CSV

Soft Starter

Instruction Manual
\textbf{ATTENTION:}

The starter is provided with the terminal for the connection of the protection conductor ( ). In order to avoid dangerous voltage on the cover of the equipment it is important to provide the connection with the appropriate section and color.

The starter, if not specified when the order was made, works with \textbf{380V Three-phase circuit} in normal service ad installation conditions.

The starter is designed with a nominal input current In and is not protected from overload. Thermic protections for both the starter and the engine need to be provided. In order to achieve a correct protection for short circuit extra-fast-fuses need to be provided in the size indicated in the table at page 12.

The optional board 00-LCV can limit the current maximum output value during the start to the value shown in the table at page 12.

The starter designation must be made by the customer and must be made on the grounds of the real current required to start. The proper work of the starter is guaranteed only on new or overhauled motors guaranteed by the constructor and properly connected.

The starter is not designed to supply capacitive loads. Possible \textit{additional power factor rectified} must be placed \textbf{before the device}.

The starter are realised in conformity with the regulations in force about:
- Insulation distances
- Conformity of the materials used in the construction

The use of the product must be made in conformity with the harmonised European regulations and in particular the EN60439-1 (CEI 17-13-1) and EN 60204-1 (CEI 44-5).

During the installation, the use and the servicing, must be respected the regulations in force concerning labour accidents prevention and engine security. ( DLgs. N° 626-19/09/94 and CEE regulation 99/382 with followed interpretations and modifications).

Version 2.0 04/97
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1.1 INTRODUCTION

CSV is a starter that uses a circuit incorporating power semi-conductor phase control technology with a close loop control of the current, which allows a gradual start-up and slowing down of standard asynchronous motors.

This system allows:
- To adjust the acceleration deceleration time
- To set the start of motor steady running speed
- To set the maximum current absorbed during the start phase
- To limit the torque peak to the mechanical transmission

If it's necessary, obtain a continuous speed control and not only controlled start, it needs to be realised the speed retroaction. The converter is suitable to receive as retroaction signal the voltage of a dynamo tachimetric. In this case the speed control is not made acting on the frequency, but on the voltage, then the motor slide, and is therefore squanderer.

It's necessary verify that the starter designation would be proper for the used motor. Before using the CSV, we advise you to read carefully this manual.

2.1 PARTS CHECK

Handle the CSV with care and avoid to force open.

Then check that:
- No parts would be damaged during the transport.
- The plate date would be the same as in your order.

If the received material is different from what you have ordered, please contact immediately our assistance offices.

3.1 INSTALLATION

Assemble the starter correctly by using the fixing holes; check that the ventilation pipes are not blocked and that there is enough space around the converter to allow a free circulation of the air.

Then, you have to take into account the following requirements:
- The room temperature (internal part of the casing) must be between +5 e +40 °C and that the relative humidity less than 90%.
  - Avoid areas rich of metallic dust and corrosive gases.
- Avoid areas where there are strong vibration; eventually you can assemble the converter on anti-vibration supports (this option can be supplied on customer request).

4.1 OPERATOR’S PANEL

The starter panel, as seen from the operator, is shown by the fig. 4.1.1 on page 5. It results divided in three sections:
- ADJUSTMENT SECTION
- WARNING SECTION
- PREDISPOSITION

The adjustment section consists of N. 5 potentiometers P1 ÷ P4 having the following functions:

<table>
<thead>
<tr>
<th>P1</th>
<th>Acceleration ramp</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2</td>
<td>Initials start up current</td>
</tr>
<tr>
<td>P3</td>
<td>Time ramp</td>
</tr>
<tr>
<td>P4</td>
<td>Gain loop seed setting</td>
</tr>
</tbody>
</table>

The warnings consists of N. 4 led DL1 ÷ DL4 which have the following functions:

| DL1 | Breakout | Highlights problems within the supply or overheating of the converter |
| DL2 | Converter OK | Its lighting during the starter feeding indicates that the converter is properly connected and that there are no fault conditions. |
| DL3 | Gear | Shows the gear needed |
| DL4 | Startup start | The engine has terminated the start |
The predisposition section has both small bridges to be joined (JP7, JP8, JP9, JP10, JP11) in order to set special functions and normal bridges (JP3, JP4, JP5, JP6) in order to set the calibration and personalization of the starter.

