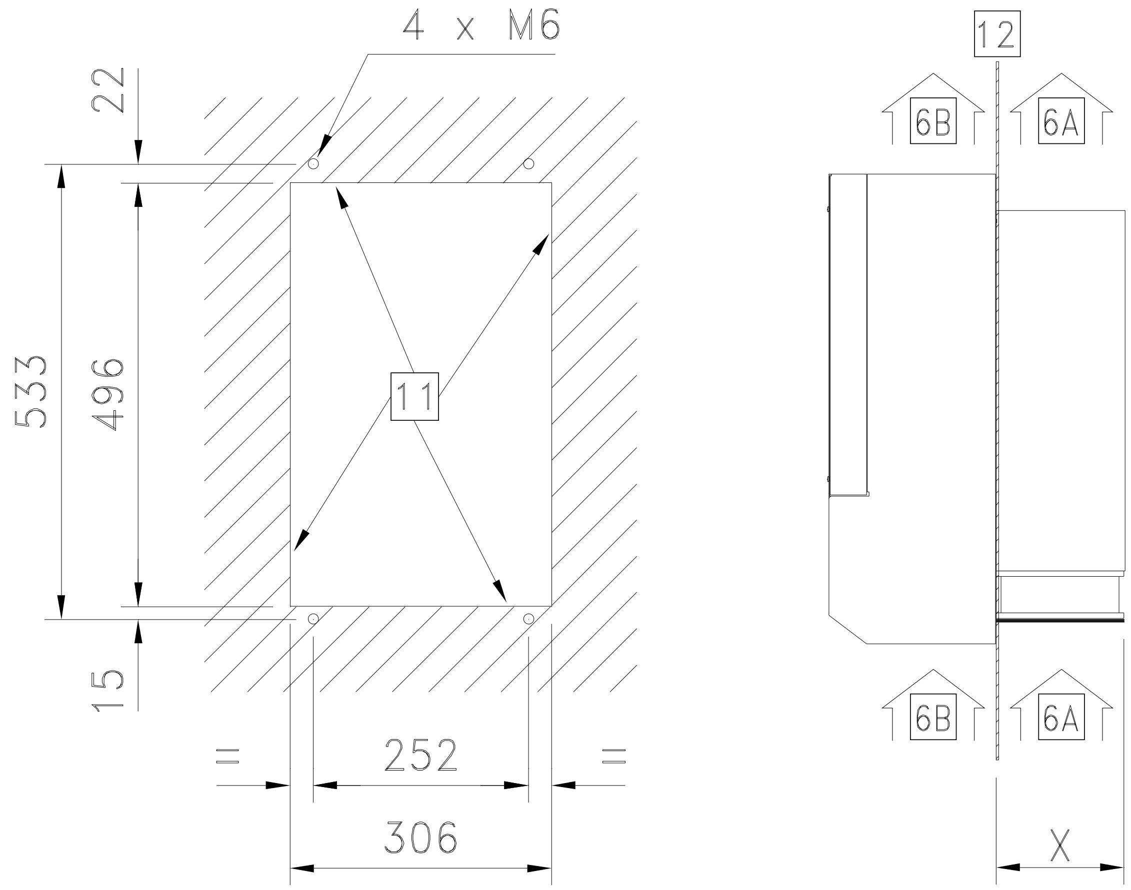


Fig.6b - Fastening dimensions and "THROUGH PANEL" assembly for CTM90.410...1200A



X	150 mm for 900A max.	
	242 mm for 1200A	

M00007-0

Fig.6c - External dimensions CTM90 1200A

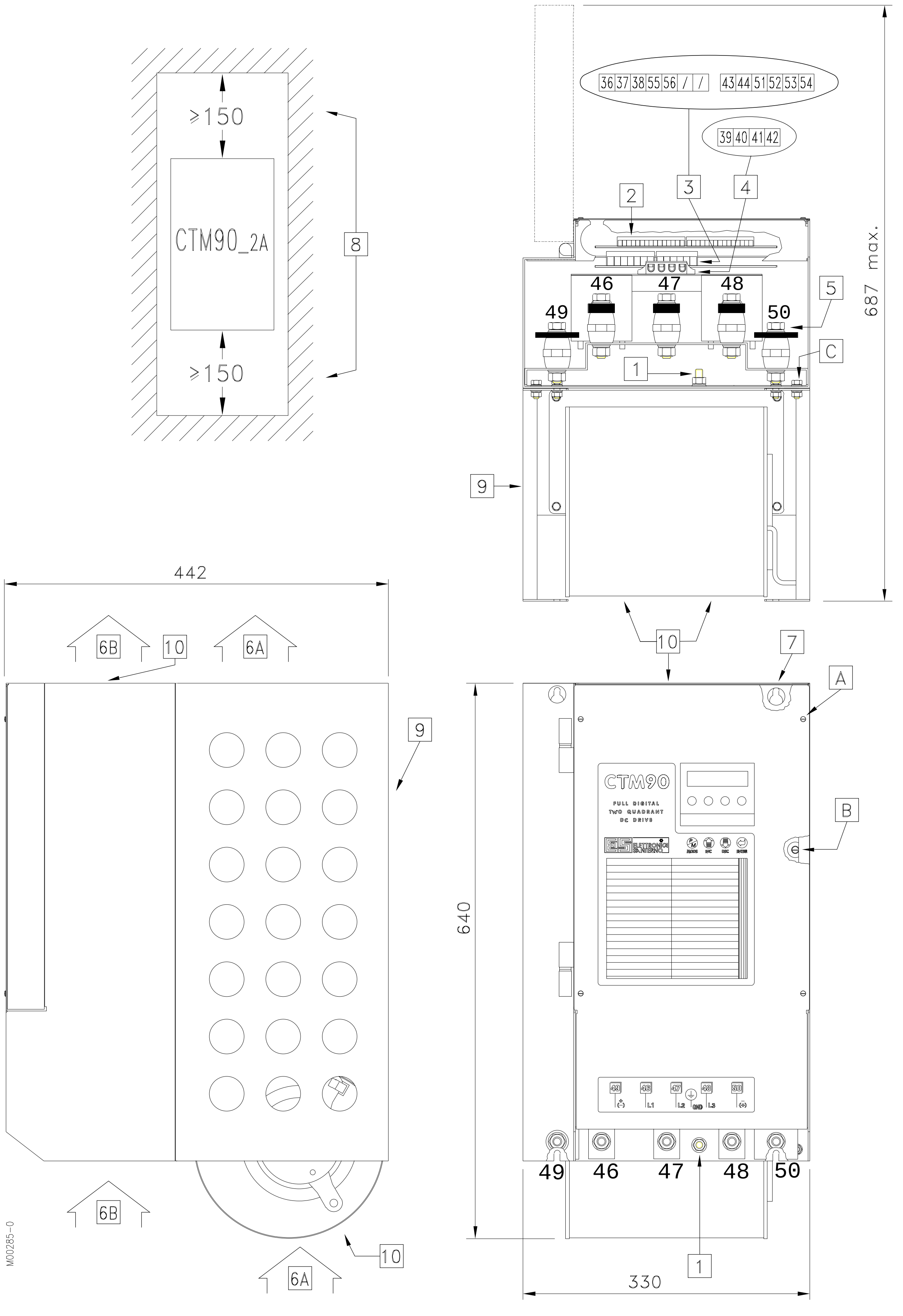


Fig.7 - Power connections and power supply CTM90.410...1200A

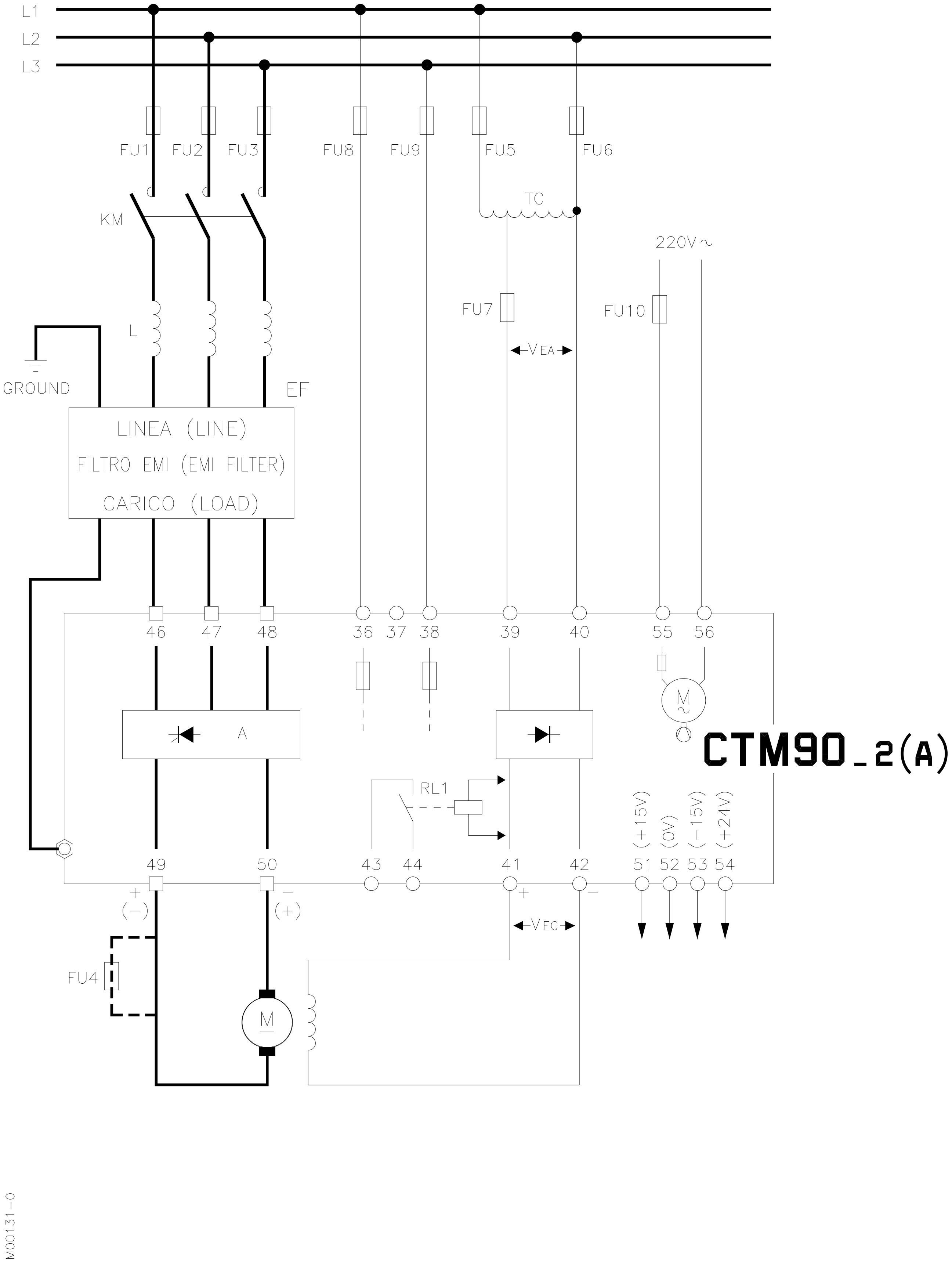


Fig.8 - Block diagram - CTM90.410...1200A

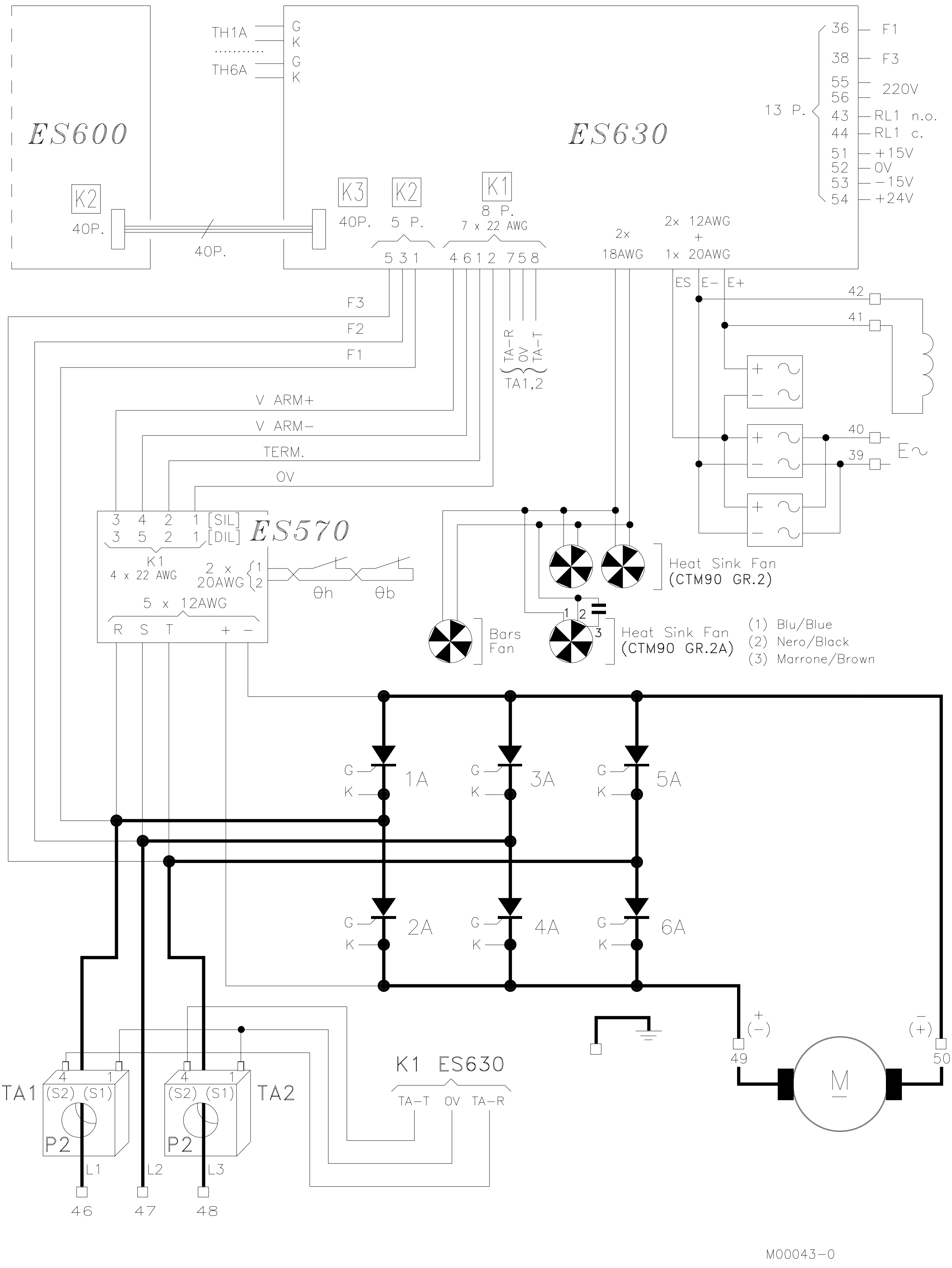


Fig.9a - CTM90. 410-600A power section lay-out

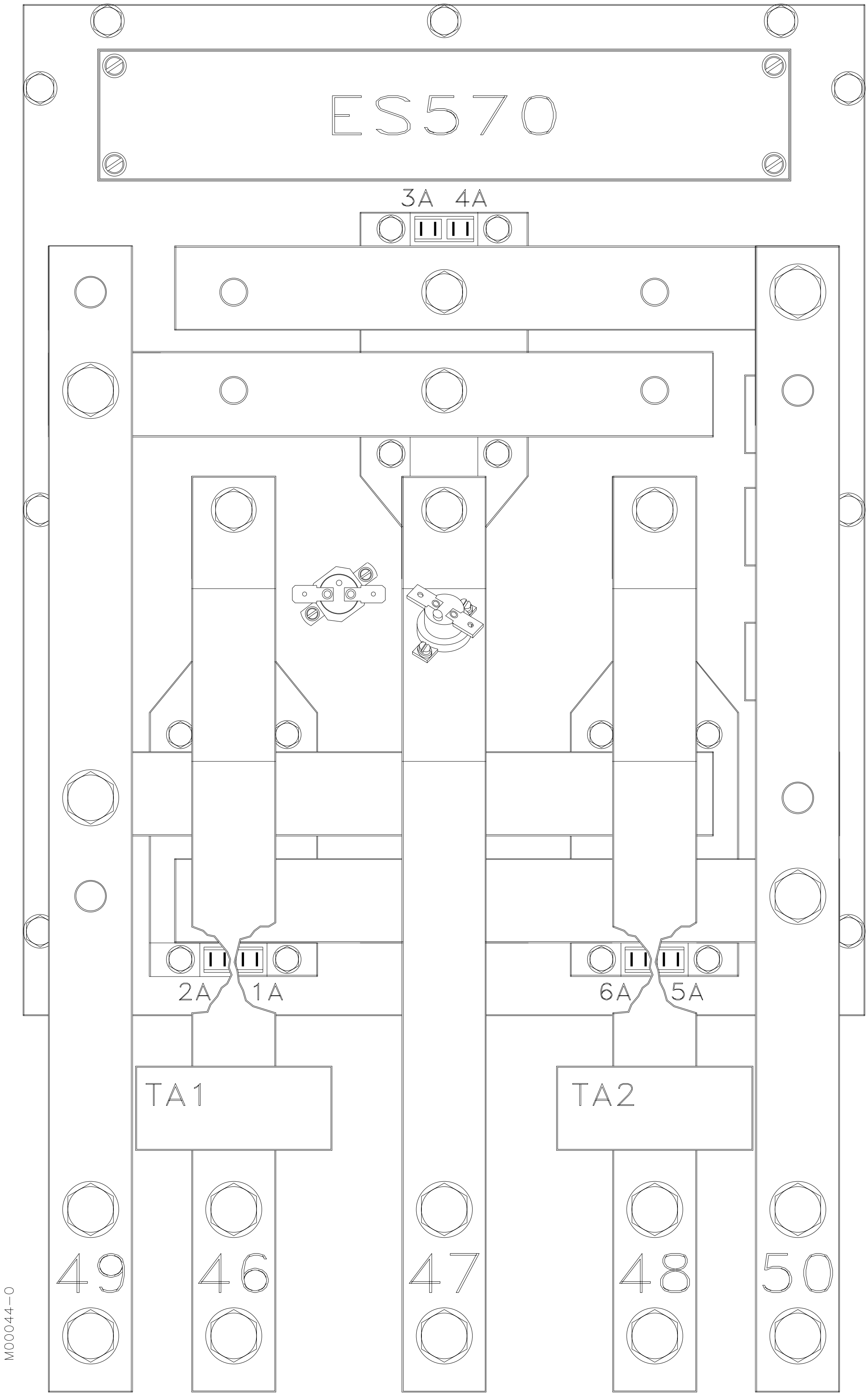


Fig.9b - CTM90 900A 1st type - Power section lay-out

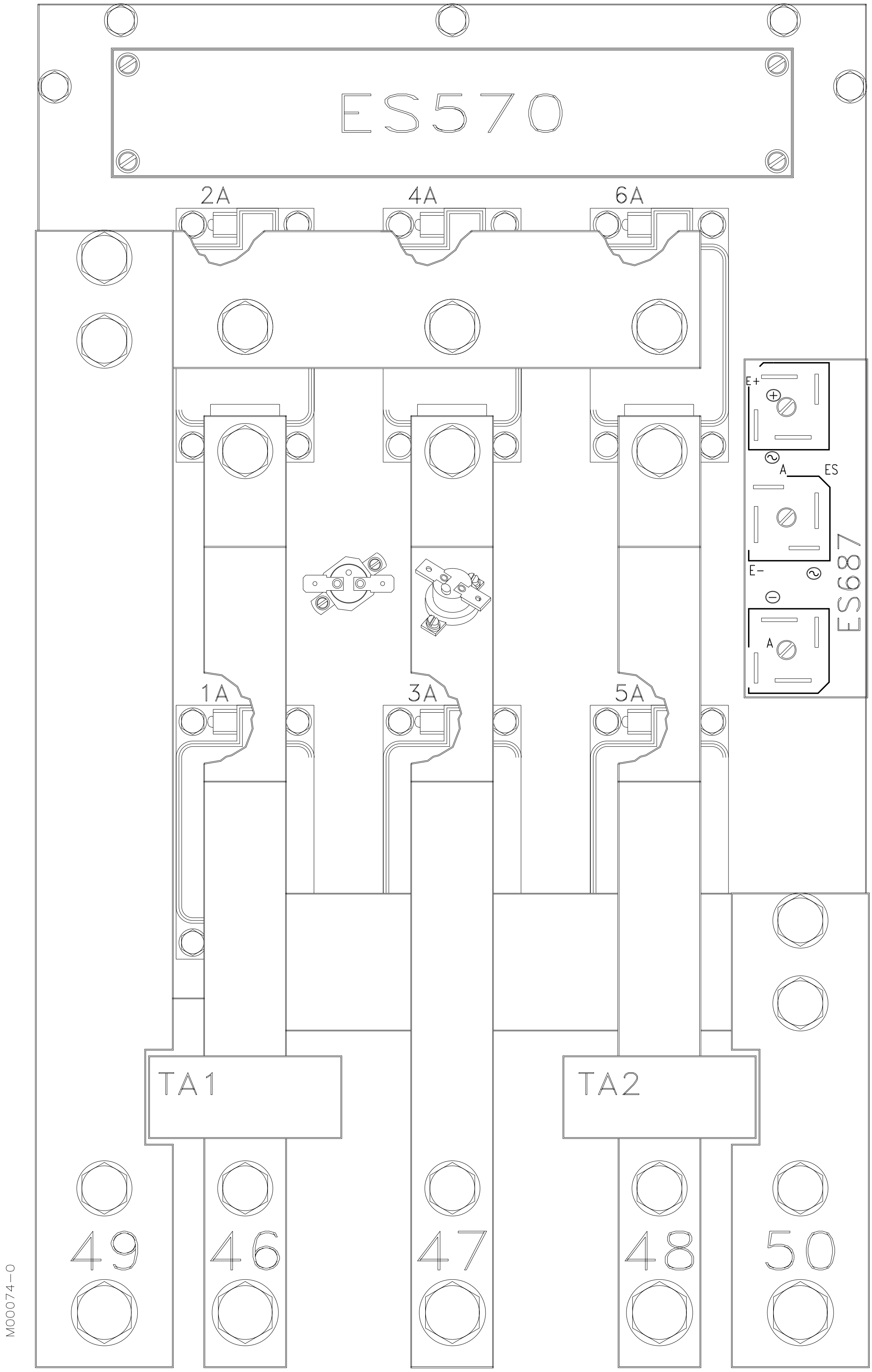
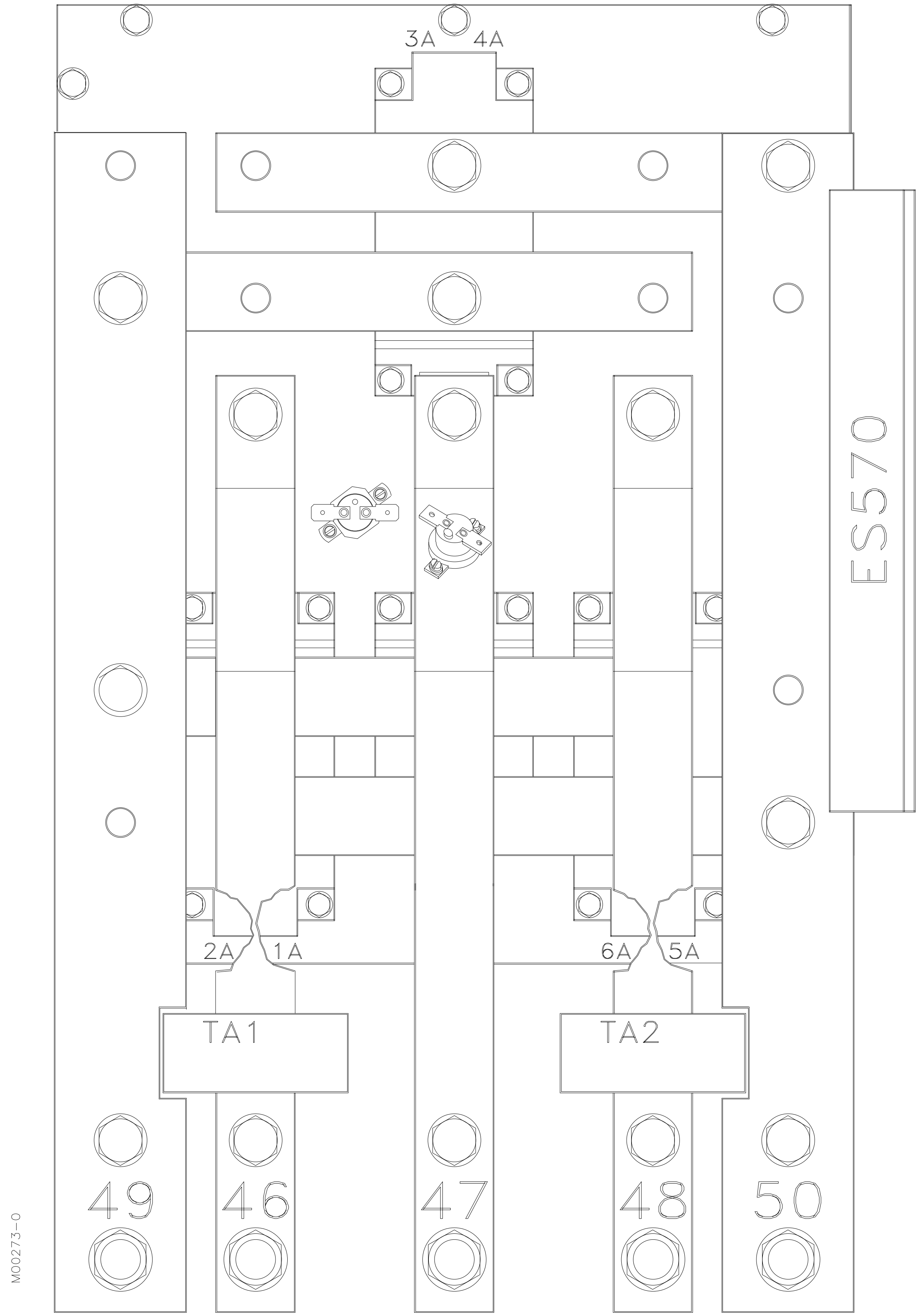


