

Soft-Starter

Arrancador Suave

Chave de Partida Soft-Starter



SSW 04



User's
Guide

Guia del
Usuario

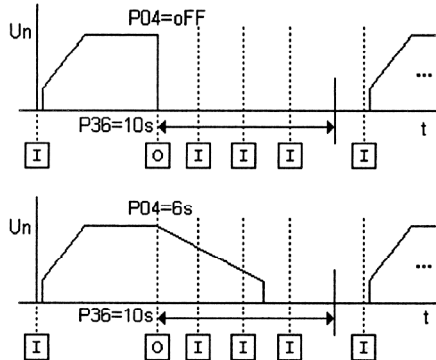
Manual
do usuário

ADDENDUM TO THE MANUAL 0899.5629 E/5 - SSW-04

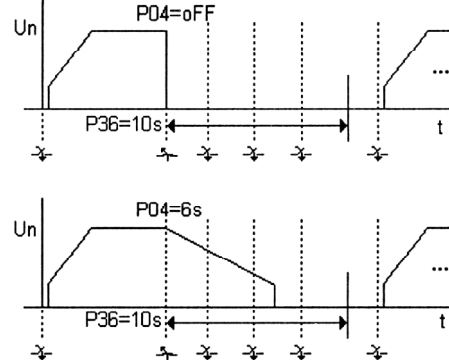
This addendum refers to the following changes that have been made on the SSW-04 software from Version 4.XX to Version 5.XX.

1. Inclusion of the time interval between starts function.
This protection acts limiting the time minimum interval between starts to avoid excessive starting and stopping according to the time adjusted in parameter P36.
- **P36:** Time Interval Between Starts (oFF, 1 ... 999s). Factory Standard: "oFF".

Operation by HMI (I/O)



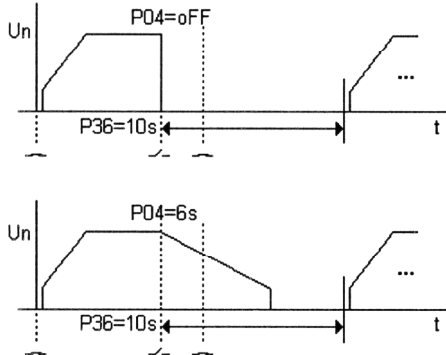
Operation by three wire digital input (E.D.1 and E.D.2)



Attention:

The SSW controller will not accept a new Start command during the time, adjusted in P36, elapsed after Stop. Identically to serial interface communication.

Operation by two wire digital input (E.D.1)



Attention.:

The SSW controller will not accept a new Start command during the time, adjusted in P36, elapsed after Stop.

NOTE!

- 1) Use this function only if you need to avoid excessive starting and stopping.
- 2) The time counter starts after a Stop command, with or without soft stop.
- 3) The time adjusted in P36 must be greater than the time adjusted in P04 for this function to work properly.
- 4) This function doesn't work for the Jog function.
- 5) During the reversal of the motor direction, the new start of the motor will be only realized after the time adjusted in P36 elapses.

ADDENDUM TO THE MANUAL 0899.5629 E/5 - SSW-04

This addendum refers to the following changes that have been made on the SSW-04 software from Version 3.XX to Version 4.XX

1. Addition of the function Watch Dog of the Serial Communication.
This protection acts when the serial communication between the master and the Soft-Starter is interrupted, causing indication and action as set in parameters P63 and P64.
 - **P63:** Watch Dog Time of the Serial Communication (oFF, 1 ... 5s). Factory Standard: "oFF".
 - **P64:** Action After Watch Dog Time is Elapsed (1, 2 and 3). Factory Standard: 1.
 - 1 = Indicates only error E29.
 - 2 = Indicates error E29 and disables the motor by ramp, if P04 is programmed different from "oFF" and motor is stopped by inertia if equal "oFF".
 - 3 = Indicates error E29 and cause general disabling of the Soft-Starter. Its cats as emergency. The motor is stopped by inertia.

NOTE!

Error E29 is reset when the correct serial communication returned.

NOTE!

Enable this function only if there is cyclic serial communication with a Master.

Set the watch dog time according to the time between telegrams sent by the master.

2. Change in the setting range of P15 to: off, 1 ... 200s.
3. Addition the following NOTE! in the item 6.3.19 - Pump Control.