A) Calibration jumper:

<table>
<thead>
<tr>
<th>jumper</th>
<th>function</th>
<th>default</th>
</tr>
</thead>
<tbody>
<tr>
<td>JP3</td>
<td>open for current loop mode (option 02-LCV)</td>
<td>close</td>
</tr>
<tr>
<td>JP4</td>
<td>close for external and internal voltage loop mode</td>
<td>closed</td>
</tr>
<tr>
<td>JP5</td>
<td>close for direct reference without voltage control mode</td>
<td>open</td>
</tr>
<tr>
<td>JP6</td>
<td>close for internal voltage loop mode</td>
<td>closed</td>
</tr>
</tbody>
</table>

A) Small jumper:

<table>
<thead>
<tr>
<th>jumper</th>
<th>function</th>
<th>default</th>
</tr>
</thead>
<tbody>
<tr>
<td>JP7</td>
<td>close for start circuit internal power supply</td>
<td>closed</td>
</tr>
<tr>
<td>JP8</td>
<td>close to exclude voltage clamp (special function)</td>
<td>closed</td>
</tr>
<tr>
<td>JP9</td>
<td>close for 60Hz frequency line</td>
<td>open</td>
</tr>
<tr>
<td>JP10</td>
<td>open to perform controlled deceleration</td>
<td>closed</td>
</tr>
<tr>
<td>JP11 A</td>
<td>close for normal mode - start/stop</td>
<td>closed</td>
</tr>
<tr>
<td>JP11 B</td>
<td>close for controlled acceleration</td>
<td>open</td>
</tr>
</tbody>
</table>

Note: don't close JP11A and JP11B simultaneously

Attention: The wrong position of the bridges might cause the failure of the starter

![Function mode grid](image_url)

Fig. 4.1.1
### 4.2 OUTPUT INTERFACE

<table>
<thead>
<tr>
<th>ABBREVIATION</th>
<th>DESCRIPTION</th>
<th>LEVELS</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1, L2, L3</td>
<td>Power supply</td>
<td>400V three-phase 50/60 Hz</td>
</tr>
<tr>
<td>U, V, W</td>
<td>Motor output</td>
<td>0÷400V three-phase partialized</td>
</tr>
<tr>
<td>Pe</td>
<td>Internal voltage reference</td>
<td>+24V CC 200 mA max</td>
</tr>
<tr>
<td>V1</td>
<td>Comando di marcia in versione standard</td>
<td>+24V 5 mA</td>
</tr>
<tr>
<td>V2</td>
<td>Comando di marcia in versione Acc/Dec</td>
<td>+24V 5 mA</td>
</tr>
<tr>
<td>Re</td>
<td>External reaction (Optional)</td>
<td>-100V CC 5 mA max</td>
</tr>
<tr>
<td>OK</td>
<td>Starter OK</td>
<td>Open coll. NO 1A 125V</td>
</tr>
<tr>
<td>FA</td>
<td>Starter stop</td>
<td>Open coll. NO 1A 125V</td>
</tr>
<tr>
<td>0</td>
<td>Common electronic circuit</td>
<td>0 VCC</td>
</tr>
<tr>
<td>C</td>
<td>Common contacts FA-OK</td>
<td>1A 250V 125 VA Max</td>
</tr>
<tr>
<td>K2</td>
<td>Pin strip option connectors protected</td>
<td></td>
</tr>
</tbody>
</table>

### 5.1 CONNECTION

The fig. 5.1.1 on page 8 shows a typical layout connection of a soft starter.

Are necessary those considerations:

**The power supply 380/400V 3 phases:**
Connect to L1, L2, L3 following the correct sequence of each phase, an incorrect phase sequence is indicated by a led (DL5) illumination; when the phase is correct the led will exhaust. If during the starting the motor should rotate in the opposite direction, please invert the U-V connections.