Fig.9c - CTM90 900A 2nd type and 1200A - Power section lay-out



MODULAR CTM90 : APPLICATION TABLE AND ACCESSORIES

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
SIZE 3	CTM90.1600	1600A	1500A	220V 3.2A	IM0122704	1300A 2.5µH	4800W	1600A
	CTM90.2300	2300A	2100A	220V 3.2A	IM01220804	2000A 1.6µH	6900W	2000A

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
SIZE 4	CTM90.2700	2700A	2500A	220V 3.2A	IM0122904	3000A 1.1µH	8100W	2500A
	CTM90.3500	3500A	3200A	220V 3.2A	IM01220904	3000A 1.1µH	10500W	3500A

NOTE: DO NOT OVERSIZE the drive as regard the motor, so as not to affect control performances, till the auto-tuning procedures block. We recommend to choose a drive size that is comparable or directly higher than the rated motor current.

(1) Continuously delivered max. current (starting from this one, NO overload is present).

(2) Rated current; starting from this value, an overload of 130% for 20s can be present.

(3) RMS power supply values for cooling fan.

(4) Elettronica Santerno code of L4 three-phase switching inductance.

(5) Rated current and inductance values of L three-phase switching inductance (see figure 9g).

(6) Losses due to drive heating at continuously delivered max. current.

(7) Fuses FU1 - 2 - 3 for bar connection protection (see figure 9g).

Note: The branch fast-acting fuses for thyristor protection are included within the power module. Therefore no external fast-acting fuse is required, either on alternate side, nor on direct side, in case of regenerative operation.

EXTERNAL AND FIXING DIMENSIONS - MODULAR CTM90 CONTROL UNIT

See figure 9d, for external dimensions.

1	Earthing screw (thread size: M6).
2	ES600 control board terminal.
3	ES630 firing board terminal.
4	Bar terminal DIN, for connection to power unit .
5	Fastening on vertical panel through 4 M5 screws.
A B	Note: To reach the control unit inside, loosen the screws A and B, make the frame slide upwards until the screws B can be removed from their holes, then tilt the frame outwards.

EXTERNAL AND FIXING DIMENSIONS - MODULAR CTM90 POWER UNIT

See figure 9e (modular CTM90 - size 3) and figure 9f (modular CTM90 - size 4), for external dimensions.

1	Fastening on vertical panel through 6 M6 screws.
X1..X8	Extractable connectors for control unit connection.
X9	Supply terminal board for cooling fan.

POWER AND SUPPLY CONNECTIONS - MODULAR CTM90

See figure 9g.

CU	Control unit.
L1/L2/L3	50/60Hz supply three-phase mains (standard 380...415 Vac).
FU1/FU2/FU3	Fuses for bar connection protection.
FU4/FU10	4A quick fuses for power unit cooling assembly.
FU5/FU6	Delayed fuses for TC auto-transformer primary protection.
FU7	Fast-acting fuse for rectifier bridge for d.c. motor field supply.
FU8/FU9	500 mA fuses min. protecting the connection at terminals 36/38 of three-phase mains.
KM	AC/DC bridge supply remote control switch.
L	Three-phase switching impedance.
MFE	Microswitches series signaling fast-acting fuse opening inside the power module.
PU	Power unit.
TC	Auto-transformer (if any) D.C. motor field supply. The alternate voltage V_{EA} on the secondary is obtained from the required direct voltage V_{EC} through the following formula: $V_{EA}=V_{EC} \cdot 1,11$
M	D.C. motor (armature circuit + field circuit).
A	AC/DC conversion bridge. The electric diagrams of power unit and control unit are shown on figures 9h and 9i.

Note: The polarities included within brackets for terminals 49 and 50 refer to the regenerative operation.

Fig. 9d - External and fixing dimensions - Modular CTM90 control unit

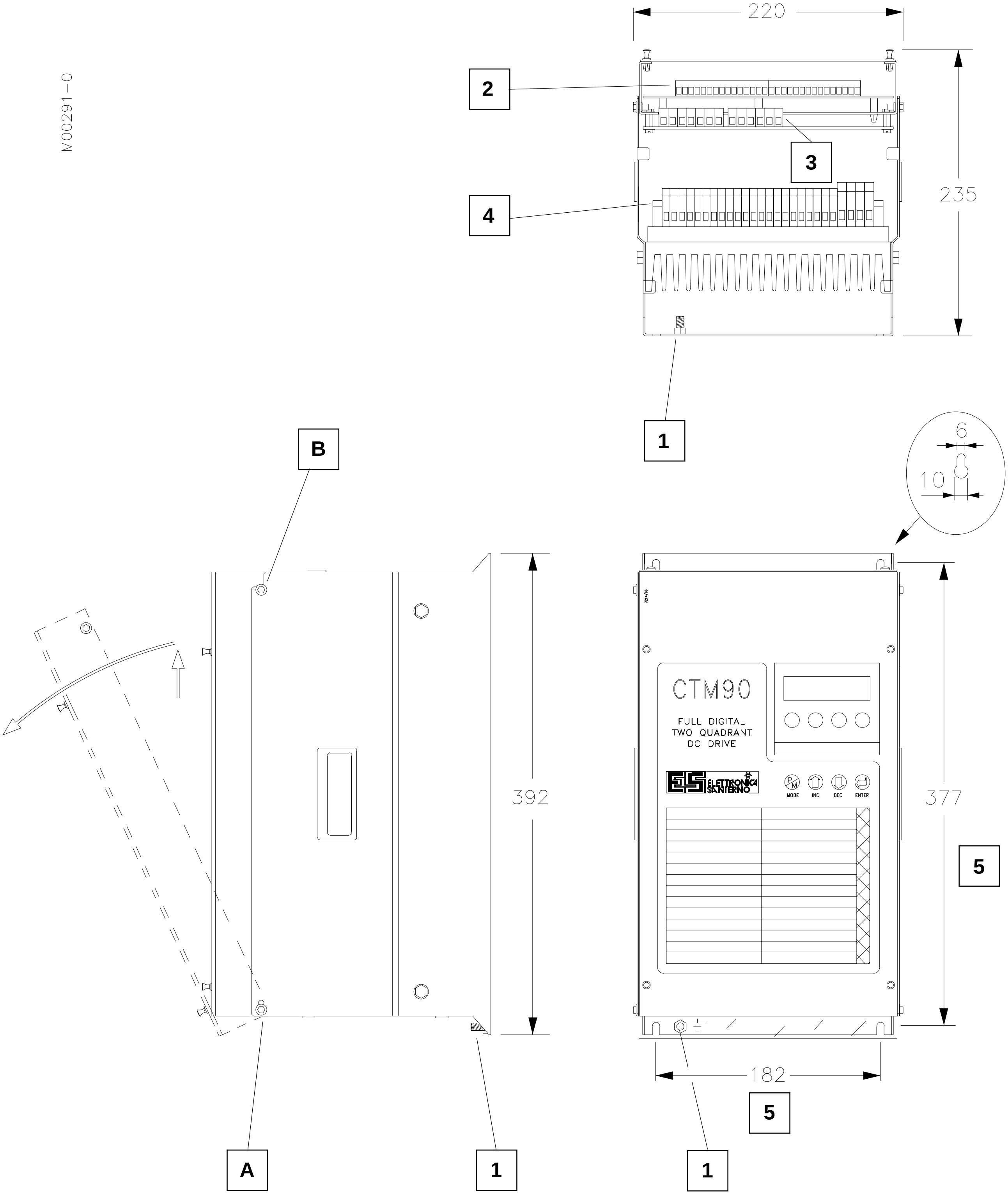


Fig. 9e - External and fixing dimensions - Modular CTM90 size 3 power unit

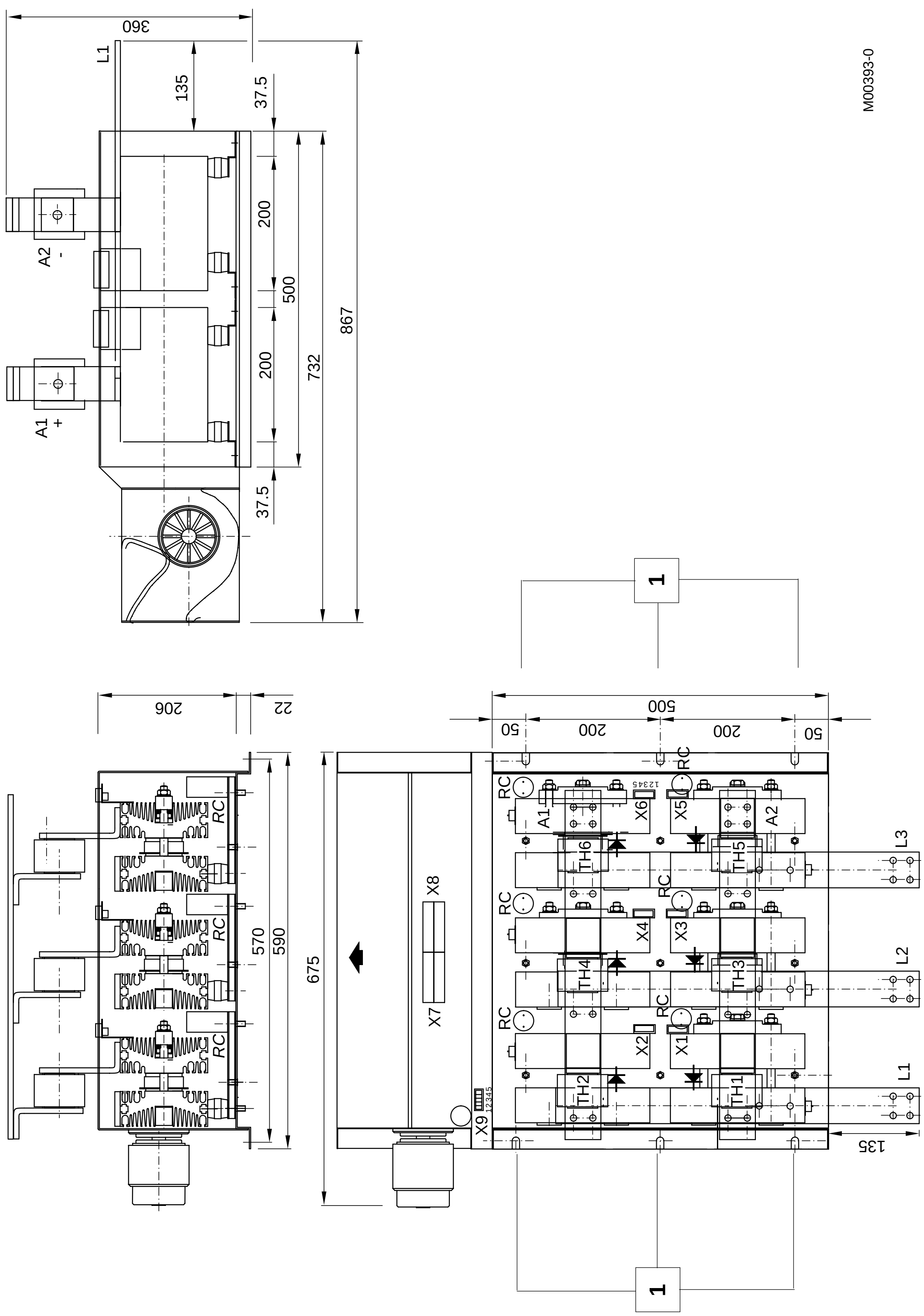


Fig. 9f - External and fixing dimensions - Modular CTM90 size 4 power unit

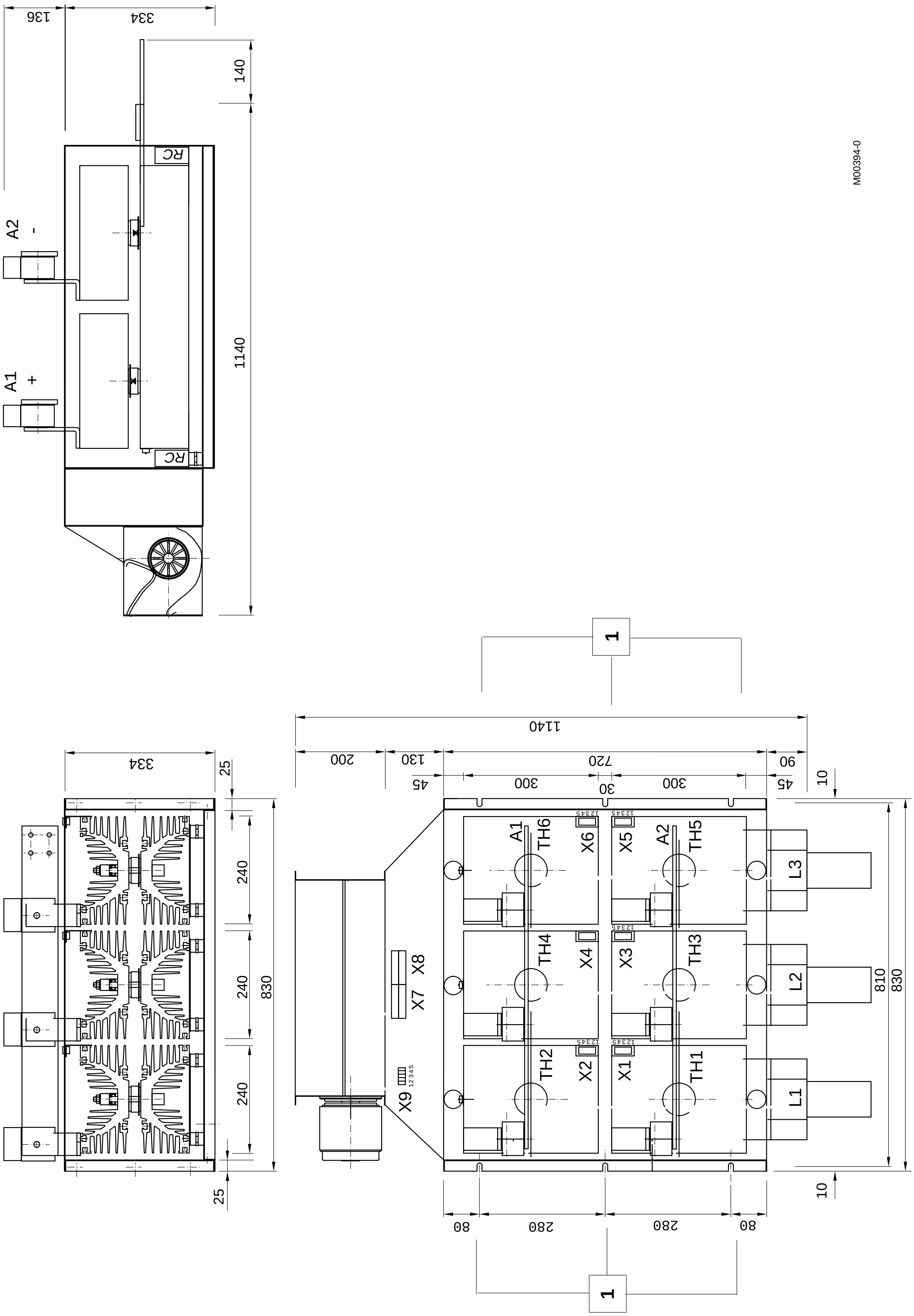
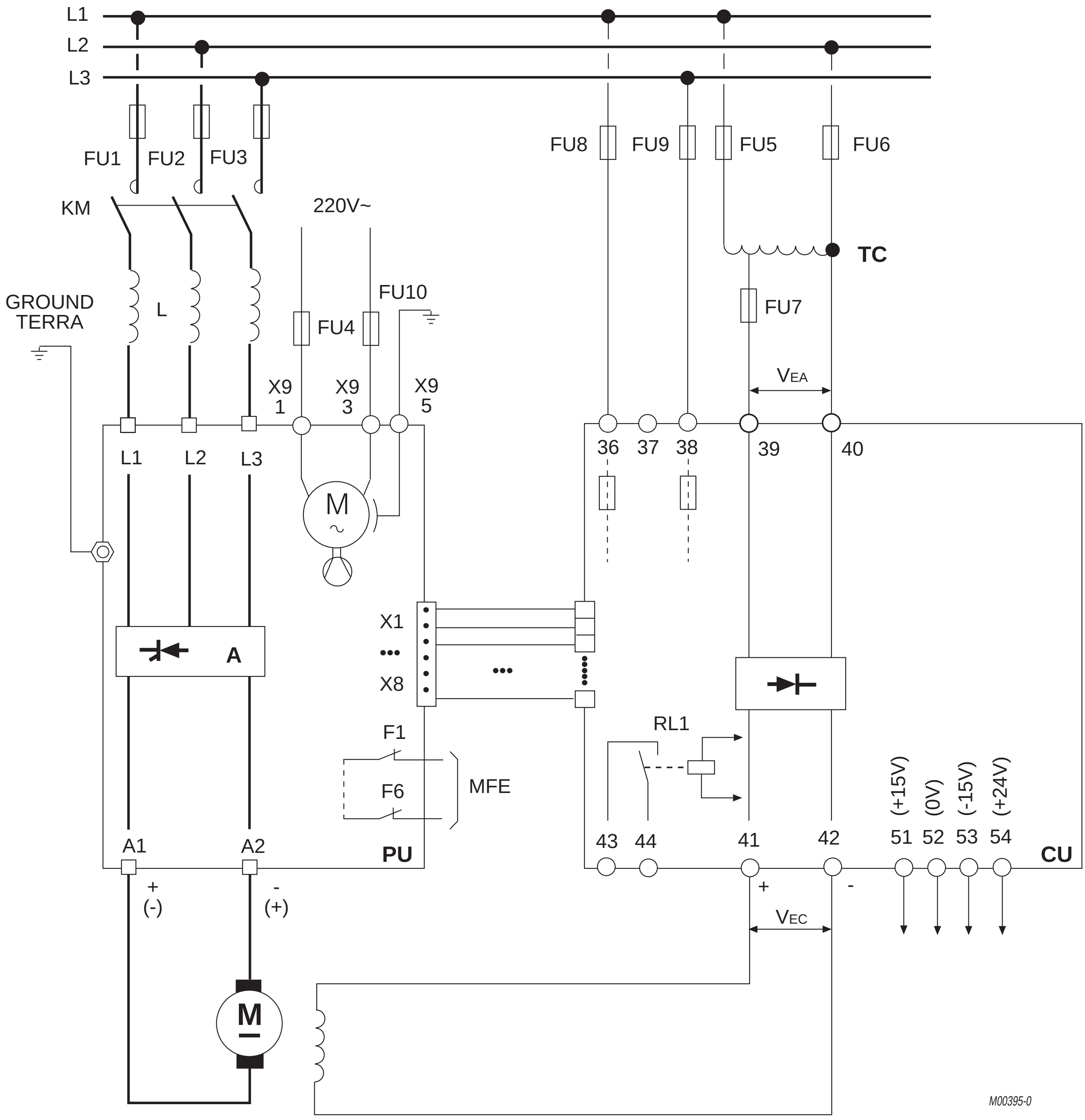


Fig. 9g - Power and supply connection diagram - Modular CTM90



Connect terminals 36 and 38 of control unit IN PHASE with bars L1 and L3 of power unit.