NOTE!

Before the first start of the Pump, disable the Pump Control function. P45 must be set at "oFF".

Set the following parameters:

- P01 = 30 (Initial Voltage)
- P02 = 15 (Acceleration Ramp Time)
- P03 = 80 (Voltage Fall Step during Deceleration)
- P04 = 15 (Deceleration Ramp Time)
- P11 = OFF (Current Limitation)

After setting the values above start and stop the Pump. Then check the correct direction of rotation, pump flow and the current of the motor.

After the above step you can enable the Pump Control (P45 = "on").

4. Addition the following items 10.2, 10.3 e 10.4 in the accessories chapter.

10.2 - RS-485.

Optionally the SSW-04 can operate in serial interface RS-485 by Weg Interface Module MIW-02.

Module Type	WEG Item
MIW-02	417100543

NOTE!

For more details see MIW-02 Manual (0899.4430).

10.3 - Fieldbus Network.

Optionally the SSW-04 can operate in communication network "FieldBus", by a gateway, Weg Fieldbus Module MFW-01.

Module Type	Protocol	WEG Item
MFW-01/PD	Profibus DP	417100540
MFW-01/DN	DeviceNet	417100541
MFW-01/MR	ModBus RTU	417100542

NOTE!

For more details see MFW-01 Manual (0899.4429).

10.4 - SuperDrive.

Programming software for microcomputer PC, for windows environment. Permits parameter programming, command and monitoring of the Soft-Starter SSW-04. It edits parameters "on-line", directly to the Soft-Starter or it edits parameters files "off-line", saving in the microcomputer. The communication between Soft-Starter and Microcomputer is by serial interface RS232 (Point to Point) or RS485 (Network Line).

Product	WEG Item
Super Drive	417102505

SOFT-STARTER MANUAL

SSW-04 Series

Software: version 5.XX

0899.5629 E/5



NOTE!

It is very important to check if the Soft-Starter Software is the same as the above.

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QUICK PARAMETER REFERENCES, ERROR MESSAGES AND STATUS MESSAGES

Software: V5.XX

Application: _____

Type: _____

Serial Number: _____

Responsible: _____ **Date:** ____/____/____.

1. Parameters

Para- meter	Function	Adjustable Range	Factory Setting	User's Setting	Page
P00	Permits parameter changing	OFF, ON	OFF		52
Regulation Parameter					
P01	Initial Voltage	25...90% U _N	30%U _N		52
P02	Acceleration ramp time	1...240 s	20s		53
P03	Voltage ramp during deceleration	100... 40%U _N	100%U _N		53
P04	Ramp time during deceleration	OFF,2...240s	OFF		54
P11	Current limit during starting	OFF, 150...500%I _N	OFF		54
P12	Immediate over current	32...200%I _N	120%I _N		56
P13	Immediate over current time	OFF, 1...20s	OFF		58
P14	Immediate undercurrent	20...190%I _N	70%I _N		57
P15	Immediate undercurrent time	OFF, 1...30s	OFF		58
Motor Parameter					
P21	Motor current setting	OFF, 30.0...200.00%I _N	OFF		72
P25	Overload class	5, 10, 15, 20, 25, 30	30		73
P26	Service factor	0.80...1.50	1.00		78
P27	Auto-reset of the thermal memory	OFF, 1...600s	OFF		78

QUICK PARAMETER REFERENCES, ERROR MESSAGES AND STATUS MESSAGES

Parameter	Function	Adjustable Range	Factory Setting	User's Setting	Page
Regulation Parameter					
P22	Rated current	16, 30, 45, 60, 85A	According to the Model		58
P23	Rated mains voltage	220, 230, 240, 380, 400, 415, 440, 460, 480, 525, 575V	380V		59
P31	Phase rotation	OFF, ON	OFF		59
P33	Voltage jog level	25...50%U _N	25%U _N		59
P34	DC braking time	OFF, 1...10s	OFF		60
P35	DC braking voltage level	30...50%U _N	30%U _N		60
P41	Voltage pulse at start (kick start)	OFF; 0.2...2s	OFF		60
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Reading Parameters					
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P72	Indication of the %I _N motor current of the switch	XXX %I _N			51