**Thermal protection:**
The starter is not provided with any thermal protection. A thermal relay (RT) needs to be provided before the starter in order to protect the starter itself and the engine as shown in Fig. 5.1.1 on page 8. For a good protection against short circuit it is necessary to provide extra fast fuses of the indicated size on the table at page 12.

**Start command:**
It’s made connecting the V1 - Pe terminals together by an N.O. contact of a power contactor KM.

**Protection conductor (C):**
The converter is provided with an anchorage for the connection of the protection conductor. Please assure yourselves have made the connection properly.

**Screening:**
Normally it’s not necessary; in case of control and warning circuits with connections cable longer than 10 meters, please use screened cables with the screen connected to earth on the converter side.

**External warnings:**
Are available on terminal (OPEN COLLECTOR output) two relays commands (24V / 500 ohm minimum) which warn the ‘CONVERTER OK’ (OK) and ‘START UP END’ (AV) conditions.

**Options:**
The converter is built with an expansion option like the limit of external current or ring of speed. The optional board is to be connected to K2 connector.
5.2 NOTES

The rephrasing group is not to connect on the starter output; in case that the rephrasing group should be necessary, connect it before the starter, as shown by the fig. 5.1.1 on page 7. The rephrasing group must be made by a fixed condenser.

5.3 ARRANGING

Before the start is necessary to make some arrangements on the jumpers of the RCV-01 boards depending on the chosen function. For the predisposition see page 5 – 6. It is recommended to leave the settings in the original position if special functions are not requested.

5.4 STARTING UP PROCEDURE

5.4.1 Starting up

After the check of the proper starter connection and of the system isolation, perform the following operations:

- Check the bridges are in the needed position
- Disconnect the motor from the starter - power the L1-L2-L3 terminals; the led DL2 must light up (if DL1 is lighted swap L1-L2)
- Operate the start up by shorting the V1 - PE connection together: The led DL3 must light up and after a while DL4 must light up as signal of startup ended.
- Operate the stop by opening the V1 - PE contact. Reconnect the motor and set the potentiometers P1 - P2 - P3 to 'zero' (anticlockwise rotation).
- Operate the start up command and rotate P2 clockwise till the motor starts to turn; adjust then P3 so that the motor starts up in desired way and time
- Repeat the start in order to optimize the operation

- If it would be necessary use a suitable starting boost to overcome the possible initial static frictions, perform as follows:
  Start with the starter in the stop condition, set the P1, P2, P3 potentiometers to 'zero'.
  Operate the start up and adjust P2 till the motor starts to turn slowly. Operate now the stop command and turn P1 as P2; reset then P2 to 'zero'.
  Operate the the start up and check if the booster (P1) is able to overcome the initial static friction; if necessary re-adjust (by decreasing if the start is too violent or increasing if not enough). Set then P2 to keep the system in slow rotation and P3 to make the motor start in desired way and time.
  To increase the starting period is enough rotate clockwise the P3 potentiometer.

6.1 NOTES FOR THE STARTER SETTING UP

A) If the motor to be started has mechanical transmissions with rather high plays, it would be necessary to set the starting current (P2) to a lower value and leave P1 to 'zero'; mechanical kick are so avoidable.

B) If rapid deceleration is required, P3 would be set to a rather high value, because it's necessary to supply a lot of current to the motor. If it was not enough, increase also P2, keeping in mind what explained at point A.

C) If a very slow acceleration is required, set P3 to a very high value (long acceleration time).

For a better understanding of the effects of the potentiometer on the engine see Fig. 6.1.1. at page 7.