Fig. 9h - Electric diagram of modular CTM90 power unit

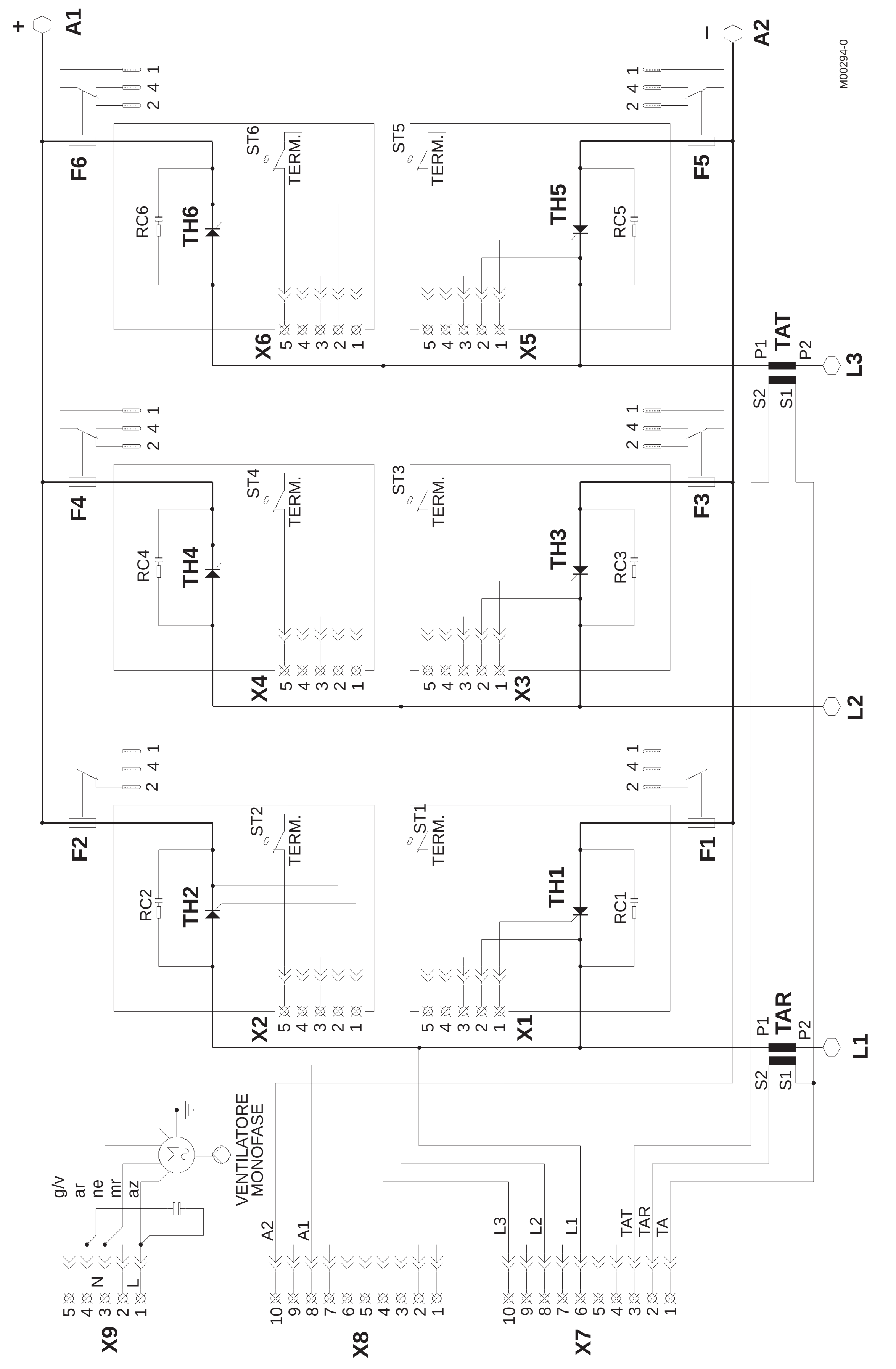
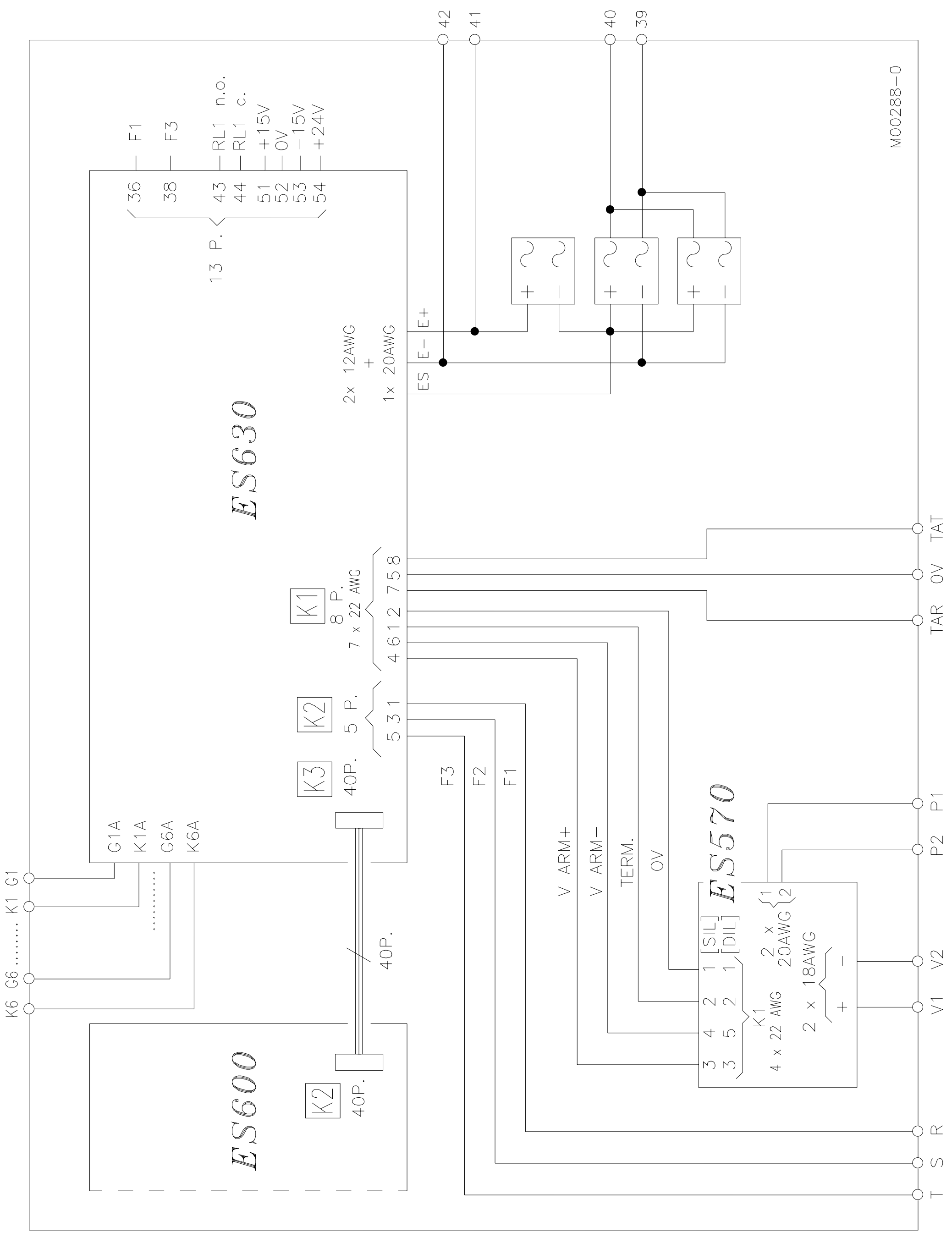


Fig. 9i -Block diagram of modular CTM90 control unit



DESCRIPTION OF EXTRACTABLE CONNECTORS - MODULAR CTM90

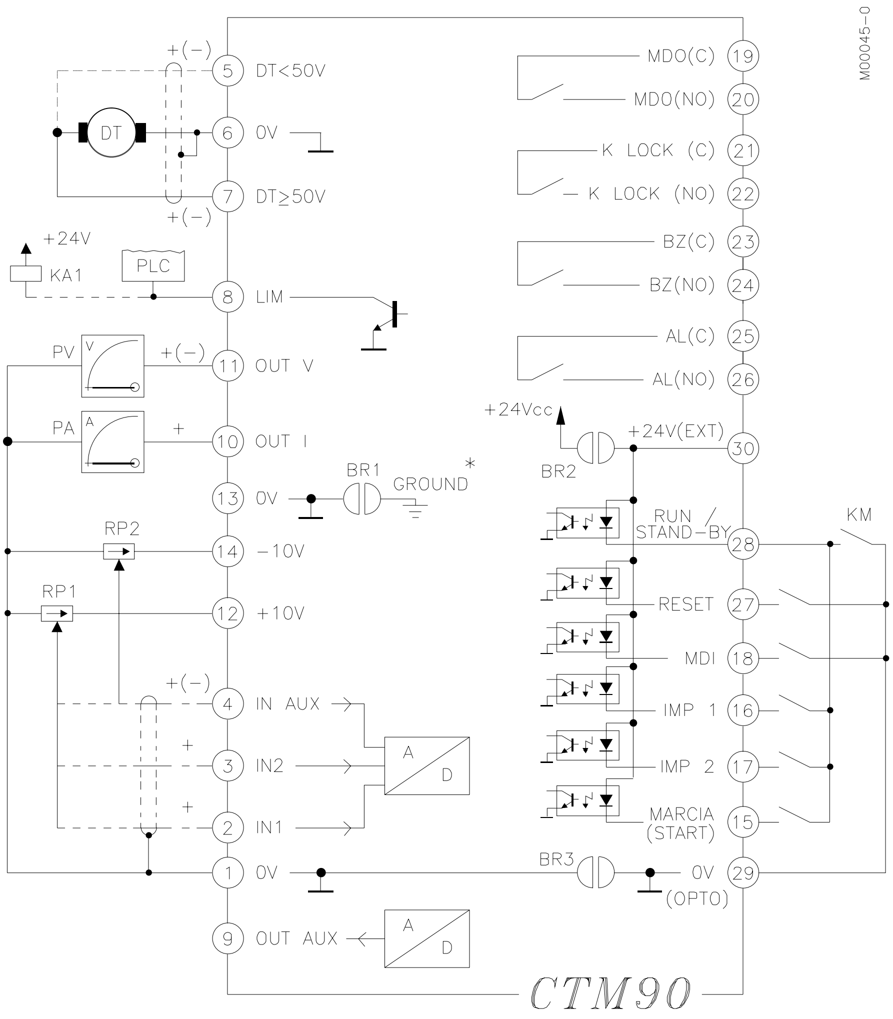
X1.1	Thyristor gate TH1	(to terminal G1 of control unit)
X1.2	Thyristor cathode TH1	(to terminal K1 of control unit)
X2.1	Thyristor gate TH2	(to terminal G2 of control unit)
X2.2	Thyristor cathode TH2	(to terminal K2 of control unit)
X2.4	Radiator thermal pellet of TH2	(to terminal P1 of control unit)
X2.5	Radiator thermal pellet of TH2	(shortcircuited with X4.4)
X3.1	Thyristor gate TH3	(to terminal G3 of control unit)
X3.2	Thyristor cathode TH1	(to terminal K3 of control unit)
X4.1	Thyristor gate TH4	(to terminal G4 of control unit)
X4.2	Thyristor cathode TH4	(to terminal K4 of control unit)
X4.4	Radiator thermal pellet of TH4	(shortcircuited with X2.5)
X4.5	Radiator thermal pellet of TH4	(shortcircuited with X6.4)
X5.1	Thyristor gate TH5	(to terminal G5 of control unit)
X5.2	Thyristor cathode TH5	(to terminal K5 of control unit)
X6.1	Thyristor gate TH6	(to terminal G6 of control unit)
X6.2	Thyristor cathode TH6	(to terminal K6 of control unit)
X6.4	Radiator thermal pellet of TH6	(shortcircuited with X4.5)
X6.5	Radiator thermal pellet of TH6	(to terminal P2 of control unit)
X7.1	Current transformer common	(to terminal 0V of control unit)
X7.2	Current transformer output TAR	(to terminal TAR of control unit)
X7.3	Current transformer output TAT	(to terminal TAT of control unit)
X7.6	Bar potential L1	(to terminal R of control unit)
X7.8	Bar potential L2	(to terminal S of control unit)
X7.10	Bar potential L3	(to terminal T of control unit)
X8.8	Bar potential A1	(to terminal V1 of control unit)
X8.10	Bar potential A2	(to terminal V2 of control unit)

Note: The pins of extractable connectors not included in the above list are NOT CONNECTED.

SIGNAL CONNECTIONS

RP1 Potentiometer (2.5 KΩ min.) for positive speed reference or for current reference (see param. # 61 and # 74).
RP2 Potentiometer (2.5 KΩ min.) for negative speed reference correction.
NOTE: Both potentiometers RP1 and RP2 can send to terminal K1/4 a current external limit signal (see param. #57 and #77).
KA1 24Vdc coil of possible relay, signaling drive in current limitation condition.
DT Tacho Generator. (Note: For further information about polarities, see the description of terminals 5 and 7 in ES600 CONTROL BOARD TERMINAL DESCRIPTION section).
KM NO auxiliary contact of the AC/DC bridge power supply remote switch.
PV Speedometer. (Note: For further information about polarities, see the description of terminal 11 in ES600 CONTROL BOARD TERMINAL DESCRIPTION section).
PA Ammeter.
* Possible earth connection to be performed outside. It is generally recommended to keep BR1 closed and NOT to perform the earth connection (see SOLDERABLE PRESETTING JUMPERS section).

IMPORTANT: THE SHIELD OF THE SHIELDED CABLES HAS TO BE CONNECTED TO THE TERMINALS INDICATED IN THE ELECTRIC DIAGRAM, AND NOT TO THE EARTH.



N.B.: Concerning the regenerative operation, on terminals K1/2-3 it is possible to set, starting from version C1.06, a negative speed reference 0...-10V (see param. #54).

Fig.10 - Signal connections for CTM90.

ES600/3 CONTROL BOARD LAY OUT

See fig.11

Adjustment trimmers

RV1 (LCD)	LCD contrast
RV4 (OUT I)	Analog output of the current signal to the terminal K1/10. Factory adjusted to get +4Vdc on this terminal with the parameters #32 and #49 at 100% (max. limit current).
RV5 (n MAX)	Max. speed reached with par. #02=100%. NOTE: for tacho generator feedback only.
RV7 (OUT V)	Analog output of the speed signal at terminal K1/11. Factory adjusted to get ±10Vdc on this terminal with 100% of Vdtn (see parameter #02).

NOTE: With the printed circuit ES600/3, the trimmers RV4-5-7 are located on the **removable board ES602**, while with the printed circuit ES600/2, these trimmers are directly tinned on the base plate and trimmer RV5 (rough adjustment) works in combination with trimmer RV6 (fine adjustment).

Solderable presetting jumpers:

BR1 closed	It connects the 0V of the board to a shielding track placed on the board edge. This track can be grounded through the proper FASTON connection which is tinned in the lower left side and named TERRA (GROUND). In this case, connect the FASTON connection to a ground socket through a proper section cable (ex.: 2.5mm^2). BR1 is normally closed.
BR1 open	The 0V of the board is insulated as regard the external shielding track.
BR2 closed	It connects to terminal board the inner voltage +24Vdc (for digital inputs). BR2 is normally closed.
BR2 open	For the digital inputs an external voltage +24Vdc is used, which gets them optoinsulated.
BR3 closed	It connects to the terminal board the inner 0V (for the digital inputs). BR3 is normally closed.
BR3 open	For the digital inputs an external 0V is used, which gets them optoinsulated.

Presetting JUMPERS:

J1-J2 closed:	They send the armature feedback signal drawn through power bars 49-50. J1 and J2 are normally closed.
J1-J2 open:	They insulate the control board and the power section (see parameter #73).
J6 (NOF):	At terminal K1/10 there is a signal proportional to the instantaneous values of the motor armature current.
J6 (F):	The above mentioned signal passes through a 2nd order low-pass filter. J6 is normally set to “F”.

Note: J3 - J4 - J5 set to "HALL" in CTM90.10...330
J3 - J4 - J5 set to "TA" in CTM90.410...3500
Do not change jumpers J3 - J4 - J5.

Display LEDs:

L1 (+15V)	+15Vdc supply presence for the analog section.
L2 (-15V)	-15Vdc supply presence for the analog section.
L3 (+5V)	+5Vdc supply presence for the digital section.
L4 (ON)	Drive in regulation (thyristors on).
L5 (LIM)	Armature current at the max. value allowed in that moment.

NOTE: LEDs L4 - 5 are present only with printed circuit ES600/3.

NOTE: It is possible to install a control board ES600/3 to replace a board ES600/2, but not vice versa.

ES630/2 CONTROL BOARD LAY OUT

See fig. 12.

Presetting jumper.
For CTM90.330A max: J3 in pos. 2, J4 in pos. 1, J8 in pos. 1.
For CTM90.410A min: J3 in pos. 1, J4 in pos. 2, J8 in pos. 2.
Do not change the jumpers J3 - J4 - J8.

Fig.11 - ES600/3 control board lay-out.

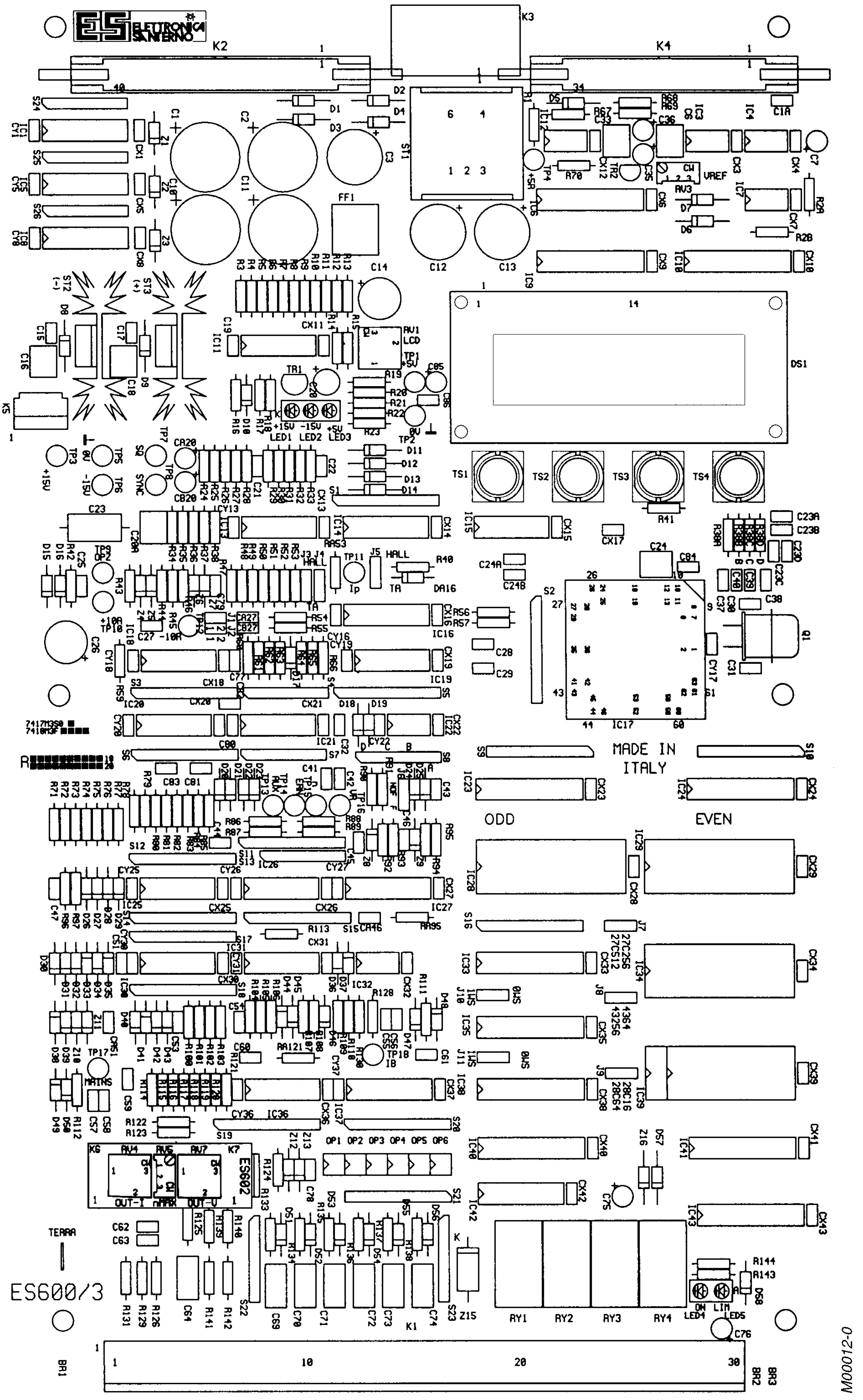
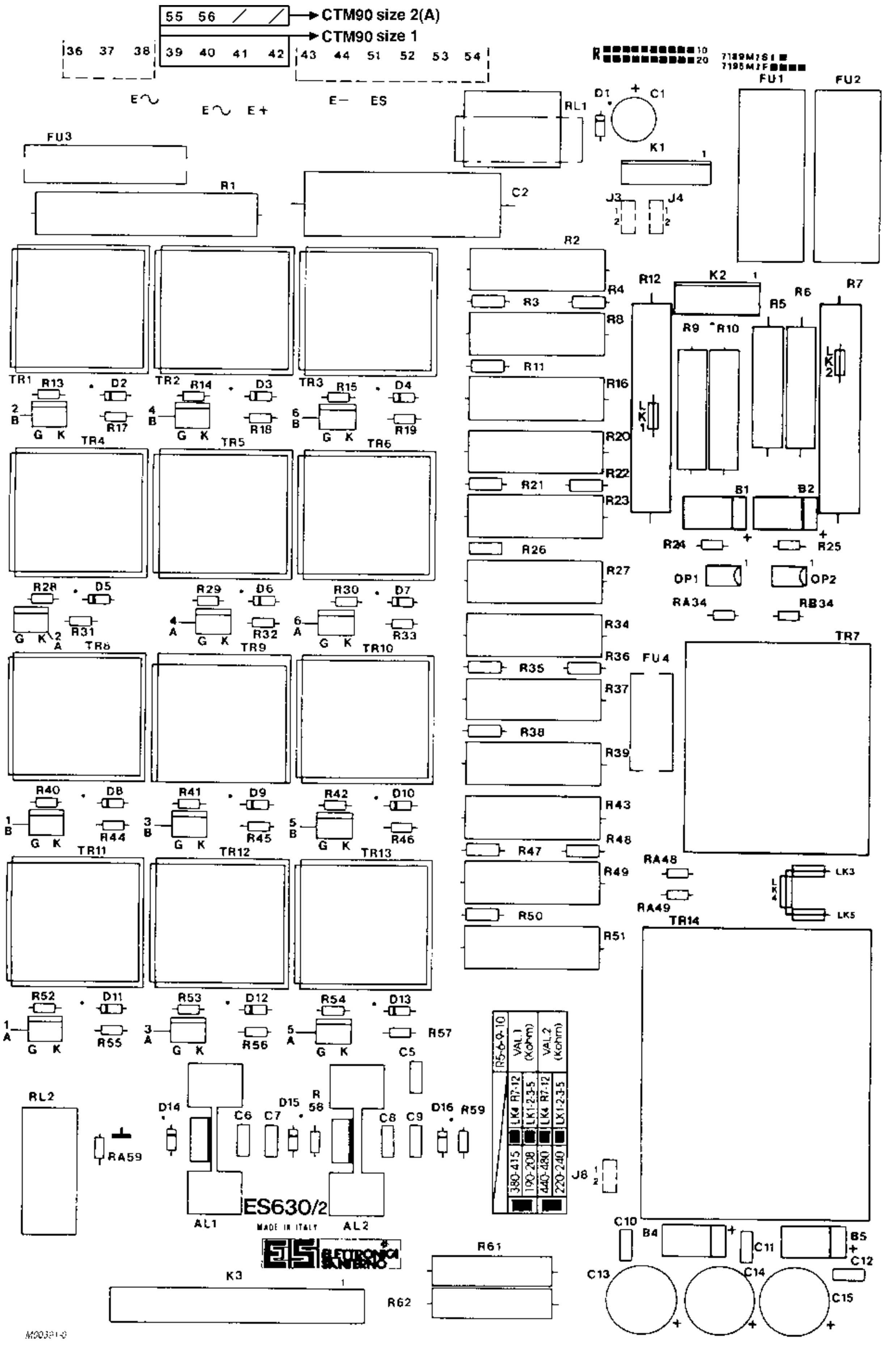