QUICK PARAMETER REFERENCES, ERROR MESSAGES AND STATUS MESSAGES

Parameter	Function	Adjustable Range	Factory Setting	User's Setting	Page
P73	Motor current indication (A)	0.0...999.9A			51
P74	Active power indication supplied to the load (KW)	0.0...999.9kW			51
P75	Apparent power indication supplied to the load (KVA)	0.0...999.9kVA			51
P76	Load power factor	0.00...0.99			51
P77	Soft-Starter output voltage indication % U_N	0...100% U_N			51
P81	Heatsink Temperature (°C)	10...110°C			51
P82	Indication of motor Thermal Protection Status	0...250%			51
P96	Last hardware error	1...8			52
P97	Second hardware error	1...8			52
P98	Third hardware error	1...8			52
P99	Fourth hardware error	1...8			52

QUICK PARAMETER REFERENCES, ERROR MESSAGES AND STATUS MESSAGES

2. Error Messages

Display	Meaning
E01	Phase failure or thyristor fault or motor not connected
E02	At the end of time of the programmed acceleration time, the voltage does not reach 100% U_N due to the current limit.
E03	Overtemperature at the thyristors and in the heatsink
E04	Motor overload
E05	Undercurrent (applicable to pumps)
E06	Immediate overcurrent
E07	Phase rotation
E08	External fault
E24	Programming error
E2X	Serial communication error

3. Soft-Starter Status

Display	Definition
rdy	Soft-Starter is ready to be enabled
PuP	Loading pump control parameters
EEP	Loading "Default" values
On	Function enabled
OFF	Function disabled

1

SAFETY NOTICE

This Manual contains all necessary information for the correct installation and operation of the SSW-04 Soft-Starter.

This Manual has been written for qualified personnel with suitable training or technical qualifications to operate this type of equipment.

1.1 SAFETY NOTICES IN THE MANUAL



The following Safety Notices will be used in this Manual:

DANGER!

If the recommended Safety Instructions are not strictly observed, it can lead to serious or fatal injuries of personnel and/or equipment damage.

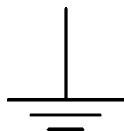
ATTENTION!

Failure to observe the recommended Safety Procedures can lead to material damage.

NOTE!

The content of this Manual supplies important information for the correct understanding of operation and proper performance of the equipment.

1.2 SAFETY NOTICES ON THE PRODUCT



The following symbols may be attached to the product, serving as Safety Notice:

High Voltages

Components are sensitive to electrostatic discharge. Do not touch them without following proper grounding procedures.

Mandatory connection to ground protection (PE)

Shield connection to ground

1.3 PRELIMINARY RECOMMENDATIONS



DANGER!

Only qualified personnel should plan or implement the installation, startup, operation and maintenance of this equipment.

Personnel must review this entire Manual before attempting to install, operate or troubleshoot the SSW-04. These personnel must follow all safety instructions included in this Manual and/or defined by local regulations.

Failure to comply with these instructions may result in personnel injury and/or equipment damage.



NOTE!

In this Manual, qualified personnel are defined as people that are trained to:

1. Install, ground, power up and operate the SSW-04 according to this manual and the local required safety procedures;
2. Use of safety equipment according to the local regulations;
3. Administer Cardio Pulmonary Resuscitation (CPR) and First Aid.



DANGER!

Always disconnect the supply voltage before touching any electrical component inside the Soft-Starter.

Many components are charged with high voltages, even after the incoming AC power supply has been disconnected or switched OFF. Wait at least 3 minutes for the total discharge of the power capacitors.

Always connect the frame of the equipment to the ground (PE) at the suitable connection point.



ATTENTION!

All electronic boards have components that are sensitive to electrostatic discharges. Never touch any of the electrical components or connectors without following proper grounding procedures. If necessary to do so, touch the properly grounded metallic frame or use a suitable ground strap.

**Do not apply High Voltage (High Pot) Test on the Soft-Starter!
If this test is necessary, contact the Manufacturer.**



NOTE!

Read this entire Manual carefully and completely before installing or operating the SSW-04.

2.1 - ABOUT THIS MANUAL

This Manual describes how to install, start-up, operate and identify the problems of the SSW-04 Soft-Starters series.

Should you require any training or further info, please contact WEG.