Fig. 6.1.1
Fig. 5.1.1 Functioning on controlled startup

380/400V 50/60Hz

phase advancing group (optional)

extrafast fuse (see pag. 12)

KM

L1 L2 L3

CSV

U V W O V2 V1 PE C OK FA

M

start

KM

Emergency

C

RL1 FA

RL2 OK

KW

start ok

OK

RT

STOP

KM

1

switching voltage max: 125V
switching current max: 1A
7.1 TROUBLE SHOOTING

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>CONDITION</th>
<th>SUGGESTED CORRECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>The engine doesn’t turn Not absorbs current</td>
<td>The start led is not lighed up (DL3)</td>
<td>Check the command V1-Pe</td>
</tr>
</tbody>
</table>

The engine doesn’t turn And not absorbs current | The converter led is off (DL1) | Probably missing of power supply. Thermic protection inside The converter. Failure on control board |

The motor turns and by increasing the absorb current doesn’t reach the max running speed (LCV version) | The required torque is higher than the one available | Check the T max Use the CSV of bigger size |

8.1 OPERATING THE STARTER

8.1.1 FLOWCHART

The flowchart of the soft starter CSV is shown by figure 8.1.1 on page 10. Here are pointed out the following main blocks:

1. **Power groupe**
   It consists of SCR control, RC filter units and units of overvoltage thyistor suppressors. The power bridge consists of 6 thyristors, connected together in antiparallel, which allow in this way the whole control of the start up/ speed decrease.

2. **Transformers and power supply unit**
   It receives the alternating voltage supply; then, after reducing it through three single phases transformers and rectifying it, using two bridges rectified, it supplies the following DC voltage:
   - ± 24V, not-regulated voltage for triggering circuits, internal and external relays supply.
   - ± 15V, regulated voltage for regulation and control circuit supply.
   The unit is protected by fuses.

3. **Control circuit and protections**
   It represents the supervisor system of all sizes and the control system of the correct command and interlock system. In particular it controls:
   - Correct phase sequence
   - Presence of all the supply phases
   - Status of the protection devices into the starter
   - Possible not enough voltage supply
   - Start up/ stop sequence correct
   - Start up completed
   - Control of the signal coming from thermal option

   The overload control is made by an electronic thermal sensor adjusted during the testing stage.

4. **Booster circuit**
   This circuit receives the start up command (contact Pe - MA closed) and changes this command into a pulse with duration of about 500mS which sends to a voltage reference circuit (practically it’s a shunt); this allows to obtain an adequate amount of start up torque to overcome possible static frictions.
   The value during the start up can be adjusted by using the potentiometer P1.

5. **Ramps Circuit**
   Practically it is an integrated circuit, whose charge and discharge are controlled by the potentiometer P3 when the start command is on V1. By adjusting the potentiometer you can reduce the starting time.

6. **Current ring amplifier circuit**
   The current control signal is comparated with the motor current one, and limitted into its maximum amount.
   The fault that there is between the nominal current and the motor one is amplified and send to the next circuit to make the pulse maker command (CFI).
7 Phaseshifter pulse amplifier circuit
The CFI is applied to this circuit that provide to the production of the SRC command pulses. Those are sent as a train of pulses (a first pulse of a quite high value and a series of other one of reduced value) to the primary of a transformer, which secondary is connected the thyristor gate; in this way an electrical isolation is obtainable between the control and power circuits.

Fig. 8.1.1

9.1 THE TECHNICAL SPECIFICATIONS

POWER SUPPLY:
- SUPPLY 380/400V
- FREQUENCY 50/60Hz

LOADS AND ADJUSTMENTS:
- Nominal output current: In
- Maximum output current: See selection table at page 12 (OPZION)
- Start up Boost: 0 + 50% V max settable
- Acceleration/Deceleration ramp: 4 + 40 sec. settable
**PROTECTIONS:**
- Wrong input phases sequence
- Overvoltages
- Overheating

**LED WARNINGS:**
- Starter ready
- Starter at work
- Starter broken
- Start up end

**EXTERNAL SIGNALS:**
- Output contact relay: 1A 125 V
- Starter ready
- Start up end

**DISSIPATION:**
- Into the power circuit: \[ P = N^{(1)} \times I^{(2)} \times \Delta V^{(3)} \]
- Into the control circuit: \[ P_{\text{max}} = 15\text{W} \]