Fig.12 - ES630/2 Firing board lay-out



ES600 CONTROL BOARD TERMINAL DESCRIPTION

See fig.11

1 (0V)
0V for ANALOG SIGNALS

2 (IN1)
Input for speed or current reference (0 ... +10V)
Rin≈20 kΩ

3 (IN2)
Input for speed or current reference (0 ... +10V)
Rin≈20 kΩ

4 (IN AUX)
Input for auxiliary reference (see parameter #57) (-10 ... +10V)
Rin≈20 kΩ

5 (DT<50V)
Tacho Generator feedback (max. 50V). Positive polarity with normal operation (not regenerative).
Rin≈25 kΩ

6 (0V)
0V for TACHO GENERATOR

7 (DT≥50V)
Tacho Generator feedback (max. about 240V). Positive polarity with normal operation (not regenerative).
Rin≈125kΩ

8 (LIM)
OPEN COLLECTOR output to signal that drive is in current limit. Transistor goes ON when I=ILIM.
24Vdc max / 100mA max

9(OUT AUX)
Analog auxiliary output that can be preset with the parameter #58 (see).
10Vdc max / 5mA max

10 (OUT I)
Current signal output for possible ammeter. Adjustable through trimmer RV4. Standard calibr.: + 4V in max. current limit (without overlimit)
10Vdc max / 5mA max

11 (OUT V)
Voltage signal output (speed) for possible voltmeter (speedometer) or cascading the references. Positive polarity with normal operation (not regenerative). Adjustable through trimmer RV7. Standard calibr.: ± 10V at max. speed, with tacho generator feedback. With armature feedback, correct the calibration using trimmer RV7.
10Vdc max / 5mA max

12 (+10V)
+10 Vdc supply output
5mA max

13 (0V)
0V for ANALOG SIGNALS

14 (-10V)
-10 Vdc supply output
5mA max

15 (START)
Enabling speed reference at K1/2, K1/3 and eventually at K1/4 (#57 = 1).
Active signal if short-circuited to 0V. By opening the contact, a fall ramp is set with the time preset by parameter #25 (at least one of the two ramps set with parameters #23 and #24 should however be other than zero) with motor set to idle operation at the end. With a CONTEMPORARY contact closure at terminals 15, 16 (17), the first dominates the other ones.
NOTE (note valid for terminals 16 and 17 too): after an alarm has stopped the drive, beside performing the RESET (if the alarm has been stored in the E^2PROM), it's necessary to open the enabling contact used in that particular moment (K1/15, K1/16 or K1/17), then close one of the three above mentioned contacts to start the drive again. **See also the section Alarm tripping and reset**.
24V / 3mA

16 (IMP1)
By closing the contact the motor runs with the 1st reference value for the jog (See #21). Active signal if short-circuited to 0V. NOTE: See note at terminal 15.
24V / 3mA

17 (IMP2)
By closing the contact the drive runs with the 2nd reference value for the jog (See #22). Active signal if short-circuited to 0V.
NOTE: See note at terminal 15.
24V / 3mA

18 (MDI)
Digital input whose meaning is determined by the value assigned to par. #74 (see).

19 (MDO (C))
Common of the inner relay configurable by par. #86.

20 (MDO (NO))
NO contact of the inner relay with meaning according with par. #86
250Vac max. / 1250 VA max.

21 (K LOCK (C))
Common of the inner relay to signal drive in effective overlimit. for max. preset time.

22 (K LOCK (NO))
NO contact of inner relay to signal drive in overlimit for max. preset time.
NOTE: The relay energizes (and closes the contact) if the drive remains in effective overlimit (param.#41) for the maximum preset time, set with #39. The display shows the warning message W13. The relay de-energizes when the drive is set in STAND-BY.
250Vac max / 1250VA max

23(BZ(C))
Common of inner relay for zero speed

24 (BZ (NO))
Inner relay NO contact for zero speed.
NOTE: The relay de-energizes (and opens the contact) when the speed is equal to zero (enabling the remote control switch KM opening).
250Vac max / 1250VA max

25 (AL (C))
Common of inner relay for alarm signaling

26 (AL (NO))
NO contact of inner relay for alarm signaling.

NOTE: The relay de-energizes (and opens the contact) in case of tripping of any of the alarms which are signalled by the display (see ALARM LIST section), excluding W13 (tripping of the overlimit block). The tripping of an alarm causes the block of the drive operation (motor idles, drive in STAND-BY). To energize the relay again, after having removed the emergency cause, use the RESET command.
250Vac max / 1250VA max

27 (RESET)
Reset control for drive OK STATUS after alarm tripping. Active signal if short-circuited to 0V.
With drive blocked because of alarm intervention, a CONTEMPORARY depressure of the two push-buttons INC and DEC on the keyboard (see fig. 13) has the same effect of closing the RESET contact.
24V / 3mA

28 (RUN/STAND-BY)
Control enabling the drive operation. Active signal if shortcircuited to 0V. The opening of the contact blocks the drive (motor idles, drive in STAND-BY).
NOTE: After the tripping of an alarm which blocks the drive, if the connection in fig. 10 for terminals 15, 16, 17, 28 is adopted, to start again is sufficient, after resetting, to open (and close again) the contact on terminal 28.
24V / 3mA

29 (0V OPTO)
External 0V for digital input optoinsulating.
NOTE: This insulation is got by letting open the solderable jumper BR3. On the contrary, by closing this jumper, the inner analog 0V is fed to the terminal board.

30 (+24EXT)
Ext. supply voltage 24Vdc for digital input optoinsulation (K1/15, K1/16, K1/17, K1/18, K1/27, K1/28).
NOTE: This insulation is got by letting open the solderable jumper BR2. On the contrary, by closing this jumper, the inner voltage +24V is fed to the terminal board.
DO NOT USE THIS TERMINAL WITH **BR2** CLOSED to supply external loads, but use the voltage +24Vdc, available at terminal 54 (**NOTE: Do not use this terminal with term. 51 and/or 53 already in use**).

IMPORTANT WARNINGS

1) Always install a three-phase switch on the alternative side and directly connect one of its N.O. auxiliary contacts to the series of the terminal K1/28 (RUN), as shown in the signal connection diagram (fig.10).

2) Never connect other single or three-phase loads in parallel to the bars 46, 47, 48: that is the remote control switch, through the three-phase impedance, must only supply the 3 a. m. bars of the converter.

ES630 FIRING BOARD TERMINAL DESCRIPTION

See fig. 12

36 - 38
Supply from threephase mains (standard 380...415V_{CA} - 50/60Hz) for supplies and synchronisms.
NOTE:CONNECT TERMINALS 36 AND 38 IN PHASE WITH THE POWER BARS 46 AND 48.
NOTE: Inner fast acting fuses (500mA/500V) are connected in series to the terminals 36 and 38.

37
Not connected

39 - 40
Supply from single-phase mains (max standard: 380...415Vac - 50/60Hz) for inner rectifier for field winding of dc motor.
NOTE:An inner fast acting fuse (16A/500V) is installed in series to terminal 39, on CTM90 330Amax only.

41 - 42
Dc supply output for dc motor field winding. Positive polarity on the terminal 41.
370Vdc max / 12 A max for CTM90 330 A max, 30A max for CTM90.410-900.

43
NO contact of inner relay to signal field presence. The relay de-energizes (and opens the contact) in case of field current loss.
250Vac max / 5A max

44
Common of inner relay to signal field presence.

51
Supply +15 Vdc
30 mA max (NOTE: **DO NOT use with term. 54 already in use**).

52
0V.

53
Supply -15Vdc
30 mA max (NOTE: **DO NOT use with term. 54 already in use**).

54
Supply +24Vdc
40 mA max (NOTE: **DO NOT use with term. 51 and/or 53 already in use**).

(in CTM90.500...900 only)

55 - 56
Cooling fans supply (100W / 220Vac).
NOTE: 2A/500V inner fast acting fuse series connected to term. 55.

POWER TERMINAL BOARD DESCRIPTION

See fig.4-5 for CTM90 size 1 and fig.9 for CTM90 size 2(A).

46 - 47 - 48
Supply from three-phase mains (standard 380...415 Vac - 50/60 Hz for modules with V_R=1400V) for AC/DC conversion bridge.
NOTE: Connect the bars 46, 47 and 48 according to the R,S,T sequence.

49 - 50
DC supply output for dc motor armature winding. Positive polarity on bar 49. With regenerative operation only: positive polarity on bar 50.

KEYBOARD AND ALPHA-NUMERIC DISPLAY

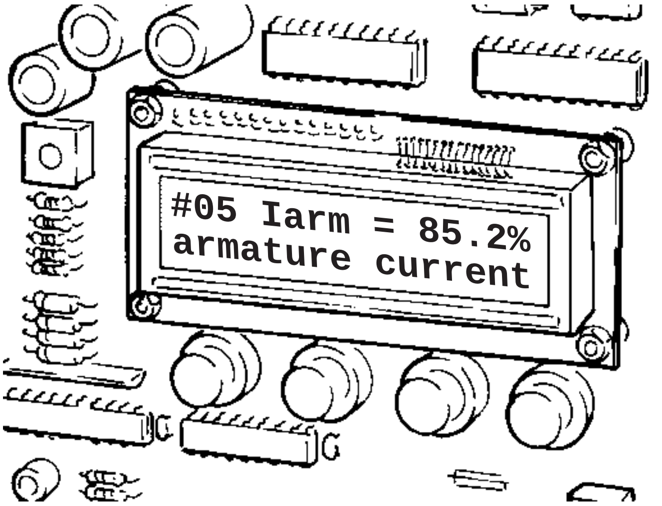


Fig.13

MOD(E) INC DEC ENTER

Control software is loaded on the two EPROM'S IC28 and IC29 in the board ES600, whose version (C1.xx) is indicated on adesive labels on them, while various parameters may be saved on EEPROM IC39 in the same board.
Every further software version is compatible with the previous one, i. e. version C1.04 can be used in lieu of the version C1.03.
NOTE: Before replacing a version earlier than C1.08 by the C1.08 itself, you have to mask (saving on E^2PROM) the A03 alarm with parameter #65. Then, with the new version installed, check the content of parameter #88, whose default value must be 1Hz/sec. If necessary write it again, and save it on E^2PROM. At the end of the operation, restore the original value on parameter #65.
The compatibility in the opposite direction is on the contrary not guaranted: for example you can meet some trouble placing a version C1.03 in a converter that already operated with the version C1.04.
Only when you install a previous version being not older than version C1.04, you can surely avoid any type of problems by **resetting the default values** (par. #14=5); in this way, however, you'll loose all data previously stored in the E^2PROM.
The drive is equipped with a two lines by 16 character LCD display, and with 4 keys to preset or display the system characteristic parameters or to show the alarm messages. The first 3 characters, in the upper left corner, refer to the parameter or alarm code (See fig. 13). The parameters are sequentially numbered from #00 to #90 **(# 89 up to vers. C 1.09 and #87 up to vers. C1.07**) and their list (with the corresponding meaning) is described in the following. Particularly:

- the parameters from #00 to #11 are read only ones, and the user cannot interact with them;
- the parameter #12 can be changed by the user, but, under certain conditions, is updated during drive operation; then, if in tacho feedback, it can be automatically calculated by auto-tuning of the c.e.m.f. (#14=4);
- the parameter #13 (read only) can be “calibrated” by the user.
- **the parameter #14 is the key parameter, containing the access code that allows to change all other parameters** (#12, #13 and from #15 upwards);
- the parameters from #15 upwards can be changed by the user and allow to completely configure the system; some of them are also changed during automatic calibration (see the corresponding section).

NOTE: with the word “page” we mean the 32 characters that simultaneously appear on the display.

The keys are called MOD INC DEC ENTER and have the following meaning:

- MOD toggles between the mode “change page number” (cursor off) and the mode “change value in the page” (blinking cursor) and vice versa; so, with cursor off , the various parameters are sequentially displayed, while with blinking cursor, the contents of a given parameter can be changed.
- INC increases the page number or the value shown in the page, according to the selected mode with MOD (as indicated by the cursor state).

- DEC decreases the page number or the value shown in the page, according to the selected mode with MOD (as indicated by the cursor state).
- ENTER saves on EEPROM (non-volatile memory) the actual value shown by the current page. This value will remain stored even after switching the drive off, and will be available when the drive is turned on again.

NOTE: For its operation, the drive uses the parameter set present in that very moment. The parameter updated with the keys INC or DEC is immediately used instead of the previous one, even if ENTER has not been pressed. Obviously this changed parameter will be lost when switching the drive off, if it has not been saved on the EEPROM.

- RESET FUNCTION: With drive blocked because of alarm tripping, CONTEMPORARY pressing the two push-buttons INC and DEC on the keyboard (see fig. 13) has the same effect of closing the RESET contact at terminal K1/27.
  If the display shows an alarm, the keypad remains active, **up to vers. C1.08**, for alarm A04 only (mains voltage out of tolerance - see mains alarm list), while **from vers. C1.09** the keypad remains active for any kind of alarm.

Fig. 14 shows some examples of how to interact with the display and the keys:

AUTOMATIC CALIBRATION

CTM90 is equipped with a special operation mode which automatically calculates the ideal parameters to be input in the current and speed loops and recognizes the basic motor and load characteristics. The various parameters already have default values, written on EEPROM, which grant an almost satisfactory operation of the drive applications.
To further enhance the performance, follow the AUTOMATIC CALIBRATION procedure.
This display-assisted procedure is performed off-line at the first start-up and whenever the user requires it (ex. when the electro-mechanical characteristics of the machine are changed).
Particularly, three types of automatic calibration are performed:
Before starting each of them, the contact on term. 15 must be OPEN.

1) Current auto-adjustment (to be performed setting the parameter #14=2 and pressing ENTER): it calculates the parameters #18, #19, #45 and #46;

2) Speed auto-adjustment (to be performed setting the parameter #14=3 and pressing ENTER): it calculates the parameters #28 and #29;

3) C.e.m.f. auto-adjustment (by setting parameter #14=4 and pressing ENTER): it calculates param. #12. It can only be performed with tacho feedback and without external field de-energizing unit.

The values found are automatically saved on EEPROM at the end of the calibration. The execution of these three operations requires about one minute.

As previously pointed out in the STARTUP BASE PROCEDURE, it is recommended to ALWAYS make the automatic current adjustment.
For speed automatic adjustment too, it may be useful. It could be avoided in case of armature feedback or when the moment of inertia of the load is variable (as in a coiler): to this purpose, see chapter **MANUAL CALIBRATION** in the Appendix, that also describes the use of the automatic adjustment of the speed parameters (parameters #80...85).
At the end, for the c.e.m.f. adjustment (only with speedometer feedback), the MANUAL input of the value is recommended as it is an easy and immediate operation: see chapter **MANUAL CALIBRATION**, paragraph "Calibration of max. counter electromotive force".

Fig.14 - Interaction with keyboard and display.

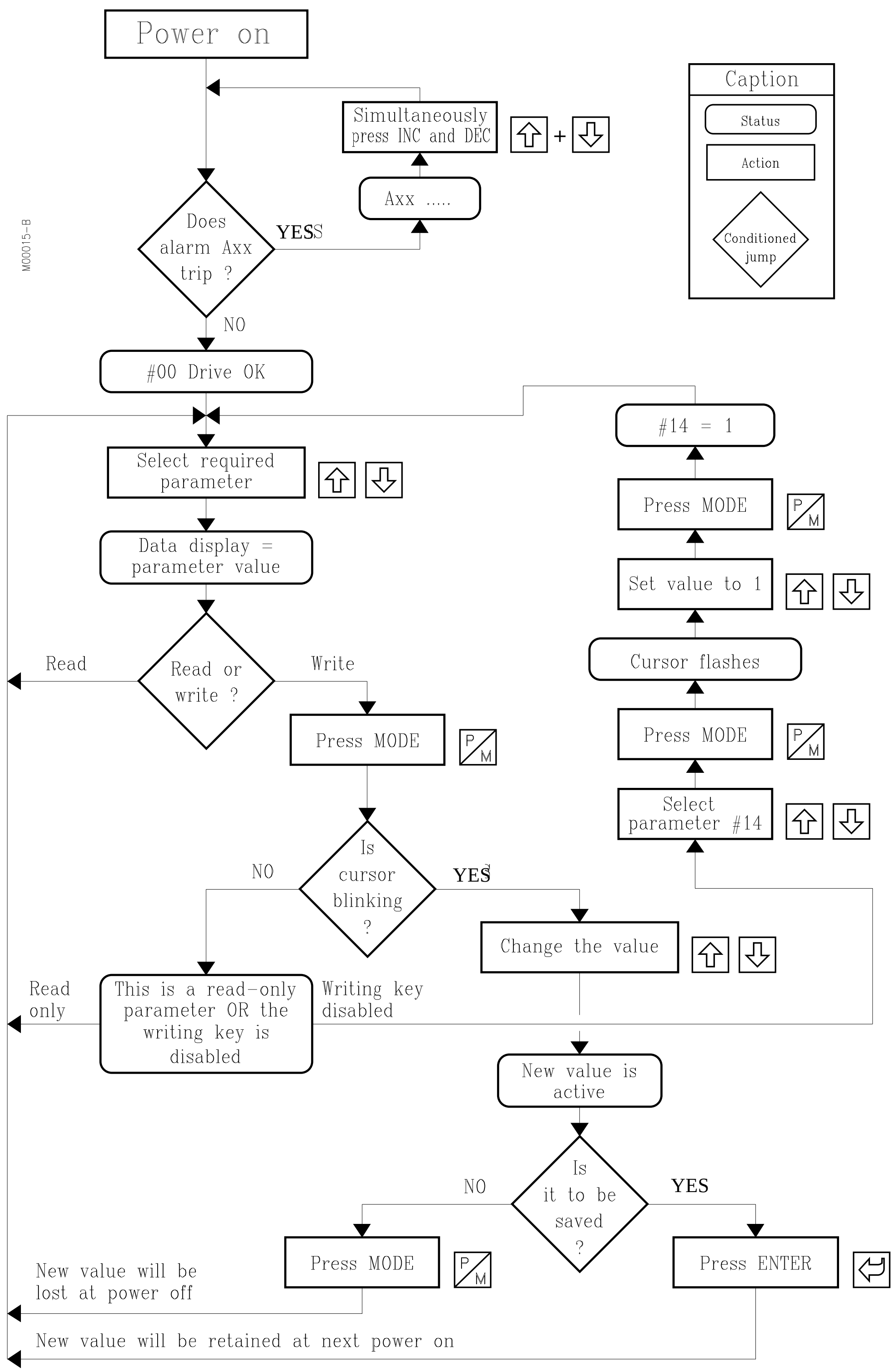
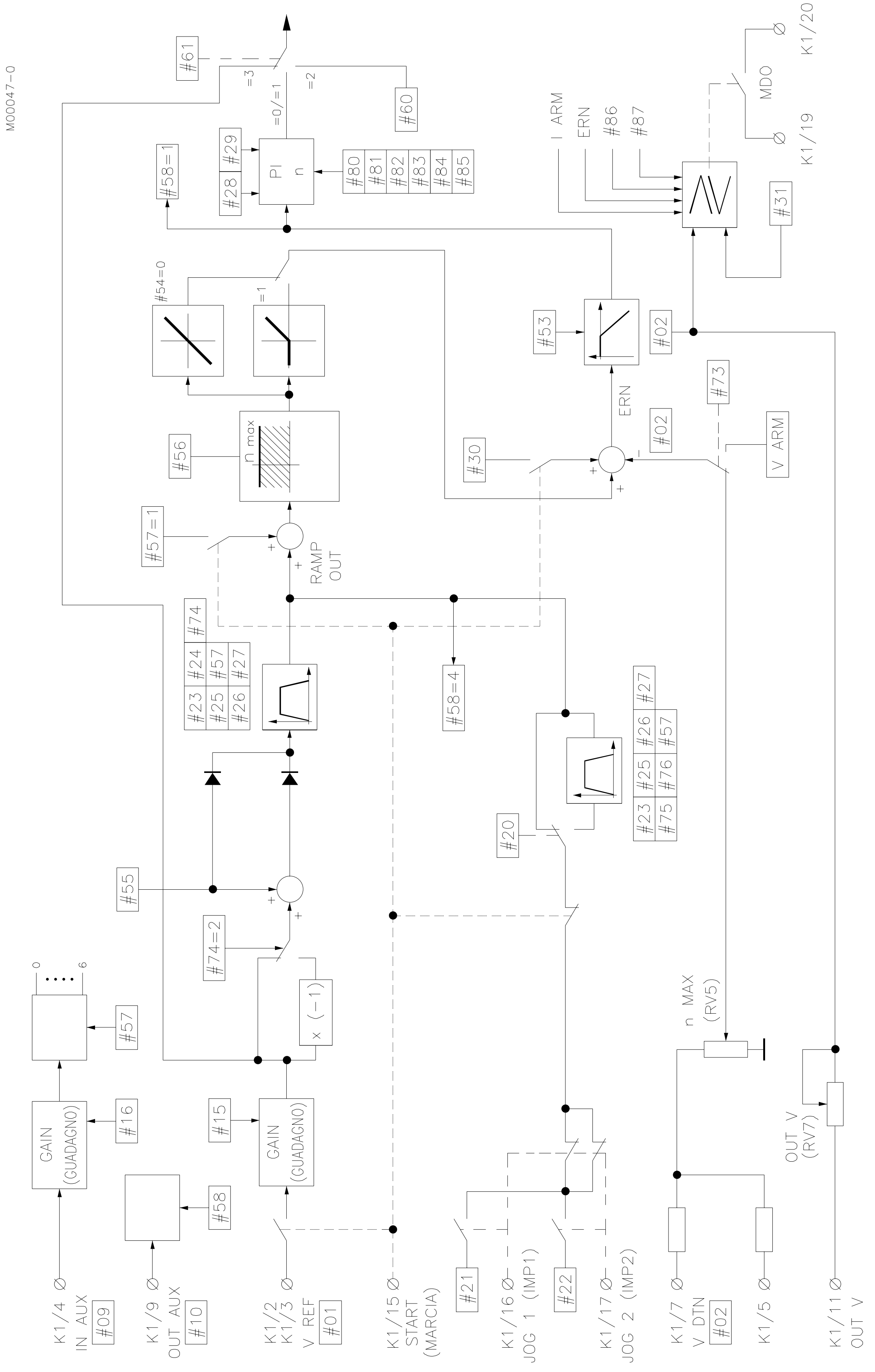
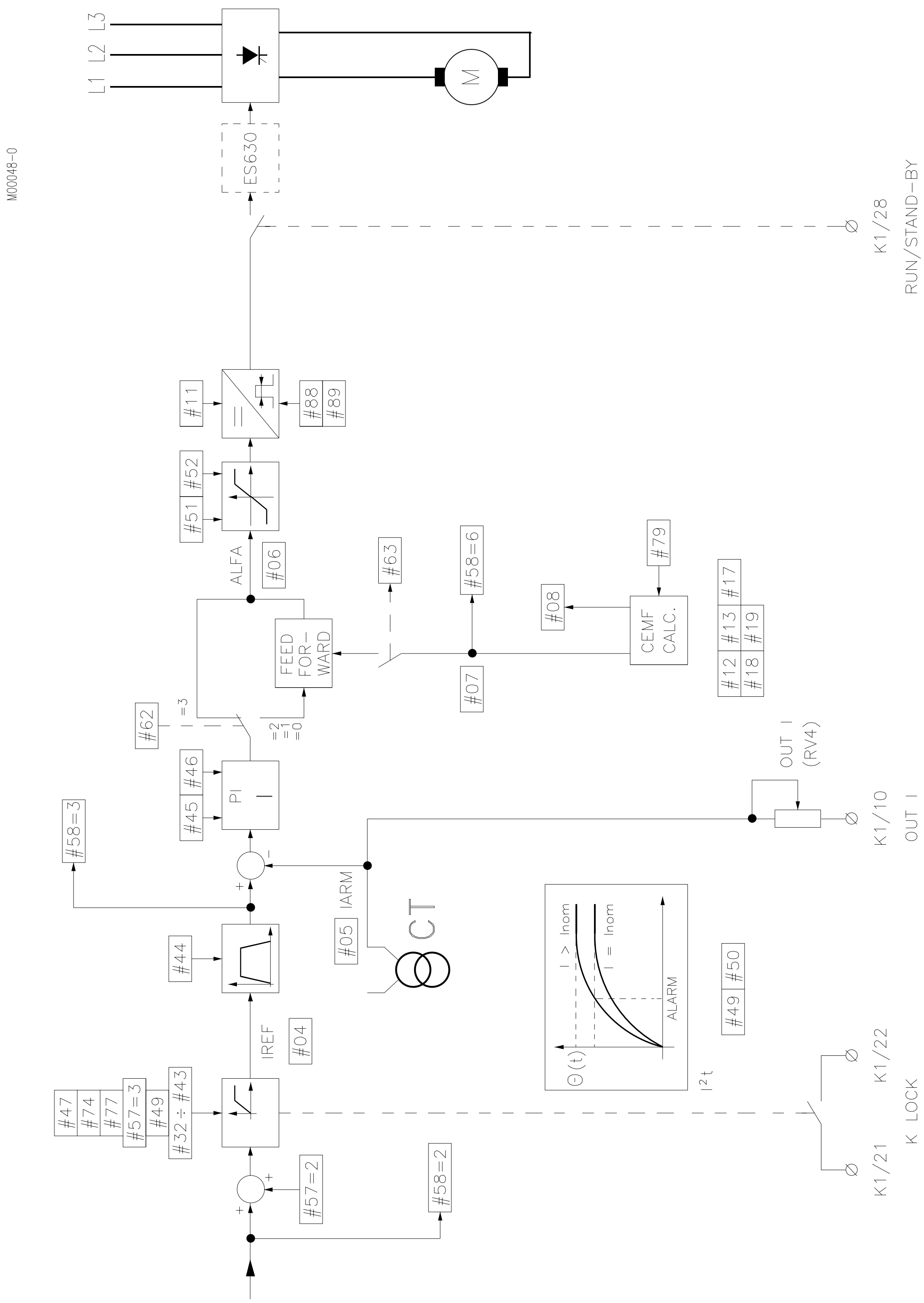