This Manual is divided into 9 Chapters, providing information to the user on how to receive, install, start-up and operate the SSW-04:

Chapter 1- Safety Notices;
Chapter 2 - Introduction;
Chapter 3 - Installation;
Chapter 4 - Power-up / Commissioning;
Chapter 5 - Use of the HMI;
Chapter 6 - Detailed Parameter Description;
Chapter 7 - Maintenance;
Chapter 8 - Technical Characteristics;
Chapter 9 - Appendix.

This Manual provides information for the correct use of the SSW-04. The SSW-04 is very flexible and allows for the operation in many different modes as described in this manual.

As the SSW-04 can be applied in several ways, it is impossible to describe here all of the application possibilities. WEG does not accept any responsibility when the SSW-04 is not used according to this Manual.

No part of this Manual may be reproduced in any form, without the written permission of WEG.

2.2 VERSION OF SOFTWARE

It is important to note the Software Version installed in the Version SSW-04, since it defines the functions and the programming parameters of the Soft-Starter.

This Manual refers to the Software version indicated on the inside cover. For example, the Version 1.XX applies to versions 1.00 to 1.99, where "X" is a variable that will change due to minor software revisions. The operation of the SSW-04 with these software revisions are still covered by this version of the Manual.

The Software Version can be read in the Parameter P71.

2.3 - ABBREVIATIONS USED

HMI	- Human machine interface (keypad + display)
HMI-3P	- Keypad + Display interface - Linked via parallel cable
RLX	- Relay output No X
DIX	- Digital input No X
I_N	- Soft-Starter nominal output current
U_N	- Rated mains voltage
LED	- Light Emitting Diode

2.4 - ABOUT THE SSW-04

The SSW-04 series is a totally microprocessor controlled Soft-Starter series which controls the starting current of three-phase induction motors. In this way mechanical impacts on the load and current peaks on the supply network are prevented.

2.4.1 - Introduction

This series includes models from 16 to 85A, being supplied from 220V, 230V, 240V, 380V, 400V, 415V, 440V, 460V, 480V, 525V or 575V. (The available types are listed in Section 8).

The models up to 45A are with natural cooling and isolated heatsink (thyristor-thyristor modules). The models from 60A and 85A have forced cooling and isolated heatsink (Thyristor-Thyristor Modules).

The electronic control circuit uses a 16 bit microprocessor with high performance, allowing settings and displaying by means of the interface (keypad + display) of all needed parameters.

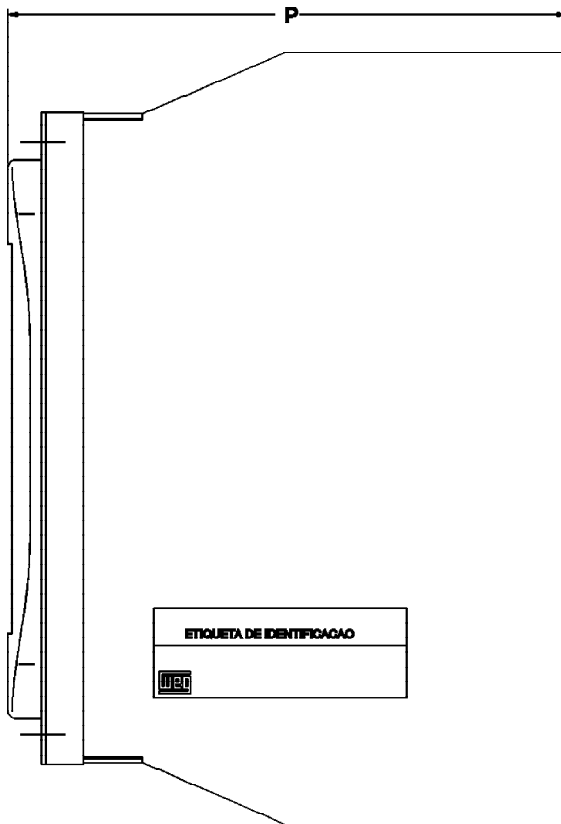
Depending on the power, this series (SSW-04) has 2 different construction forms, as shown in Figure 2.1.