(1) \( N \) = Phases number = 3
(2) \( I \) = Phase current (effective value)
(3) \( \Delta V \) = equivalent voltage drop (usually 1.2V)

- Maximum allowed starting: 15 per hour with a 2 minutes pause between one starting and the other

**AMBIENTAL CONDITIONS:**
- Storage temperature: -10 / +70°C
- Work temperature: +5 / +40°C
  The starter is able to provide the nominal value up to 50 °C into the screen; higher than this temperature is necessary a decreasing of the performances equal to the 2% for every temperature increasing °C degree. Maximum temperature 55 °C.
- Relative humidity: 90% without condensing
- Altitude: 1000 mt. above sea level

**PROTECTION DEGREES:**
- 20 frontal (IP20 total optional)
9.2 INITIALS FOR THE ORDER AND DIMENSIONS

<table>
<thead>
<tr>
<th>DIM (mm)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>200</td>
<td>183</td>
<td>170</td>
<td>150</td>
<td>168</td>
<td>25</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>200</td>
<td>233</td>
<td>170</td>
<td>150</td>
<td>218</td>
<td>25</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>200</td>
<td>233</td>
<td>200</td>
<td>150</td>
<td>218</td>
<td>25</td>
<td>8</td>
</tr>
<tr>
<td>4</td>
<td>260</td>
<td>233</td>
<td>200</td>
<td>210</td>
<td>218</td>
<td>25</td>
<td>10</td>
</tr>
</tbody>
</table>
10 OPTIONS AND SPECIAL FUNCTIONS

10.1 By-pass Plan

If the starter is working just a few times a day might be useful to use a by-pass contactor that helps saving electricity when the starter is switched on. Fig. 10.1.1 shows the typical connection scheme:

Fig. 10.1.1

1. switching voltage max: 125V
2. switching current max: 1A
10.2 OPERATING WITH CONTROLLED ACCELERATION/DECELERATION

Set the following short bridges on the 02-RCV board (to localize the bridges see Fig. 4.1.1 page 5):

JP10 OPEN
JP11 POSITION B

If V1 is closed the engine accelerates, if V1 is open decelerates.
The running set on V2 must be maintained for both acceleration and deceleration.
See Fig.10.2.1. at page 14 for standard connection.

Fig. 10.2.1
10.3 OPERATING WITH FEEDBACK OF EXTERNAL LCV LINE

Set the following small bridges on 02-RCV board (to locate the small bridges see Fig. 4.1.1 page 5):

- JP3 OPEN
- JP4 CLOSED
- JP6 CLOSED

Insert the cable for connection of 00-LCV board into K2 connector of 02-RCV board.
On LCV board make the passages of TA (N° spyrals) indicated on table 10.3.1. at page 15, they are function of necessary I max. Set the small bridges on 02-RCV board for maximum output.
Connect following the scheme shown on Fig.10.3.2. at page 16.
For the settings: proceed as for normal version by regulating the 02-RCV board:
P1 for boost current
P2 for detached current
P3 for ramp time
P4 for gain loop speed

Tab. 10.3.1

<table>
<thead>
<tr>
<th>Number of coils</th>
<th>max JP1 closed</th>
<th>max JP1 open</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>250</td>
<td>200</td>
</tr>
<tr>
<td>2</td>
<td>125</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>85</td>
<td>65</td>
</tr>
<tr>
<td>4</td>
<td>60</td>
<td>50</td>
</tr>
<tr>
<td>5</td>
<td>50</td>
<td>40</td>
</tr>
</tbody>
</table>

calls must be in the same direction for both TA

Note: 300Amax with D1-LCV.
for max output current see pag.12

![Diagram of connections](image-url)
Fig. 10.3.2

380/400V 50/60Hz

phase advancing group (optional)

FUSE AM (see pag. 12)

KM

RT

LCV

TA1 TA2

K1 K2

U V W O V2 V1 PE OK FA

CSV

M 3～

Emergency

RL1 FA

RL2 OK

OK

start

STOP

RT

KM

start ok

1 switching voltage max: 125V
switching current max: 1A

Pag. 16