Fig.15 - Block diagram of the control (to be cont'd)





... cont'd Fig.15 - Block diagram of the control.

Fig.16 - Main parameters diagram.

PARAMETERS LIST

P **-Parameter no.**
R -Range of allowed values
D -Factory preset value
F -Function

P #00 Drive OK (Axx...)

F Drive operation status

P #01 Vref

R -100 %.. +100%
F Speed or current reference: the sum of values at term. K1/2 and K1/3 is displayed, always considering the amplification (or de-amplification) to which this value is internally subject, obtained with param. #15. If, for example, the motor runs at 2000 rev/min. with a 10V reference and #15=1.00, then with a 10V reference and #15=0.25 the motor will run at 500 rev/min. (displaying #01=25% and #02=25%), while with a 2.5V reference and #15=2.00, the motor will run at 1000 rev/min. (displaying #01=50% and #02=50%).

P #02 n (Varm)

R -100%..+100%
F Speed feedback from tacho generator: the value present at terminal K1/5 (DT < 50V) or at term. K1/7 (DT ≥ 50V) is displayed. 100% of this value corresponds to the max. speed preset through the trimmers RV5 (together with RV6 up to the board ES600/2).
In case of armature feedback (see param. #73), the armature % value is displayed; the 100% of this value is set through parameter #12 (see). In this case, trimmer RV5 (together with RV6 up to the board ES600/2) has no effect.

P #03 Ern

R -5% .. +5%
F Speed error: it displays the difference (software error) between the values of global speed reference (parameter #01 when only term. K1/2 and/or K1/3 are used) and of parameter #02.

P #04 Iref

R 0% .. 130%
F Current reference: the current loop input is displayed (that is equal to the output of the speed loop as modified by one of the parameters # 32 to #43). The scaling is the same as for parameter #05 (see hereunder).

P #05 Iarm

R 0% .. 130%
F Armature current: the current feedback signal is displayed, which is obtained through the current transformer(s). 100% of this value corresponds to the r ated one (ex. 100% = 180A for a CTM90.180).

P #06 alfa

R αmot .. αbrake
F Delay angle for thyristors switching on. This angle is calculated starting from the intersection points of the chained three-phase voltages.

P #07 CEMF

R -400 .. +440 V (norm. displayed range with supply 380Vac)
F With tacho-generator feedback: counter-electromotive force. It is internally calculated by the armature voltage and the motor electric features. With armature feedback the calculation is not performed.

P #08 Varm

R -400 .. +440 V (norm. displayed range with supply 380Vac)
F With tacho-generator feedback: armature voltage V internally calculated. With armature feedback the calculation is not performed.

P #09 INAUX

R -100% .. +100%
F Aux. input which can be configured through par. #57: the value at terminal K1/4 is displayed, always considering the amplification (or de-amplification) to which this value is internally subject, obtained with param. #16. If, for example, the motor runs at 2000 rev/min. with a 10V reference and #16=1.00, then with a 10V reference and #16=0.25 the motor will run at 500 rev/min. (displaying #09=25% and #02=25%), while with a 2.5V reference and #16=2.00, the motor will run at 1000 rev/min. (displaying #09=50% and #02=50%).

P #10 OUTAUX

R -10 V .. +10 V
F Auxiliary output that can be set through param. #58: the value at terminal K1/9, directly in volt, is displayed.

P #11 f

R 45 Hz .. 65 Hz
F Mains frequency

P #12 ke • n_{max} (if #74=1: #12 Varm at Vref=100% from Vers. C1.11)

R 200 .. 1000 V (norm. displayed range with supply 380Vac : 200 ... 440V)
D 440 V
F With tacho-generator feedback: value of the counter-EMF ($E=k_e$•n) where n=100%. With armature feedback (see #73) it represents the 100% of the armature value, i.e. max value which is intended to supply at the output. See also appendix: MANUAL CALIBRATION.

P #13 Vmains

R 190 .. 700Vnom (190...480 Vnom **up to Version C1.13** and 190...600 **in Vers. C1.14**)
F Mains voltage value present on the power section supply: it normally corresponds to the supply measured on the control section. If the two voltages are different (on request only), with tacho generator feedback, the parameter 13 should necessarily indicate the supply voltage of the power section. It is possible to change the displayed value if it does not match the real one, which can be detected through a multimeter on the terminals 36-38. The default value corresponds to the supply voltage present on these terminals. If this value is changed, the new value will be lost at the "restore default" (#14=5) command.

P #14 Code

R 0 .. 7
D 0
F Access code to programming and calibration:

0: normal operation; only the same parameter #14 can be changed. At the beginning and at the end of every automatic calibration it is always #14=0;
1: all parameters from #12 upwards can be changed;
2: automatic calibration of current loop (parameters #18, #19, #45 and #46 are calculated);
3: automatic calibration of speed loop (parameters #28 and #29 are calculated);
4: max.counter-EMF ($E = k_e • n_{max}$) calibration. Param. #12 is calculated (with tacho feedback only).
(for information about the first three above mentioned steps, see section AUTOMATIC CALIBRATION).
5: DEFAULT parameters restore (see note);
6: actual parameters back-up (see note);
7: restore of parameters for which back-up has been made (see note);

Note: During the startup of a machine, many parameters can be subject to changes. The control #14=5 allows to call back the default parameters set.
If, on the contrary, a new parameters set (different from the default one) is considered satisfactory; the control #14=6 allows to save it in a back-up area of the E^2PROM.
To call back the "satisfactory" set after making different changes, use the control #14=7, even if some changed

parameters have been saved or if the drive has been powered off.
If the drive is switched off, the default or back-up set is displayed at power on, according to wether the control #14=5 or #14=7 has been used (these restore controls are therefore save controls too), otherwise the last saved parameters are displayed, if the #14=6 control was used.

After setting up the drive, always perform a back-up of current parameters (#14=6) and write down the value of parameters different from the default ones on the last page of this manual.

P #15 G(Vref); G (I ref)

R 0.10 .. 5; 0.10 .. 5
D 1.00; 1.00
F Gain internally applied to the speed reference or, respectively, to the current reference, arriving at term. K1/2 and K1/3 (see #01). References greater than 10V will be cut to this value (considered 100%).
Note: Algebric sum of signals entering terminals K1/2 and K1/3 must NOT exceed 10V, as absolute value.

Up to version C1.06 only:

P #15 G(Vref)

R 0.10 .. 10.0
D 1.00
F Gain internally applied to the speed or current reference arriving at term. K1/2 and K1/3 (see #01). References greater than 10V will be cut to this value (considered 100%).

P #16 G(AUX)

R 0.10 .. 5 (0.10 ..10.0 **up to version C 1.06**)
D 1.00
F Gain internally applied to the auxiliary input arriving at term. K1/4 (see #09). References greater than 10V will be cut to this value (considered 100%).

P #17 Vrate

R 190 .. 700V (190...480 **up to Version C1.13** and 190...600 **in Vers. C1.14**)
D 380 V
F Rated mains voltage. NOTE: When changing this param., the power section and the ES630 firing board should have been properly preset (if required). This parameter controls the creation of possible out of tolerance mains alarms, depending on the value shown by parameter #13.

P #18 RxI

R 0 .. 267V
D 10 V (for 380Vac mains)
F Armature resistive drop voltage measured in output, with current set at drive rated value. Parameter calculated through current auto-calibration.

P #19 LdI/dT

R 152 .. 15200 V
D 760 V
F Armature inductive drop voltage measured in output, with current change rating in 1ms, equal to the drive rated value. Parameter calculated through current auto-calibration.

P #20 Jog operat.

R 0 .. 2
D 0
F Type of operation for jog run:

0 (with common ramp): the reference values relevant to #21 and #22 are fed through the ramp block (see #23, #25, #26, #27) before entering the speed loop.
1 (without ramp): the reference values relevant to param. #21 and #22 are used directly as a set point of the speed loop, bypassing the ramp block.
2 (with separate ramp): the reference values relevant to par. #21 and #22 are fed through a different ramp block (see #75, #76) before entering the speed loop.

P #21 Jog1

R 0 .. 100%
D 5%
F 1st reference value for jog. This value is active with open contact on START (K1/15) and closed contact on IMP1 (K1/16).
NOTE: With both contacts K1/16 and K1/17 closed, no internal reference is created.

P #22 Jog2

R 0 .. 100%
D 5%
F 2nd reference value for jog. This value is active with open contact on START (K1/15) and closed contact on IMP2 (K1/17). NOTE: See note in par. #21.

P #23 tUP

R 0 .. 300 s
D 0 s
F Ramp rise time of the drive from 0% to 100% of the reference (see fig. 17).
NOTE (note valid also for par. #24, #25, #75, #76): the internally generated ramps are equal to those displayed only if the drive is not in limit current and if the delivered current is other than zero (see also the corresponding notes under STANDARD FEATURES).

P #24 tDOWN

R 0 .. 300 s
D 0 s
F Ramp fall time of the drive from 100% to 0% of the reference (see fig. 17).
NOTE: see note at par. #23.

P #25 tSTOP

R 0 .. 300 s
D 0 s
F Fast ramp fall time of the drive when opening the START contact at terminal K1/15.
NOTE: this additional fall ramp is set only if the ramp circuit is included: in particular, at least one of the two ramps set through par. #23 and #24 should be other than zero.
NOTE: see note at par. #23.

P #26 Ramp start round.

R 0 .. 10 s
D 0 s
F Starting rounding of the ramps (both rise and fall ones) defined by par.#23,#24. This rounding is got geometrically by the parabola being tangent to the broken line that is formed by the set point of the reference (see fig. 17).

P #27 Ramp end round.

R 0 .. 10 s
D 0 s
F Final rounding of the ramps (both rise and fall ones) defined by par.#23,#24. This rounding is got geometrically by the parabola being tangent to the broken line that is formed by the set point of the reference (see fig. 17).

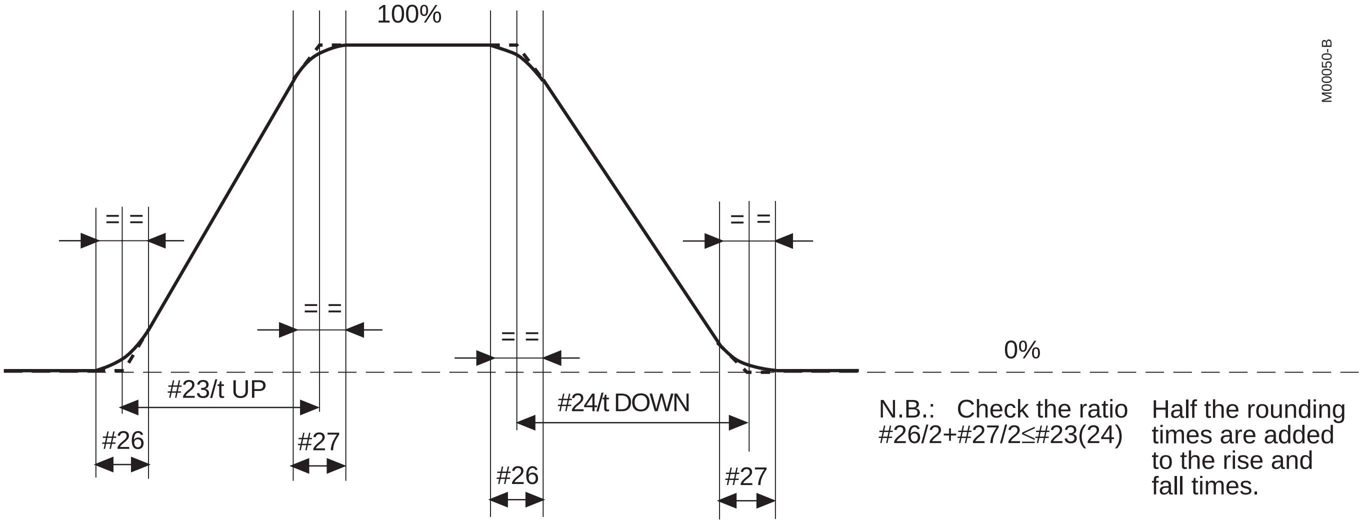


Fig.17

P #28 kp; kp2 (just kp **up to version V1.23**)

R 0..100; 0..100

D 3.83; 3.83

F Gain k_p of the speed loop expressed according to the formula G(s) = kp (1+1/T_i • s). Parameter calculated through speed auto-calibration. See also appendix: MANUAL CALIBRATION. N.b.: see note concerning **parameter #74**.

P #29 Ti; Ti2 (just Ti **up to version V1.23**)

R 0.01 .. 1s + “0”; 0.01 .. 1s + “0”

D 0.510 s; 0.510 s

F Integral time T_i of the speed loop, according to the formula G(s) = kp (1+1/T_i • s).
Caution: To set par. #29 = “0” is equivalent to setting an infinite integral time (proportional regulation only). Parameter calculated through speed auto-calibration. See also appendix: MANUAL CALIBRATION.
N.b.: see note concerning **parameter #74**.

P #30 os n

R -1 .. +1%

D 0%

F Offset calibration at speed loop output (with enabled speed controller: #62=0 or #62=1). It is possible to adjust this parameter if the motor, even if with zero speed reference, slowly tries to rotate.

P #31 (ST with #86=0)

R 0..110%

D 25%

P #31 (ET with #86=1)

R 0.00..10.0%

D 2.5%

P #31 (CT with #86=2)

R 0..100%

D 25%

F Threshold value for MDO digital output switching at term. 19-20, with meaning according with #86 and hysteresis fixed by #87. Percent value respectively set in the three cases:

a) - refers to the speed corresponding to maximum reference.
b) - represents speed error, i.e. the difference between maximum reference percentage and maximum speed percentage (such difference is equal to #03).
c) - refers to the current corresponding to the rated value (ex: 100A for CTM90.100).

Param. from #32 to #43, hereafter described, adjust the max. current delivered to the motor. The main param., which all calculation are referred to, is #49 (motor rated current). According to this param. a current can be set up to the rated value (max. continuous) of the drive. It is then possible to select a limit current independent of the speed or a function of it. In the first case, the limit current is adjusted through param. #32 , that sets a percentage of param. #49. In the second case, the dependence of the speed can be set at two values through param. #34 and #36, or through a hyperbolic law using param. #37 and #38 instead of #34 and 36. The current limit value, set moment by moment through the a.m. parameters, can be finally increased (according to a given law) or decreased through param. #39 and #41 or #43, accordingly.

P #32 Ilim1

R 0 .. 300%
D 100%
F 1st limit value relevant to bridge (A). This value is given as % of the motor rated current (par.#49) and is used as long as n≤#36. For n>#36, the param. #34 is used (see fig. 18).
NOTE: The product of param. #32 and #49 must NOT exceed the drive rated current.

P #33

NOT USED

P #34 Ilim2

R 0 .. 300%
D 100%
F 2nd limit value relevant to bridge (A). This value is given as % of the motor rated current (par.#49) and is used only if n>#36. For n≤#36, the param. #32 is used (see fig. 18).
NOTE: The product of param. #34 and #49 must NOT exceed the drive rated current.

P #35

NOT USED

P #36 nlim

R 0 .. 100%
D 100%
F Speed at which switching from the 1st to the 2nd limit value occurs (that is from #32 to #34). It is used to get a broken curve for current/speed (see fig. 18).

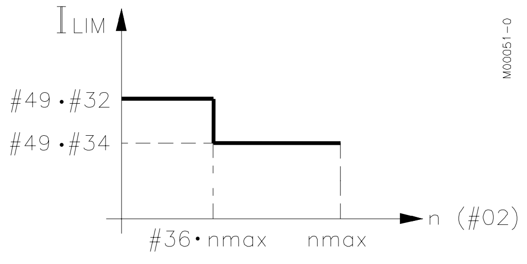


Fig.18

P #37 n* (not used **in Vers. C1.13**)

R 0 .. 100%

D 100%

F Speed n* above which the current limit becomes a hyperbolic function of the speed n according to the formula: Ilim=k/(n-n_0) (see fig. 19)

By setting par. #37 to any value, i.e. the initial n* speed of the hyperbolic line, and selecting the percentage value too (par. #38) whose current limit must be at the end of the hyperbolic trend (at nmax), this line is initially connected to the current limit value for speed lower than n*.

The following formulas are valid:

k = I* • #38(1 - #37)/(I* - #38)

n_0 = (I* • #37 - #38)/(I* - #38).

Selecting #38 = #37 • I* (i.e. n_0 = 0),

a constant max. power operation is obtained (armature weakening).

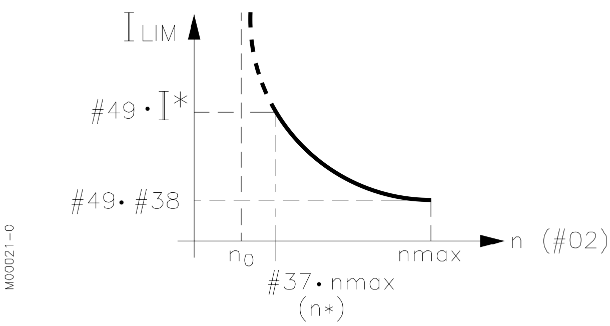


Fig.19

P #38 Ilim (not used **in Vers. C1.13**)

R 0..300%

D 100%

F Current limit value at max. speed (n=100%).
See parameter #37 for its use.