2

INTRODUCTION

MEC	Rated Current	Width L mm (in)	Depth P mm (in)	Height H mm (in)	Weight kg (lb)
1	16A 30A 45A	140 (5.51)	199 (7.83)	275 (10.83)	5.2 (11.46)
2	60A 85A	140 (5.51)	283 (11.06)	275 (10.83)	9.0 (19.84)

SIDE VIEW



FRONT VIEW

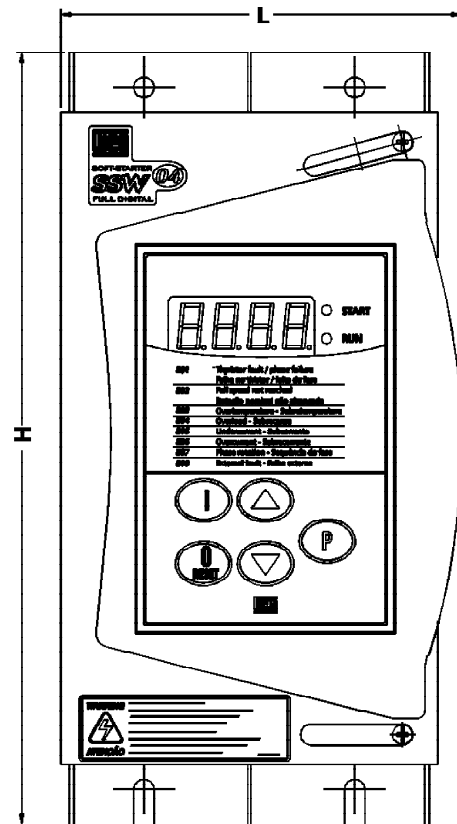


Figure 2.1 - Construction forms

2.4.2 - Simplified Block Diagram of the SSW-04

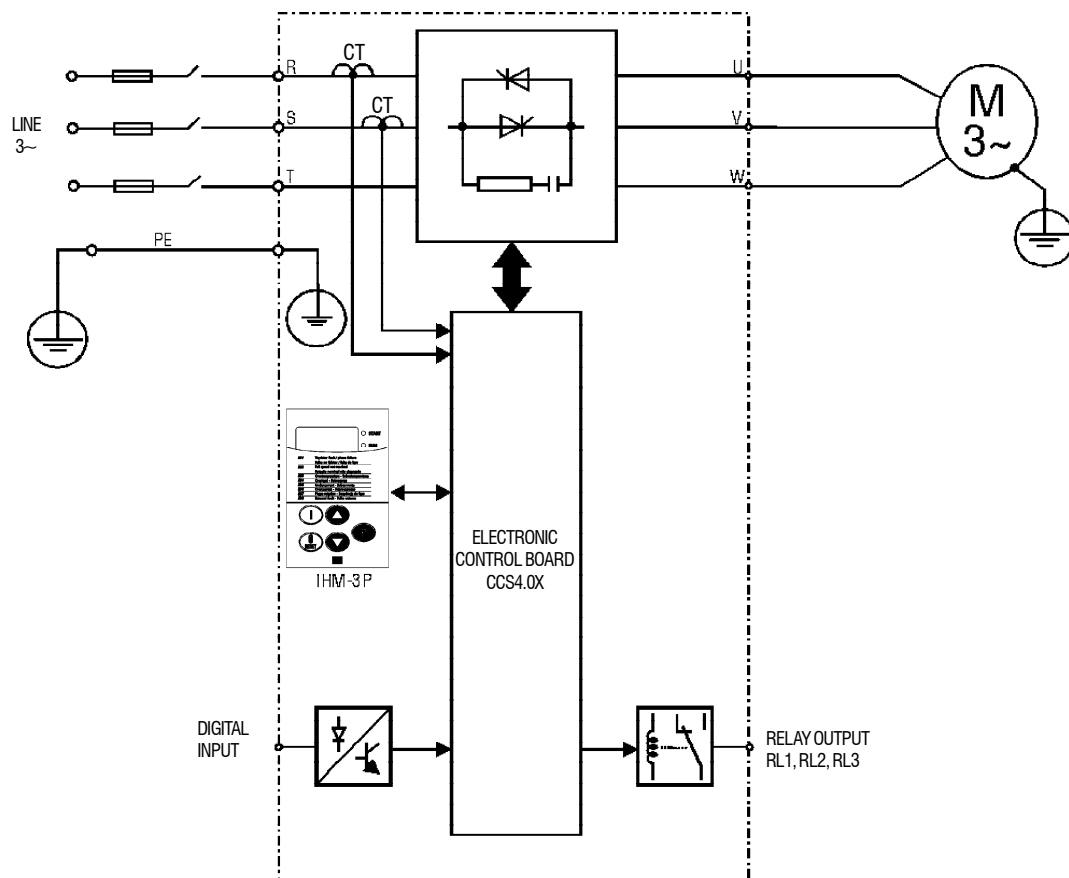


Figure 2.2 - Simplified Block Diagram of the SSW-04

In the power stage, the line voltage is controlled by means of 6 SCR's that allow the variation of the conduction angle of the voltage supplied to the motor.