Tracing more than one function for current limitation, each speed value will always correspond to the LOWER value among those taken by the limit current curves (see fig. 20).

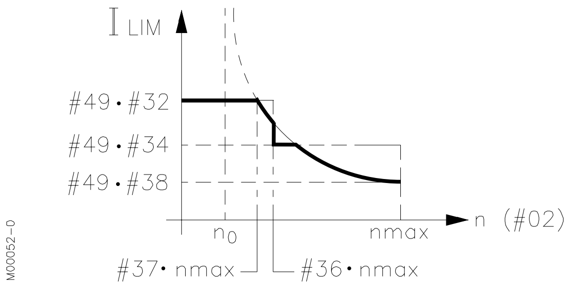


Fig.20

P #39 tlim

R 0.1 .. 20 s

D 2 s

F Time during which the current limit value is increased of the percentage value set through param. #41 (if its value is at least equal to 101%) when the drive reaches the current limit. condition. If at the end of this timed period the drive is not in current limit, then the transient can be repeated each time the drive reaches the current limit, but only if a time equal to 6.4 times the parameter #39 has elapsed. Otherwise (that is if the drive is in current limit when the time of #39 has elapsed) the relay KLOCK closes (terminal K1/21 and K1/22) and corresponding warning trips: see Machine depending Alarms.

P #40

NOT USED

P #41 +lim

R 100 .. 300% (100...200% **up to Version C1.13**)

D 100%

F Percentage of overlimitcorresponding to bridge (A), allowed for the time preset by #39. This value is intended as applied to the value of effective limit existing for that given speed (see note in fig. 20).

NOTE: IT IS NOT POSSIBLE TO SET AN EFFECTIVE OVERLIMIT HIGHER THAN 130% OF DRIVE RATED CURRENT. Otherwise, the max. values given in the drive rating table would be exceeded. On the contrary, replace the drive (and its external circuits) by a bigger one. It is possible to adjust this parameter to have at disposal for a certain time, e.g. at the starting, a torque higher than the motor nominal one.

P #42
NOT USED

P #43 clim
R 0 .. 100% **(1..100% up to version C1.08)**
D 50%
F Percentage reduction of the current limit for both bridges due to the closing of MDI contact at terminal K1/18 with par. #74=0. This value is applied to the limit existing in that moment (see parameters #32 to #41 included and their notes).

P #44 tCURR
R 0 .. 100 ms
D 0 ms
F Ramp rise and fall time of the current reference (output of speed loop).

P #45 kpin
R 0 .. 5
D 0.14
F Gain k_{pin} of the current loop, according to the formula: $G(s) = k_{pin} (1+1/T_{iin} \bullet s)$. Parameter calculated through current auto-calibration.

P #46 Tiin
R 0.5 .. 50 ms + “0”
D 25.5 ms
F Integral time Ti_{in} of the curr. loop, according to the formula: $G(s) = k_{pin} (1+1/T_{iin} \bullet s)$. Caution: to set par. #46 = “0” is equivalent to an infinite integral time (just proportional regulation). Parameter calculated through current auto-calibration.

P #47 Quadrants enabling
R Enabled/disabled (for each of the two quadrants 1° and 2°)
D Enabled (for both quadrants 1° and 2°)
F For each of the two possible working quadrants in the speed/ torque plane (see fig. 21), this parameter allows their independent enabling or disabling. The parameter value can only be changed with the RUN contact at term. K1/28 open.

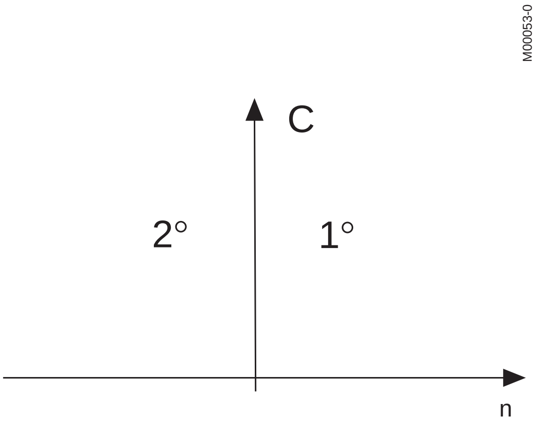


Fig.21

P #48
NOT USED

P #49 Rated I mot.
R 0 .. 100%
D 100%
F Relationship between the motor rated current and the drive rated current. For example, for a 540A rated motor supplied by a 600A drive, set #49=90%. This is the reference value for all calculations concerning the different current limits and is the one used for alarm tripping on motor I^2t (see #50). A proper setting of par. #49 (mainly) and #50 (secondly) allows an electronic protection of the motor against overheating.

P #50 I^2t

R 0 .. 180 min

D 10 min

F Thermal time constant T of the motor. The heating of a motor, receiving a constant current I_0, is represented by the curve $\theta(t) = K \bullet I_0^2 \bullet (1-e^{-t/T})$.
This heating is proportional to the square of the effectively delivered current (I_0^2).
$K \bullet I_0^2/T$ gives the curve slope at the origin.
The corresponding alarm (A14) trips if the current delivered effectively to the motor during the time exceeds the asymptotic value allowed (see fig.22, which shows two different trends, in time, concerning the heating of a motor through which two current values pass, which are constant in time). If the manufacturer's data is missing, it may be used, as thermal constant T, a value equal to 1/3 the time during which the motor temperature reaches a constant value. Obviously, motors with larger rate currents show larger time constants. Generally, in parameter #50 a value around 20 min may be set with some hundreds amps motors, up to a value around 60 min with 500-600 amps motors.

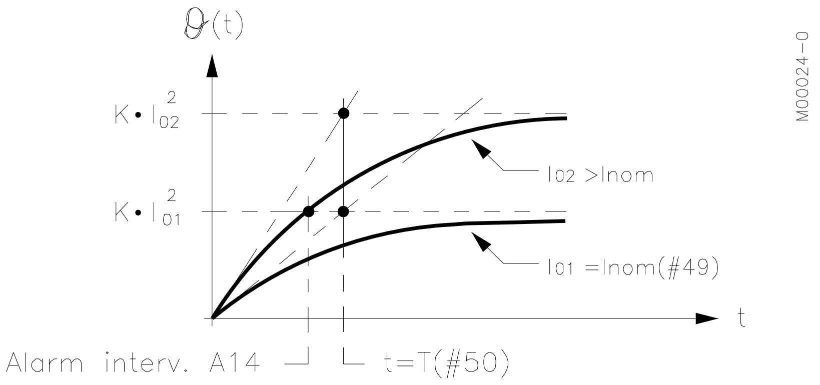


Fig.22

P #51 αmot

R 0 .. 180°

D 25°

F Min. delay angle for thyristor switching on when the drive operates as motor. It limits the value of #06.

P #52 αbrake

R 0 .. 180°

D 150°

F Max. delay angle for thyristor switching on when the drive operates as brake (regeneration). It limits the value of #06.

P #53

R 0 .. 300 ms

D 0 ms

F It represents the tau time constant of the 1st order low-pass filter (which can be inserted on the speed error) having the formula G(s)=1/(1+tau • s).
NOTE: #53=0 means disabled filter. The filter can be enabled to solve certain stability problems with error signals that are subject to quick changes.

P #54 Speed reference polarity

R 0 .. 1

D 1

F Allowed polarity for speed references:

  0: bipolar
  1: positive only

The possible polarity cut is applied to the main speed reference arriving at term. K1/2 and 3, and to the global speed reference too, i.e. the sum of the main ref. and the auxiliary ref. arriving at term. 1/4. If e.g. positive references only are acceped, the possible negative references will be cut and considered zero; this will be applied to the global reference too.
A possible polarity reversal, that can be obtained by setting parameter #74=2 (see), has priority on the action of par. #54.

In order to be able to set a minimum speed (#55, see later) the setting of #54 =1 is required.
N.B. In regenerative operation, the possibility of setting negative speed references allows the operation in the 2nd quadrant not only as torque control but directly as a speed control.

For version C1.04 only:

P #54

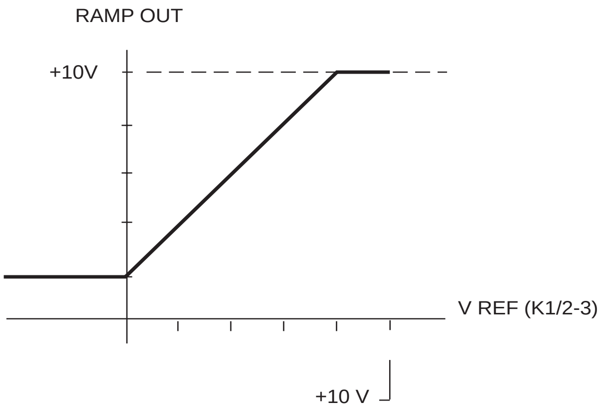
NOT USED

P #55 n_{min}

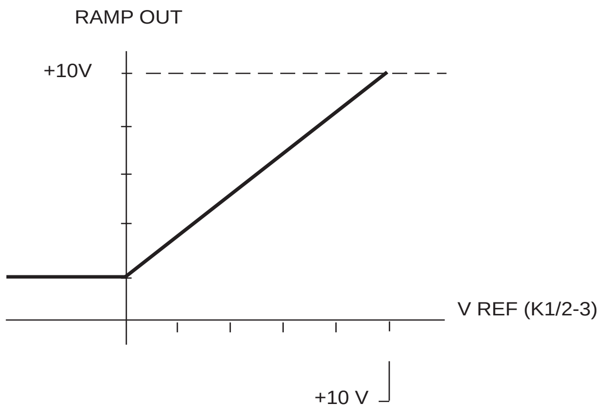
R 0 .. 100%
D 0%
F Minimum value of reference output from ramp circuit.
To set a minimum speed, it is necessary that parameter #30 (offset)=0. To have a min. positive reference output from ramp circuit, even if the main ref. potentiometer is set to zero or to negative values, set parameter #55 to the required n_{min} value.
Fig. 23 shows the ramp circuit output as function of the main speed reference, assuming #55=20%, for two different values of parameter #15.

Fig.23

M00025-0



(#15 = 1.00)



(#15 = 0.80)

Note that a possible auxiliary speed reference arriving at term. K1/4 is algebraically summed to the ramps output, cutting and considering zero every negative polarity for the global speed reference. To save on E^2PROM the value set for n_{min}, previously save the correct value of parameter #54. For version C1.04 only, this is not required.
The enabling or disabling of the minimum speed, at the value set on parameter #55, is externally controlled through simultaneous closure or opening of the contacts IMP1 and IMP2 (K1/16 and 17), once the start contact at term. K1/15 has been closed.

P #56 n_{max}

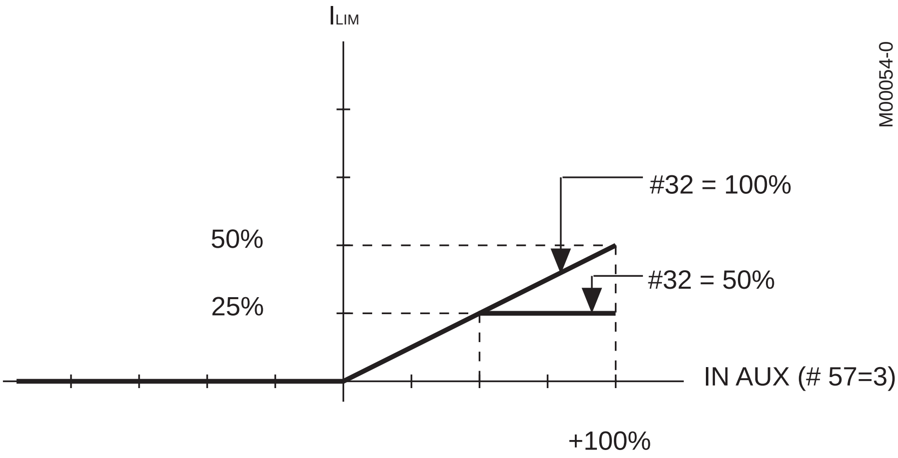
R 0..100%
D 100%
F Maximum value of the global speed reference.
This parameter prevents the set speed from exceeding a given value. This limit is also applied to the main reference at terminals K1/2 and 3.

P #57 IN AUX

R 0 .. 6
D 0
F Meaning of aux. input IN AUX (term. K1/4) (see also #09,#16)

0: cut off (no meaning);
1: additional reference of the speed loop (added to the value of the terminals K1/2 and K1/3);
2: additional ref. of the curr. loop (added to the output of the speed loop and to the value of #60);
3: external current limit (see note);
4: t_{UP} external reduction (see note);
5: t_{DOWN} - (see note);
6: external reduction of all ramps set through parameters #23 and #24.

NOTE FOR EXTERNAL LIMIT: At 100% of signal (according to the gain set by #16) and with #32=100%, the limit current is the one set by #49. If, on the contrary, #32 (or other internal limit param) is <100%, then full scale will be a proportionally smaller limit current (See fig. 24 where it is assumed #49=50% and that the allowed polarity- through par. #77 - is positive).



NOTE FOR RAMPS EXTERNAL REDUCTION: When term. K1/4 is used as a reduction of ramp times, the analogue reference arriving-as absolute value (the polarity doesn't matter) determines the ramp times as **percentage** of the values of parameters #23 and #24: therefore, with an input of ±10V and parameter #16=1, the ramp times will be equal to those shown on the display.

Assume what follows:

#23 = 30 s
#57 = 4
#16 = 1.00

If ±5V is sent to term. K1/4, the result is t_{UP}=15 s (50% of the original value), while the other ramp time will be unchanged. Note that the possible roundings are reduced by the same percentage.

P #58 OUT AUX

R 0 .. 7
D 0
F Meaning of aux. output OUT AUX (terminal K1/9) (see also #10):
0: 0 volt;
1: speed loop input (5V at 100%);
2: output of the PI speed controller (10V at 100%);
3: current reference (param. #04) (10V at 100%);
4: output of the ramp circuit (10V at 100%);
5: power approx. delivered to the motor (P= cemf •I) (5V with #08=400V, or #02=100% if #74=1, and #05=100%);
6: counter-EMF (E = k_e • n) (param. #07) (±5 at 400V) (±10V at 510V **up to Vers. C1.10**).
7: Three values output to synchronize the external introduction of inertia compensations.
- during acceleration ramp —> -10V
- when motor at speed —> ØV
- during deceleration ramps —> +10V

NOTE: For a pair of drives that have to operate according to the MASTER/SLAVE configuration, the current reference that must be delivered by the master drive can be obtained at term. K1/9 by setting #58=3.
NOTE: In armature feedback, OUT AUX value with #58=6 is not calculated.

P #59

NOT USED

P #60 Iref+

R -100 .. +100%
D 0%
F Additional current reference (added to the signal that may be present on IN AUX if #57=2).

P #61 Speed PI

R 0 .. 3
D 0
F Type of operation of the speed loop:
0: both the proportional and the integral part of PI are active;
1: only the proportional part of the PI is active (reduced to a P);
2: the speed loop is not operating: the current reference is given by parameter #60;
3: the speed loop is not operating: the current reference is given by the reference at terminals K1/2 and K1/3, through the gain (**from version C 1.07 up**) set on par. #15/G (I ref), or by internal references entered by contacts IMP1 or IMP2. If the drive has not to always follow a current reference, but has to be alternatively switched between the MASTER and SLAVE configuration, see param. #74.

P #62 Current PI

R 0 .. 3
D 0
F Type of operation of the current loop (see also #63);
0: both the proportional and the integral part of the PI are active; the feed forward is active (recommended value);
1: the current loop is not operating; the feed forward is active
2: only the proportional part of the PI is active (therefore reduced to a P); the feed forward is active.
3: the current loop is not operating; the feed forward is not active.

P #63 feed forward

R 0 .. 1
D 0
F With tacho-generator feedback: Type of operation of feed forward (see also #62):
0: the counter-EMF force is used (p. #07)(recommended value);
1: the counter-EMF force is not used (p. #07).
With armature feedback (see par. #73), the armature voltage itself (par. #02) is used for feed forward.

P #64 Alarm for armature

D not masked (included)
F Alarm A16, for interrupted armature, is masked or not. In armature feedback this parameter is inactive.

P #65 Alarm for freq.

D not masked (included)
F Alarms A02, for mains frequency out of tolerance, and A03, for unstable mains frequency, are masked or not.

P #66 Alarm for V main

D not masked (included)
F Alarm A04, for mains voltage out of tolerance, is masked or not.

P #67 Alarm for phase fail.

D notmasked (included)
F Alarm A05, for power loss, is masked or not.

P #68 Alarm for tacho

D not masked (included)
F Alarm A11, for tacho generator faulty, is masked or not.

P #69 nslave

R 0 .. 31
D 1
F Shows the drive address as slave in the serial network to which it may be connected.

P #70 Baud rate (not used **since Vers. C1.14**)

R 4800/9600 baud
D 9600 baud
F Shows the baud rate of the serial connection.

P #71 Parity (not used **since Vers. C1.14**)

R 0 .. 1
D 1
F Shows if the parity check is present or not in the series connection.
0: parity present (even);
1: no parity.

P #72 Alarm writing delay A04/A05

R 0 ..1
D 1
F Tripping of alarm A04 for mains voltage out of tolerance and of alarm A05 for power loss.
0: Immediate. The alarm trips immediately when the mains voltage goes out of tolerance or as soon as just one of the power section phases is missing.
1: After 0.4s. Alarms trip only 0.4s after the event of mains voltage out of tolerance or of power loss. If within this interval the alarms disappear, the drive automatically continues its operation.

This parameter, set as default, is useful to prevent alarm A04 from tripping in case of an instantaneous mains drop, lasting less than 0.4s. Alarms 04/05 are not written even when the mains completely disappears for a no matter how long time.

Up to version C1.06 only:

P #72 Power loss delay

R 0 ..1
D 1
F Alarm A05 tripping for power loss
0: Immediate. The alarm trips instantaneously when just one of the power section phases is missing
1: After 0.4s. The alarm A05 trips after 0.4s; if within this interval the phases appears again, the drive automatically continues its operation.

P #73 Speed feedback

R 0 .. 1
D 0
F Type of speed feedback.
0: The speed loop feedback is fed by tacho generator: the max. speed is adjusted by trimmer RV5 (together with RV6 with the printed circuit ES600/2).
1: The speed loop feedback is taken by the armature voltage: the max. speed is adjusted by par. #12.

NOTE: The switching between the two operation modes can be done with disabled drive only. In addition, (**up to version C1.08**) to change par. #73 (to change feedback type) is necessary TO EXCLUDE the speed parameter adaptation (see par. #81).
With armature feedback present, the jumpers J1 and J2 must be closed. With tacho generator feedback, these jumpers may be open if it is desired to have a galvanic insulation between the control board and the power section.

P #74 MDI

R 0 ... 4 (0...3 **up to Version C1.13**)
D 0
F Digital input meaning at terminal K1/18.
0: % decrease of current limit (see par. #43)
1: Sets par. #61 at 3, that is the speed control is cut off and the reference on K1/2 or K1/3 or the internal references sent by closing terminals IMP1 and IMP2 (K1/16 and K1/17) become current references (the drive is preset to SLAVE mode, see note).
2: Polarity reversal. At contact closure, a polarity reversal is made for the SPEED references at term. K1/2-3-4 and for the jog references set through parameters #21 and #22 (changing the sign of parameters #01, #09, #21, #22 that appear on the display).
3: Ramp exclusion. When the contact is closed, all ramp times, previously set through the par. #23 and #24, and their roundings are set to zero. Inputs to terminals K1/2-3 become then direct inputs (see note).

(From Version C1.14 only):
4: Uses Kp2 and Ti2. When the digital input is closed to 0 Volt, parameters Kp2 and Ti2 instead of Kp and Ti are computed by the speed automatic calibration, and then used by the control. In addition, if the automatic speed parameter adapter is enabled (#81=1), the Kp2* and Ti2* (see #84 and #85) values instead of the Kp* and Ti* values will be considered as proportional gain and integral time values.

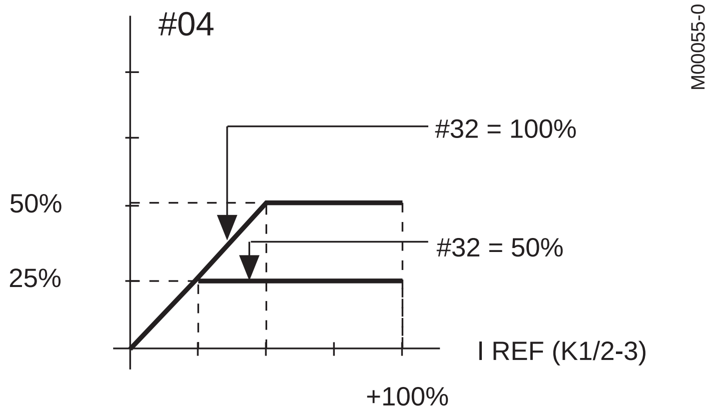


Fig.25

NOTE FOR #74=1: The possible ramps (see parameters #23.. 25) are set to zero, while the parameter #15/G (I ref) allows a calibration of the obtained current. Fig. 25 shows the trend of the current reference (parameter #04) set as function of the external current reference arriving at term. K1/2 or 3 (according to the gain set by par. #15), assuming #49=50%.

NOTE FOR #74=3: When term. K1/2 and/or 3 are switched from direct inputs to ramp inputs, reopen the contact on term. K1/18 before sending the new speed reference, otherwise the ramp will not be performed.

Up to version C1.06, par. #74 has only the meanings 0, 1 and 2.

P #75 tUPj

R 0 ... 300 s
D 0 s
F Ramp rise time of drive from 0 to 100% of JOG reference enabled by closing one of the two contacts K1/16 or K1/17. Active with par. #20 = 2.
NOTE: see note at par. #23.

P #76 tDNj

R 0 ... 300 s
D 0 s
F Ramp fall time of drive from 100 to 0% of JOG reference for opening of contact K1/16 or K1/17. Active with par. #20 = 2.
NOTE: see note at par. #23.

P #77 External lim.

R 0 ... 1
D 0
F Polarity of ext. limit signal present on K1/4, active with par. #57 = 3
0: Positive polarity only (ex: 0= ... +10V)
1: Negative polarity only (ex: 0= ... -10V).

P #78 Arm. Comp.

R 0 ... 200 %
D 100 %
F Percentage of arm . resistive fall compensation RxI, measured through param. #18 as regard the delivered current. With tacho generator feedback (#73=0), this compensation is automatically cut off. With armature feedback, this parameter has to compensate for the speed reduction that occurs when the armature current increases (required torque increase).

P #79 n defl.