For the internal supply of the electronics, a switched source is used with several voltages, fed independently of the power supply.

The control board contains the circuits responsible for the control, monitoring and protection of the power components. This board also contains the control and signalling circuit to be used by the user according to its application as a relay output.

All parameters or controls for the operation of the Soft-Starter can be displayed or changed through the HMI.

2

INTRODUCTION

2.4.3 - Description of the control board - CCS 4.00 or CCS 4.01

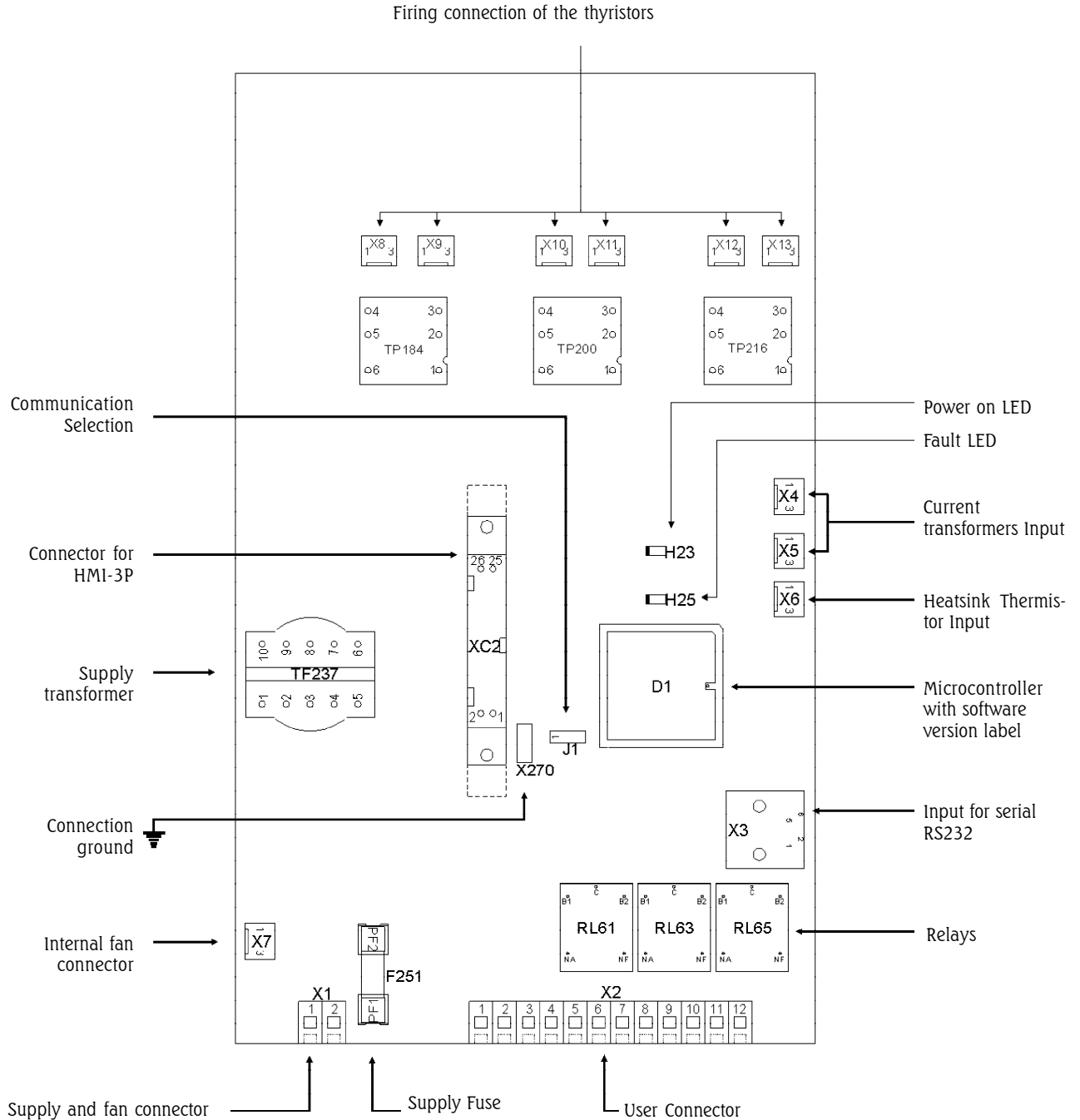
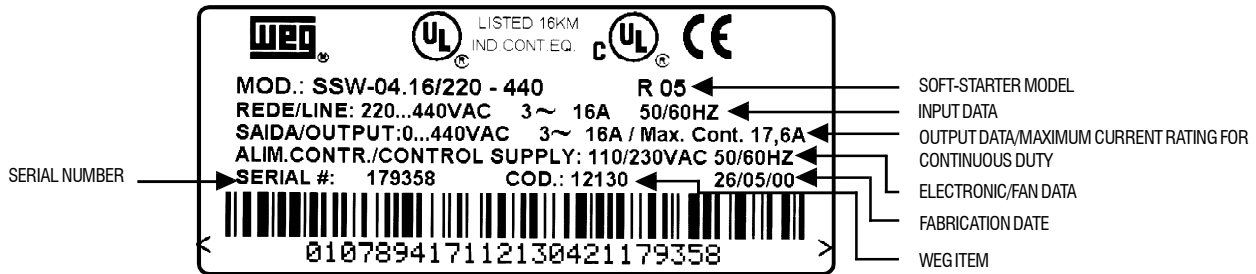