R 0 ... 100%
D 100%
F Initial speed of a possible external weakening.
If the motor has a zone with field control, where the c.e.m.f. is constant, this parameter should be set to a value lower than 100%, i.e. the speed value (as percentage of the max. one) at which the filed begins to decrease: this ensures an accurate calculation of the c.e.m.f. at any speed, even when the armature current (parameter #05) is lower than 1%.
For example, for a motor with weakening from 1000 rev/min. to 4000 rev/min., with 440V max. armature voltage at 1000 rev/min., set #79=25% and #12=440V.

P #80 Inc Ti in ramps

R x1...x1000
D x1
F Increase of integral time Ti (#29) of speed PI, by a multiplying factor, during transients in ramp internally performed by the drive.
This parameter avoids speed overshoot with short ramps: see also appendix MANUAL CALIBRATION.

#81 n loop var.

R 0..1
D 0
F Change of gain and of integral time of speed PI, depending on error Ern. This error is equal to parameter #03.
0: n loop parameter variation excluded
1: n loop parameter variation included
The parameters set #81..#85 avoids speed overshoot with references subject to quick changes that take the drive to current limit: see also appendix MANUAL CALIBRATION.
The parameters change curves, with variation included, are as shown in fig. 26. The Kp2* and Ti2* instead of the Kp* and Ti* values are considered, only if #74=4 and the digital input configurable at terminal K1/18 is closed to zero Volt (**from Vers. C1.14** only).

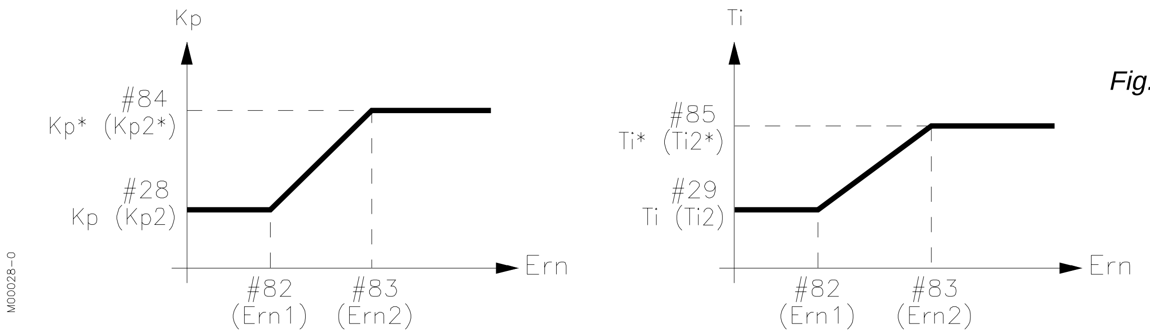


Fig.26

#82 Ern1

R 0..100%
D 0,5%
F Value of error Ern below which, with speed param. variation included, the gain and the PI integral time are represented by #28 and #29.

#83 Ern2

R 0..100%
D 1.0%
F Value of error Ern over which, with speed param. variation included, the gain and the PI integral time are represented by #84 and #85.

#84 Kp*; Kp2* (Kp* only **up to Vers. C1.13**)

R 0...100; 0...100
D 3.83; 3.83
F Value of speed PI gain which is entered, with param. variation included, when Ern > Ern 2.

#85 Ti*; Ti2* (Ti* only **up to Vers. C1.13**)

R 0.01..1s + “0”; 0.01..1s + “0”
D 0.510s; 0.510s
F Value of speed PI integral time which is entered, with param. variation included, when Ern > Ern2.
Caution: setting par. #85 = “0” is equivalent to setting an infinite integral time (proportional regulation only).

P #86 MDO

R 0..2
D 0
F Meaning of MDO contact at term. 19-20
0 : Speed threshold exceeded, set with #31, with hysteresis fixed by #87.
1 : Set speed reached (motor at speed), i.e. percent speed error smaller (as absolute value) than threshold fixed by #31, with hysteresis fixed by #87.
NOTE: In this configuration, the digital output is not active if an additional speed reference is used on term. K1/4.
2 : Current threshold exceeded, set with #31, with hysteresis fixed by #87.
See also parameters #31 and #87 description.
Fig. 27 shows the various switching laws.

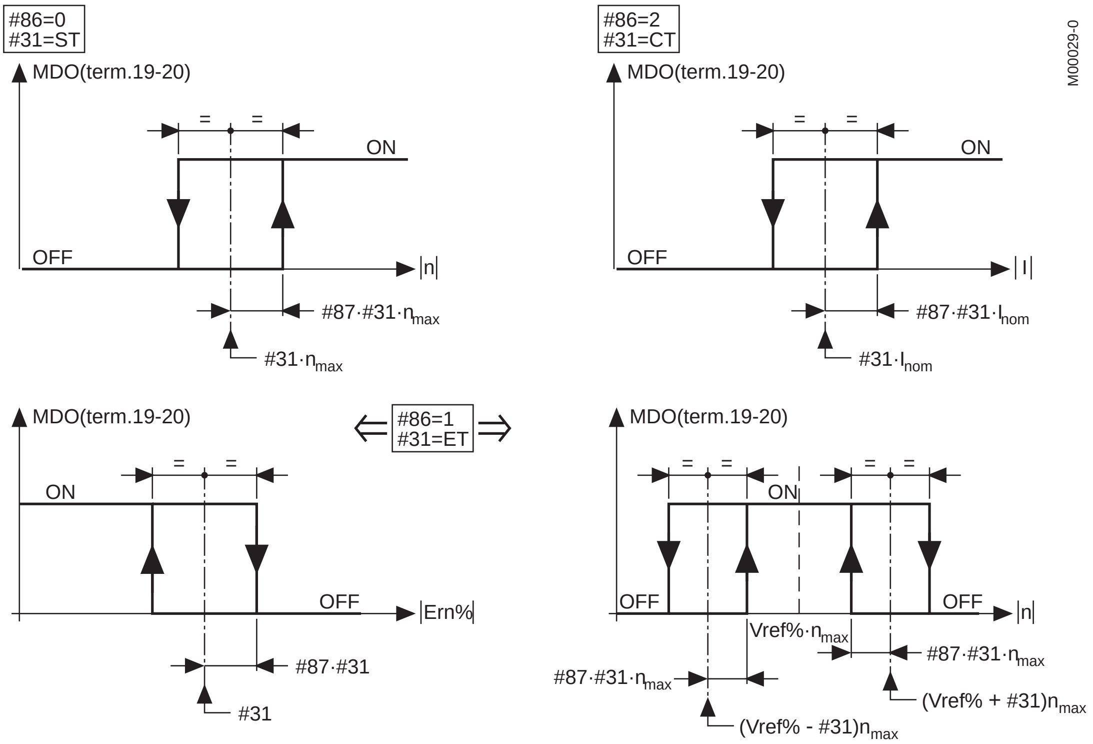


Fig.27

P #87 Hysteresis

R 0..100%
D 5%
F Hysteresis on MDO digital output switching at term. 19-20, with meaning according with #86, around the threshold set by #31.
Following parameters are available for version C1.08 and later versions:

P #88 df/dt

R 1...64 Hz/sec
D 1
F Maximum allowed variation for the mains frequency.
This parameter is useful in the cases of **power supply through a generator unit**, where frequency can show remarkable variations: the higher the preset number, the faster the adjustment. Set the minimum value possible, but enough to prevent any misoperation or block of the converter.
N.b.: If a too high frequency adjustment speed is set, the armature current ripple may increase.

P #89 Alarm writing delay A03

R 0...1.6s
D 0s (immediate tripping)
F Tripping of the A03 alarm for instable frequency.
0: immediate
1: after 0.4s
2: after 0.8s
3: after 1.6s

Set this parameter to 0, in order to be able to detect any too fast frequency variation df/dt in the shorter time possible, and to prevent the converter block due to other alarms (i. e. A12).
If, on the contrary, large frequency variation with a very short duration can be expected, in situations where it is unlikely to get the converter block due to other alarm types (i.e. when it is supplied but still in stand-by), then set par.#89 to an adequate delay. In this way the frequency variation will be allowed to fall within the permissible limits, preventing the writing and the subsequent storing of alarm A03.

The following parameters are available from version C1.10 only:

P #90 Load select

R 0...1
D 0
F Load type connected to the output drive:
0: motor
1: inductance

When the load to be supplied is not a D.C. motor armature, or a resistive load, but it is an inductive load, as for example an electromagnet or the excitation winding of a D.C. motor, this parameter should be set to 1.
Note: To supply an inductive load , the required equipment should comply with specification 092 and should be provided with external protection filters as shown in the documentation"CRM90 for application on electro-magnet".

ALARM TRIPPING AND RESET

When an anomaly is detected, generally the microprocessor writes immediately on the display the corresponding alarm, blocks the converter operation and controls the de-energizing of the internal relay for alarm signal. This writing can be **delayed**, for the three alarms A03, A04 and A05, through a proper setting of the corresponding parameters #89 e #72, while for the alarm A16 a fixed delay of 5 secs. is programmed. For alarm A11 too, **from software version C1.09**, a fixed delay of 500ms is programmed.
After 0.5 secs. after the writing on the display, the event is stored on the E^2PROM, excluding when in the meantime the supply mains lacks too (storing is simultaneous to the writing up to version C1.06 only).
To release the converter and restore the normal RUN condition, first clear the alarm storing from the E^2PROM, through a RESET (keys INC and DEC simultaneously pressed, or closing at 0V of terminal K1/27, and this will take effect only if the alarm source has disappeared) then open (and close again) the contact to enable the reference in use at that very moment (K1/15, K1/16, or K1/17).

ALARM LIST

MAINS ALARMS

D -Display
S -Meaning

D A01 Wrong cyclic sequence

S 1) The cyclic sequence RST of the power section (terminals 46/47/48) is incorrect, or:
S 2) The terminals 46 and 48 are not in phase with the terminals 36 and 38.
NOTE: THIS ALARM DOESN'T INCLUDE THE CONDITION: 46/47/48=RST, 36/(37)/38=TSR.
NOTE: The alarm immediately trips at the closing edge of START contact (K1/15) or IMP1 (K1/16) or IMP2 (K1/17).

D A02 Mains freq. < 45Hz or > 65Hz

S 1) the mains frequency is lower than 45 Hz, or:
S 2) " " " is higher than 65 Hz.
Alarm A02 can be masked with param. #65.

D A03 Unstable mains freq.

S The mains frequency is unstable (frequency changes higher than the value on par. #88).
Alarm A03 can be masked with param. #65 and can be delayed, **from version C1.08 up**, with par. #89.

D A04 Mains volt. out of tolerance

S 1) The mains voltage is lower by 15% than the rated one (set by par. #17), or:
S 2) Mains volt. > by 10% than the rated one.

After a momentary drop of power supply, stored in the E^2PROM, the A04 alarm may be deleted as usual by contemporary pressing the keys INC+DEC, or through the RESET terminal at K1/27. On the contrary, if the alarm is due to an incorrect setting of #17 as regards the mains rated value, it is possible to change page on display by pressing the key INC or DEC, allowing to set (and change) param. #17.
Alarm A04 can be masked with param. #66 and can be delayed, **from version C1.07 up**, with par. #72.

D A05 Phase fail. on power sect.

S No voltage present at power section. At least one of the phases of the power section is missing (ex. due to the blowing of one of the fuses FU1-FU2-FU3: see fig.2, fig. 7).
NOTE: The alarm is delayed by about 2 s at the closing edge of both contacts K1/28 and K1/15 (or K1/16 or K1/17), while it trips immediately or after 0.4s if run condition is active (see par. #72).
Alarm A05 can be masked with param. #67.

ALARMS DEPENDING ON THE MACHINE

D -Display
S -Meaning

D A11 Tacho Generator failure

S 1) The tacho generator is not connected at least to one of the terminals K1/5-K1/6 or K1/7-K1/6, or:
S 2)The tacho generator is inverted (exchange the 2 terminals each other) or:
S 3) The tacho generator is faulty.

The alarm A11 can be masked with param. #68.

NOTE: Alarm A11 may sometimes trip, for example, at startup if the current waveform is irregular or unstable (e.g. if auto-calibrations have not been performed).

A12 Current higher than 200%

S The instant armature current (peak value) exceeded 200% of the rated current for the drive (ex. it exceeded 80 A for a CTM90.40).

W13 Overlimit lock (A13 up to version C1.07)

S The drive has been in effective overlimit (see parameter #41) for all the allowed time (see par. #39).

NOTE: This alarm is only a warning and doesn't cause, unlike all other alarms, the block of the drive and the opening of the relay AL (K1/25-K1/26), but only the closing of relay KLOCK (K1/21-K1/22). The message disappears when the drive enters the STAND-BY mode (K1/28 opening). If trip occurs, it is possible to change page on display (with the drive still running) just pressing INC button or DEC button. Obviously the message will remain stored in #00, and it will disappear (and contact at term. 21-22 will open) only opening RUN contact between term. K1/28 and 0V.

A14 I^2t control tripping

S The motor is too hot. This alarm trips after a time depending on the parameters #49 (motor rated current as regard the rated current of the drive) and #50 (thermal constant of the motor).

For a more detailed description, see #50 in the parameter list.

A16 Interrupted armature

S 1) At least one of the two connections to the armature terminals 49 and 50 is open, or:
S 2) The fuse FU4 is blown up (see fig.2 and fig. 7) on the D.C. side.

The alarm is delayed of about 5 s.
The alarm A16 can be masked with param. #64, but only if the drive is in tacho generator feedback.

ALARMS DURING THE CALIBRATION

D -Display
S -Meaning

A20 Excitation non disconnected

S 1) During the current calibration (parameter #14=2) the excitation circuit has not been disconnected (terminals 39 and 40), or:
S 2) the motor is rotating due to residual magnetism, even if the excitation is not connected.
In the second case, mechanically block the motor to perform calibration properly.

A21 Current limit too low

S During the current calibration (parameter #14=2) the current limit has been set too low; to perform calibration, properly increase the parameter #49. At the end of calibration, reset it to its previous value.

A22 Auto-calibration interrupted

S During an automatic calibration, the START contact (K1/15) or the STAND-BY contact (K1/28) has been opened.

A24 Speed not reached

S During the counter-EMF calibration (par. #14=4), the required speed cannot be reached (probably due to an excessive field current value).

ALARMS INTERNAL TO THE DRIVE

D -Display
S -Meaning

D A30 No 24V at pulse transformers

S The thyristors cannot switch on due to the loss of the voltage +24Vcc on the primaries of the pulse transformers on the board ES630.

D A31 Heatsink too hot

S Tripping of the thermostat on the heatsink of the power section (T > 80 °C). In the CTM90.500...900, this thermostat is series connected to a second one installed on the supply central bar, to signal any possibile anomaly to the upper fan.

D A32 Synchronisms failure (up to version C1.08: microcontroller failure)

S Problems in the synchronisation circuit on the voltage and/or current waveform.
NOTE: Alarm A32 can sometimes trip if the current or voltage waveform is irregular or unstable (e.g. if the autocalibrations have not been performed).

D A33 Blank or not present EEPROM

S 1) EEPROM absent, or:
S 2) EEPROM not programmed, or:
S 3) EEPROM faulty, or:
S 4) jumper J9 on ES600 not corresponding to the actual size of the EEPROM. In all these cases the drive can operate with the standard set of parameters stored in the EPROMs (that can be changed but of course not stored).

D A34 Serial communicat. interrupted

S This alarm trips if the master serially connected to the drive doesn't send a correct message within 30s, once the inputs simulation from PC (and not from field, by default) has been set.

For version C1.04 only:

D A38 Current cannot be formed

S The counter-EMF is too high and the drive is not able to deliver current (probably due to an excessive value of field current).

The following alarms are only present starting from version C1.09:

D A35 Wrong parameters on E^{2}PROM

S The contents of some zones in the E^{2}PROM working area is altered (zone related to some values shown on the display, or zone that cannot be displayed). This working area is checked any time the drive is supplied. In this case, by making a backup of current parameters (par. #14=6) at power off, it is recommended to reset the alarm and restore the back-up parameters (par. #14=7), thus writing the E^{2}PROM working area again. If alarm A36 trips (see below), it is necessary (after resetting the alarm) to restore the default values (par. #14=5) and to change by hand all those parameters that have been written down at the end of setup.

D A36 Wrong back-up parameters

S The content of some zones in the E^{2}PROM back-up area is altered. This back-up area is checked any time the back-up parameters are restored. In this case this area cannot be used: it is necessary (after resetting the alarm) to restore the default values (par. #14=5) and to change by hand all those parameters that have been written down at the end of setup.

A??

S An alarm, not included within the known ones, has been saved.
In this case, just reset the alarm.

SERIAL COMMUNICATION

a) General

CTM90 can be serial connected to external devices, making thus accessible, both in reading and in writing, all parameters usually accessible by means of the display and of the 4 keys (see the corresponding chapter). The electric standard that has been used is RS485, two wires (see fig.28). This choice is based on the fact that this standard grants, as regards the normal standard RS232-C, better immunity margins against noises, even in long paths, reducing therefore the possibility of communication errors.
The drive acts practically as a slave, (that is, it can only answer to questions sent by another device) and must be connected to a master asking for a communication (typically a PC).
This can be performed directly or in a multidrop network of drives, where however a master is still required (see fig. 29).

b) Direct connection

In case of direct connection, the electric standard RS485 can be used directly, obviously if in the PC a port with this standard is available.
The logical “1” (usually called MARK) means that the terminal TX/RX_A (terminal K3/1) is positive as regard the terminal TX/RX_B (terminal K3/2). On the contrary, the logical “0” is usually called SPACE. This convention remains valid even for a network connection.

c) Network connection

The use of the CTM90 in a drive network is made possible by the standard RS485 with its bus structure, where all single device “hangs”. Depending on the length of the connection and on the baud rate, up to 32 drives can be connected each other.
Each of them will have its own identification number, that can be preset through parameter #69, marking him solely in the network controlled by the PC. Then the baud rate (parameter #70) and the parity (parameter #71) must be set as well, so as to clearly specify the connection modes.
The number of stop bit, on the contrary, is fixed and is 1.
For each of the two connection types above described, an optoinsulated interface module RS485/RS232-C is available, allowing to easily interface the drive or the drive network to a PC equipped only with the standard port RS232-C.
In this case, the connection to be performed must comply with the MARK and SPACE conventions described above under the paragraph “b”.

d) The software.

The programs to be loaded on the PC are delivered directly by Elettronica Santerno and use the standard protocol ANSI X3.28 (expressly designed for connections using ASCII control characters).
Alternatively, when an autonomous implementation of a PC program is required, a manual with all information concerning the protocol and data format is available.

CONNECTOR K3 - ES600/2 CONTROL BOARD - SERIAL CONNECTION

1(TX/RX A)	Differential input/output A (bi-directional) according to the standard RS485. Positive polarity as regards K3/2 for a MARK.
2 (TX/RX B)	Differential input/output B (bidirectional) according to the standard RS485. Negative polarity as regards K3/1 for a MARK.
3 (TX AUX)	Digital signal reproducing the denied transmitter (see fig. 28).
4	not connected
5 (DGND)	0V digital
6	not connected
7	not connected
8	not connected
9 (+5VDIG)	+5V digital

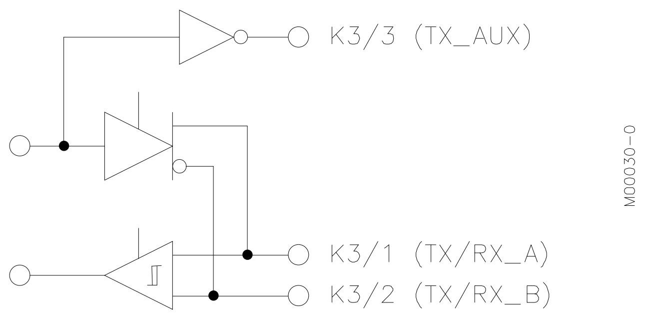


Fig. 28 - Electric diagram of series interface RS485

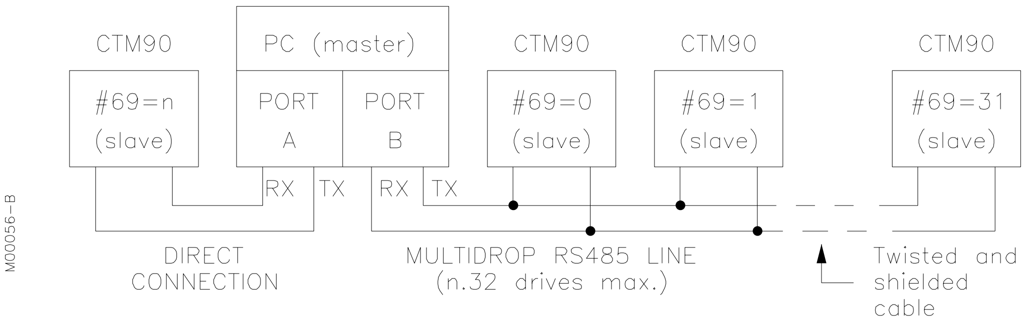


Fig.29 - Master/slave connection.

EMC FEATURES AND INPUT FILTER

Radio-frequency interferences (RFI) can be generated where the drive is installed. The interferences can occur both on the air (irradiated interferences), and through the power cables (conducted interferences). Sometimes, due to these interferences, the drive can operate improperly, even if the CTM90 unit is provided with a high noise immunity and complies with the EMC standards. Also, the drive itself can produce interferences due to switching of power semi-conductors that represent its output stage.
A malfunction can be detected in the devices installed close to the drive or connected at the same supply or earth conductor.

To eliminate any interference that can affect the drive operation, proceed as follows:

- keep the drive power cables separated from the signal cables;
- use shielded cables for the drive control signals and connect the shield to 0V, as shown on the connection diagram;
- always install anti-noise filters on the coils of remote control switches, solenoid valves, etc.

IMMUNITY TESTS OF THE DRIVE	
Electrostatic discharges:	level 3 EN 61000 - 4 - 2
Burst:	level 3 EN 61000 - 4 - 4
Surge:	level 3 EN 61000 - 4 - 5
Mains freq. magnetic fields:	level 4 EN 61000 - 4 - 8
Radio freq. electromag. fields:	10V/m ENV50140 and according to Walkie Talkie test.

If malfunctions are detected in the devices installed close to the drive, take the following precautions:

- install the drive input filter;
- keep the drive power cables separated from the other cables;
- use shielded cables to connect sensors, instruments, etc.
- install any noise-sensitive device as far as possible from the drive.

The connection cables between filter and drive should be as short as possible.

Here is a list of the filters recommended for the different drive models, so that the conducted and irradiated interferences are included within the levels conforming to EN55011 class B and VDE0875G (civil environment) standards. These filters are not required inside an industrial environment as, in this case, switching inductance is enough.

Drive type	Filter type	Rated voltage (V)	Rated current (A)	Filter code
CTM 90.10	FLTA-B 4T	460 at 50/60 Hz	3 x 10	AC1710105
CTM 90.20	FLTA-B 7,5T	460 at 50/60 Hz	3 x 16	AC1710205
CTM 90.40	FLTA-B 11T	460 at 50/60 Hz	3 x 30	AC1710305
CTM 90.70	FLTA-B 30T	460 at 50/60 Hz	3 x 80	AC1710805
CTM 90.100	FLTA-B 30T	460 at 50/60 Hz	3 x 80	AC1710805
CTM 90.150	FLTA-B 55T	460 at 50/60 Hz	3 x 150	AC1711305
CTM 90.180	FLTA-B 55T	460 at 50/60 Hz	3 x 150	AC1711305
CTM 90.250	FLTA-B 90T	460 at 50/60 Hz	3 x 200	AC1711505
CTM 90.330	FLTA-B 132T	460 at 50/60 Hz	3 x 280	AC1711805
CTM 90.410	FLTA-B 160T	460 at 50/60 Hz	3 x 360	AC1712005
CTM 90.500	FLTA-B 250T	460 at 50/60 Hz	3 x 500	AC1712405
CTM 90.600	FLTA-B 250T	460 at 50/60 Hz	3 x 500	AC1712405
CTM 90.900	FLTA-B 500T	460 at 50/60 Hz	3 x 1000	AC1713405
CTM 90.1200	FLTA-B 500T	460 at 50/60 Hz	3 x 1000	AC1713405

INSTALLATION, CALIBRATION AND MAINTENANCE

Preliminary inspection

After receiving the drive, please check it carefully in order to verify damages due to transport and if the clamps are released or other components are disconnected. If there are damages, take the necessary measures. Check that all the rating corresponds to the use; if not, contact your dealer or ELETTRONICA SANTERNO.

Installation

When assembling the unit, it is necessary to make sure that the air circulates in vertical direction. See par. “External and fixing dimensions”.
During the wiring of the unit, please comply with the following precautions:

Avoid positioning the wires of the tacho generator and of the signals close to the power wires and other possible electromagnetic trouble sources. Use shielded cables, with shield connected to 0V.

Make connections as short as possible.

CAUTION: Make sure that the phases connected to terminals 36 and 38 are THE SAME as the ones connected to terminals 46 and 48 of the power circuit.

Calibration

After completing the wiring and after checking that all connections and solderings are perfect, follow the operations described in the STARTUP BASE PROCEDURE:

Maintenance

The maintenance of the drive is mainly a matter of periodical checking.

The first precautions against troubles due to a faulty working, are the cleanliness of the machine and its installation in an environment free of vibrations and not too hot, which allow for a long life of all components.

A prompt attention to any trouble, even to the small ones, detected during periodical inspections or checkings, will certainly help for the drive long life and avoid expensive operation breaks.

APPENDIX: MANUAL CALIBRATION

To change the results of the automatic calibrations concerning current, speed and the calculation of counter-EMF or when automatic calibration is not possible, manually adjust the characteristic parameters of the adjustment loops. Fig. 30 shows the block diagram with two proportional-integral adjustment loops.

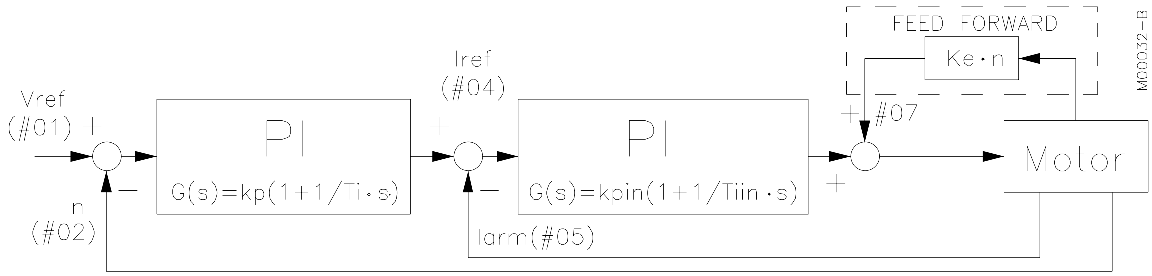


Fig. 30

A) CURRENT LOOP CALIBRATION

Generally the automatic calibration of current gives satisfactory values, therefore it is not necessary to adjust manually. Anyway, if you need to change some parameters, this calibration must be performed before the speed calibration (automatic or manual).
The parameters to be set are:

#18 **(R•I)** = armature resistive voltage drop
#19 **(Ldi/dt)** = armature inductive voltage drop
#45 **(kpin)** = current PI gain
#46 **(Tiin)** = integral time of current PI.

Parameters #18 and #19 are obtained through the following calculation:

R arm. res. in Ω x **I** drive rated current —> #18 (R•I)

L armature induct. in Henry x **dI/dT** rated change in 1ms —> #19 (LdI/dT)

Es: MOTOR SICME P180L3/440V/wind. 07=>R=0.099Ω, L=1.8mH
DRIVE CTM90.330 = —> I=330A

#18 = 0.099 x 330 = 33V
#19 = $1.8 \times 10^{-3} \times 330 / 10^{-3}$ = 594V

NOTE: Any error beyond 20÷30% in these parameters setting may cause a wrong operation during the transient and possible malfunctions corresponding to the tacho generator fault alarm, as they are used in the calculation of feed forward, counter-EMF (#07) and armature voltage (#08).
Parameters #45 and #46 can be experimentally changed by the use of an oscilloscope, starting from the default values or from the ones obtained through automatic calibration. The procedure to be adopted is shown in fig. 31.

OBSERVATIONS:

Fig. A1÷A6 show examples of different current waveforms which can be detected on TP11 for different values of param. #45 and #46.

Note what follows:

GAIN INCREASE #45:
The system gets ready with decrease of response time, to the detriment of an initial current overshoot.

INTEGRAL TIME DECREASE #46:
The response time decreases causing a higher irregularity of the current waveform.
NOTE: Pay attention not to excessively increase #45 and not to excessively decrease #46, so as to avoid excessive overshoots on the current which may cause fuses blow-out.

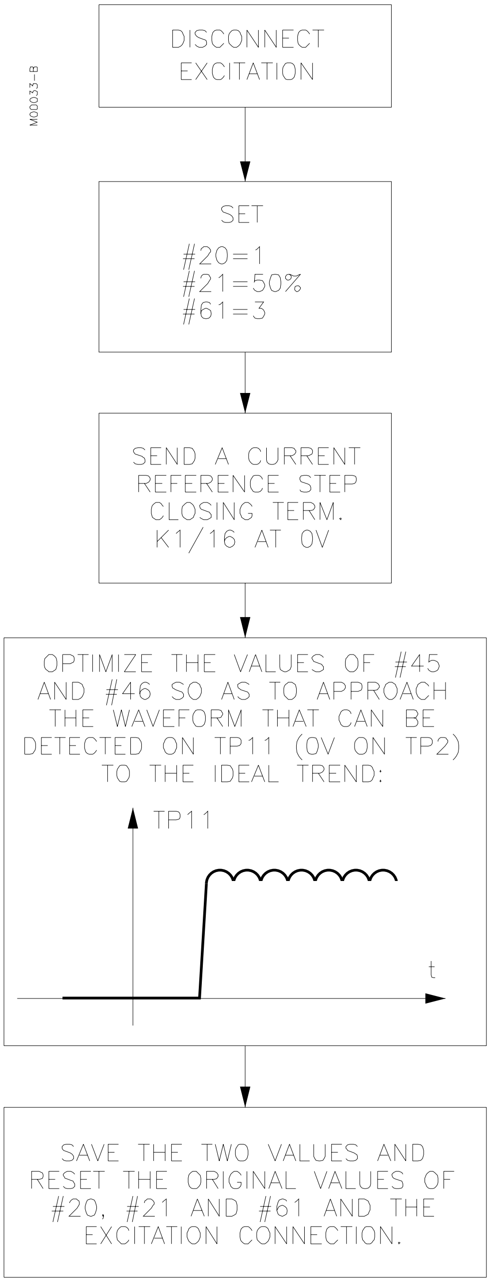


Fig.31

B) SPEED LOOP CALIBRATION

Sometimes, the automatic speed calibration can give values that are not completely acceptable, especially when the drive load (ex: flywheel load) can dynamically change during the operation. However, this calibration should be performed after the current loop one. In the followings, it is supposed to have **EXCLUDED** the speed parameters variation and therefore to have just one value for gain and integral time.

The parameters to be set are:
#28 (kp) = speed PI gain
#29 (Ti) = speed PI time

They can be experimentally changed too, by the use of an oscilloscope, starting from the default values or from the ones obtained with the automatic calibration.
The procedure to be adopted is shown in fig. 32.

OBSERVATIONS:

Fig. A7÷A18 show examples of different speed waveforms (tacho generator) that can be detected on TP15, together with the corresponding waveforms that can be detected on TP11 for different values of param. #28 and #29.

Note what follows:

<u>GAIN INCREASE #28:</u>
The system gets ready and the initial speed overshoot decreases causing a higher irregularity of the current wave form.

<u>INTEGRAL TIME DECREASE #29:</u>
The response time decreases to the detriment of the presence of oscillations in the two speed and current waveforms.

NOTE: Anyway, the speed rise ramp is set by the drive current limit (the ramp slope directly depends on the delivered current).

In certain cases, the best results are obtained by adjusting parameter #53 (error signal filtering), to have a good stabilizing effect, without affecting the dynamic performance.

If on the contrary the speed parameters adaptation is **INCLUDED**, the aspects till now discussed have to be differently reconsidered.
In general words, it is possible to state the followings:

a) **Optimization of the answer to a step reference, without introducing instabilities at the steady state, is got only by speed parameter variation**. An example of setting may be the following:

#82 (Ern 1) = 0.5 %
#83 (Ern 2) = 1%
#84 (Kp*) = 3...5 times the parameter #28 (Kp)
#85 (Ti*) = 3...5 times the parameter #29 (Ti)

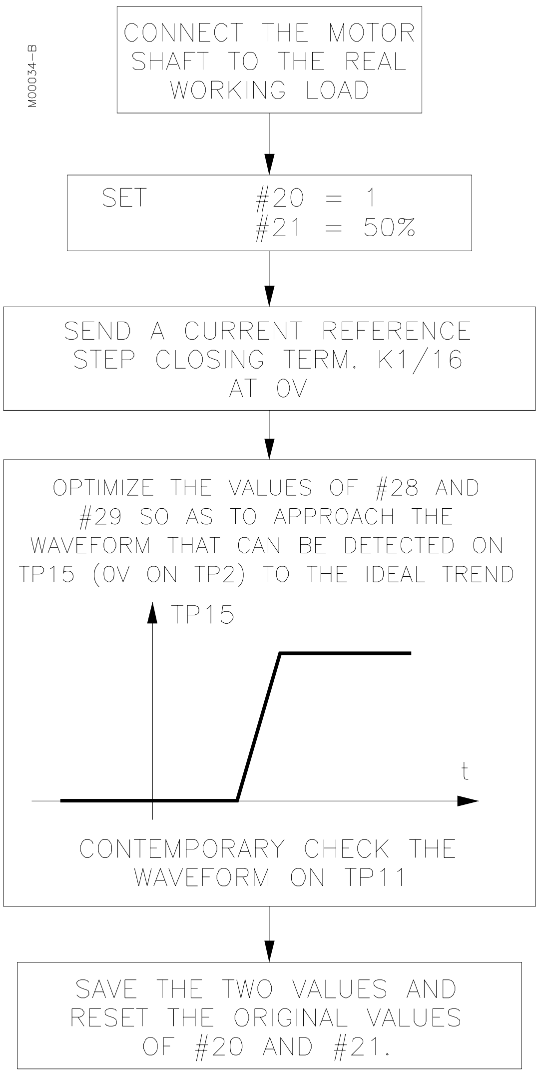


Fig. 32

Under these conditions, it's possible to observe again TP15 by an oscilloscope trying to get closer to the ideal trace by a certain value of param. #84 (the other one, #85, is much less influent on the answer). The advantage to have the speed parameter adaptation is to have during transient (in limit current) a sufficient high gain Kp* not to have overshoot, and then at steady state a not too high gain Kp and a not too small Ti, to have a fast and precise control without excessive modulation in current waveform.

In case of two different working phases, the motor can have two different inertia torques (e.g. two different reduction ratios). In this condition, the reference step answer can be optimised by selecting each time the value pair Kp* and Ti*, or the value pair Kp2* and Ti2* using the digital input on terminal K1/18 after setting #74=4 (**from Vers. C1.14 only**).

b) **At a constant speed reference, the optimization of the answer at a given torque step is obtained by adjusting the speed parameters.** This happens, for example, with machine tools undergoing a sudden stress due to the pieces to be machined. An example of setting, different from that of case a), is the following:

#82 (Ern1) = 0,5%
#83 (Ern2) = 1%
#84 (Kp*) = 3...5 times param. #28 (Kp)
#85 (Ti*) 0.1...0.5 times param. #29 (Ti)

c) **Optimization of the answer NOT to a step, but a reference RAMP internally generated by the drive, enough long not to cause the drive to enter in limit current, is got only by parameter #80 (Ti increase in ramp)**. Correctly increasing the integral time during ramp, will cause a perfectly linear trend of the speed over the time. Obviously, the longer the ramp time, the smaller the need to set param. #80.

C) CALIBRATION OF MAX. COUNTER-ELECTROMOTIVE FORCE

The parameter to be set is:

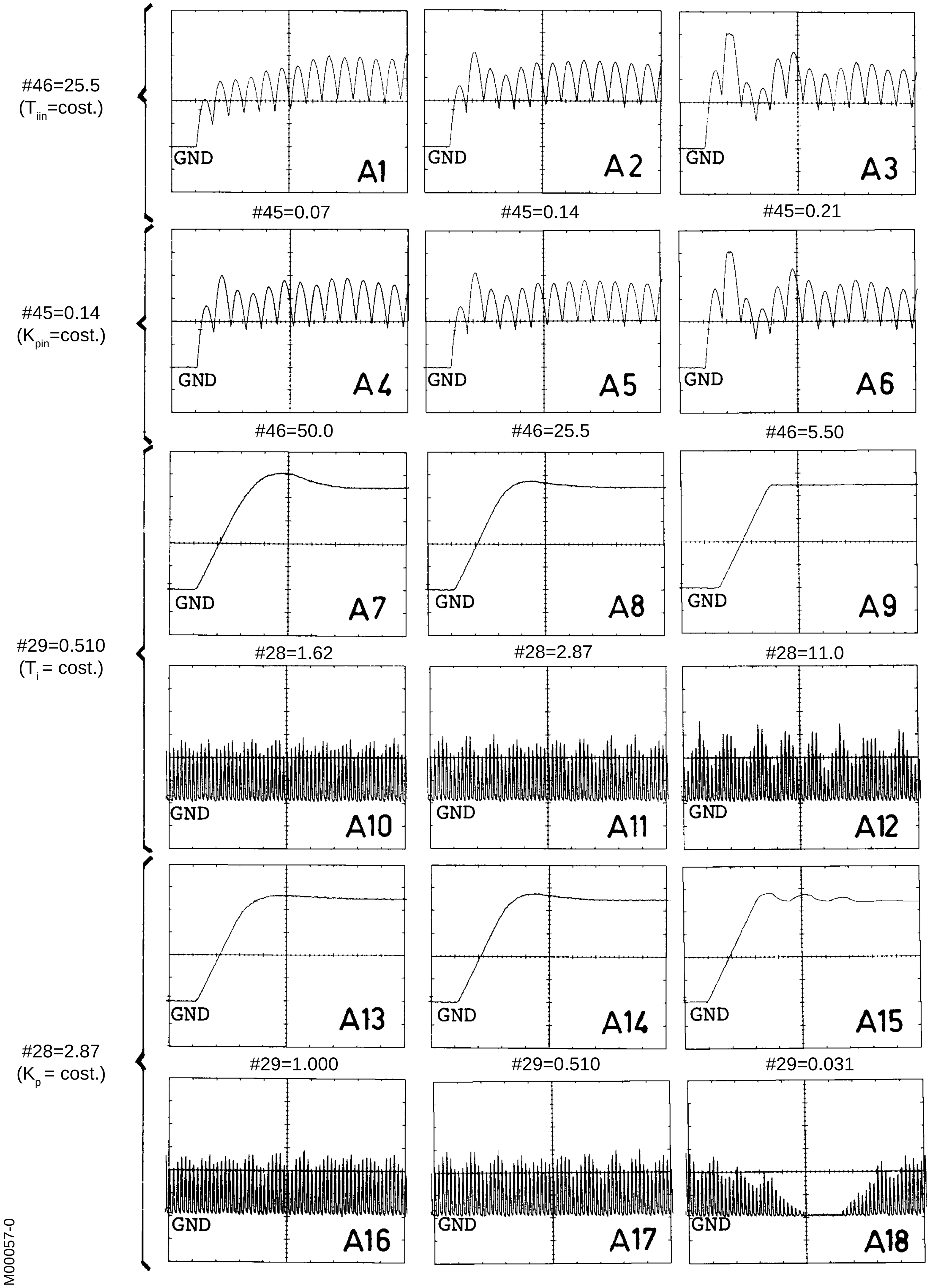
#12 ($K_e \cdot n_{max}$)

Remember that, when the drive starts operating, whichever is the value stored in the a.m. parameter (default value, or obtained through manual or automatic calibration), it is, under certain conditions, recalculated.
On the other side, parameter #12 is important as, under certain conditions, it allows to calculate the c.e.m.f. (parameter #07) and the feed forward (that is predominating in transients as regards to the PI control). So, until the above recalculation conditions are reached, the value stored in the above parameter must be quite correct.
If an external weakening is not present (parameter #79=100%), for a manual insertion of this parameter, from the nominal values c.e.m.f.$_{nom}$ and n_{nom} of the counter electromotive force and the speed, and from the n_{max} value of the max. speed, the following is obtained:

$c.e.m.f._{nom} \cdot n_{max} / n_{nom}$ —> **#12($k_e \cdot n_{max}$)**

The c.e.m.f.$_{nom}$ can be obtained, even with a certain approximation, from the nominal armature voltage (normally 440V for a 380V threephase supply).
So, for example, for a motor with 440V at 2000 rev/min., having a max. speed of 1500 rev/min. set #12=330V.

If, on the contrary, an external weakening is present (parameter #79<100%), in parameter #12 simply set the value of the max. armature voltage, already reached at the speed indicated by parameter #79 and constant up to n_{max}.
Note that, in case of external weakening, the manual adjustment of parameter #12 is the only solution, as the automatic adjustment is disabled.


#46=25.5
(T_{iin}=cost.)
GND
A1
GND
A2
GND
A3
#45=0.07
#45=0.14
#45=0.21
#45=0.14
(K_{pin}=cost.)
GND
A4
GND
A5
GND
A6
#46=50.0
#46=25.5
#46=5.50
GND
A7
GND
A8
GND
A9
#29=0.510
(T_i= cost.)
#28=1.62
#28=2.87
#28=11.0
GND
A10
GND
A11
GND
A12
GND
A13
GND
A14
GND
A15
#28=2.87
(K_p= cost.)
#29=1.000
#29=0.510
#29=0.031
GND
A16
GND
A17
GND
A18
M00057-0

USER PARAMETERS CHANGED AS REGARDS THE DEFAULT VALUE

Parameter	Default Value	Changed Value	Parameter	Default Value	Changed Value
#12 - k_e x n_{max}	440 V	----------------	#53 - RC	0 ms	----------------
#13 - Vmains	Supply term.36-38	----------------	#54 - Speed ref.	pos. only	----------------
#15 - G (V ref)	1.00	----------------	#55 - nmin	0%	----------------
#15 - G (I ref)	1.00	----------------	#56 - nmax	100%	----------------
#16 - G (IN AUX)	1.00	----------------	#57 - K1/4 IN AUX	cut out	----------------
#17 - Vmains	380 V	----------------	#58 - k1/9 OUT AUX	0 Volt	----------------
#18 - RxI	10 V	----------------	#59		----------------
#19 - Ldi/dT	760 V	----------------	#60 - Iref+	0%	----------------
#20 - jog operation	#23/#25	----------------	#61 - PI speed	operating	----------------
#21 - jog 1	5%	----------------	#62 - PI curr.	operating	----------------
#22 - jog 2	5%	----------------	#63 - feed forward	uses cemf	----------------
#23 - tUP	0 s	----------------	#64 - armature alarm	not mask.	----------------
#24 - tDN	0 s	----------------	#65 - freq. alarm	not mask.	----------------
#25 - tSTOP	0 s	----------------	#66 - V mains alarm	not mask.	----------------
#26 - Start round	0 s	----------------	#67 - ph. fail. alarm	not mask.	----------------
#27 - End round	0 s	----------------	#68 - tacho fail. alarm	not mask.	----------------
#28 - kp	3.83	----------------	#69 - nslave	1	----------------
- kp2	3.83	----------------	#70 - baud rate	9600	----------------
#29 - Ti	0.512 s	----------------	#71 - parity	disabled	----------------
- Ti2	0.512 s	----------------	#72 - A04/A05 delay	0.4 s	----------------
#30 - os n	0%	----------------	#73 - Speed feedback	tacho g.	----------------
#31 - ST	25%	----------------	#74 - K1/18 MDI	CLIM	----------------
#32 - Ilim1	100%	----------------	#75 - tUPj	0 s	----------------
#33		----------------	#76 - tDNj	0 s	----------------
#34 - Ilim2	100%	----------------	#77 - ext. lim.	positive	----------------
#35		----------------	#78 - Arm. comp.	100%	----------------
#36 - nlim	100%	----------------	#79 - n field weakening	100%	----------------
#37 - n*	100%	----------------	#80 - k x Ti	1	----------------
#38 - Ilim	100%	----------------	#81 - Par. Adapt.	cut out.	----------------
#39 - t+lim	2 s	----------------	#82 - Ern1	0,5%	----------------
#40		----------------	#83 - Ern2	1.0%	----------------
#41 - +lim	100%	----------------	#84 - kp*	3.83	----------------
#42		----------------	- Kp2*	3.83	----------------
#43 - clim	50%	----------------	#85 - Ti*	0.512 s	----------------
#44 - tcurr	0 ms	----------------	- Ti2*	0.512 s	----------------
#45 - kpin	0,14	----------------	#86 - K1/19-20 MDO	ST	----------------
#46 - Tiin	25.5 ms	----------------	#87 - hysteresis	5%	----------------
#47 - Quadrants	1,2	----------------	#88 - df/dt	1 Hz/s	----------------
#48		----------------	#89 - A03 delay	immed.	----------------
#49 - Rated I mot.	100%	----------------	#90 - load select.	motor	----------------
#50 - I^2t	10 min	----------------			
#51 - αmot.	25°	----------------			
#52 - αbrake	150°	----------------			