Figure. 2.3 - Layout of the electronic control board CCS 4.00 or CCS4.01

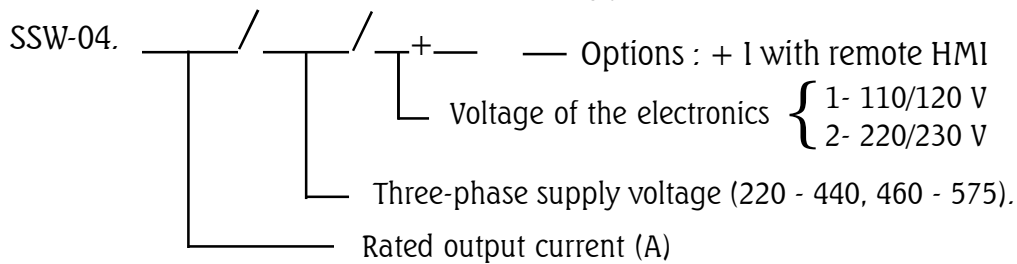
2

INTRODUCTION

2.5 - PRODUCT IDENTIFICATION



Soft-Starter Type



Max. Cont.: It's the maximum current that the Soft-Starter can have in continuous duty. For this current the Soft-Starter can only have 1 start per hour.

EXTERN HMI

- HMI-3P1: HMI with LEDs, 1 m (3.28ft) cable
- HMI-3P2: HMI with LEDs, 2 m (6.56ft) cable
- HMI-3P3: HMI with LEDs, 3 m (9.84ft) cable

2.6 - RECEIVING

The SSW-04 is supplied in cardboard boxes. The outside of the packing container has a nameplate that is the identical to that on the SSW-04. Please check if the SSW-04 is the one you ordered.

Open the box, remove the foam and then remove the SSW-04.

- SSW-04 nameplate data matches the purchase order;
The equipment has not been damaged during transport.
- If any problem is detected, contact the carrier immediately.

If the SSW-04 is not to be installed immediately, store it in a clean and dry room (Storage temperatures between - 25°C and 60°C). Cover it to prevent dust, dirt or other contamination of the drive.

3

INSTALLATION

3.1 - MECHANICAL INSTALLATION

3.1.1 - Environment

The location of the SSW-04 installation is a determining factor for obtaining a good performance and a normal useful life of its components.

Regarding the installation of the Soft-Starter we make the following recommendations:

- Avoid direct exposure to sunlight, rain, high moisture and sea air.
- Avoid exposure to gases or explosive or corrosive liquids;
- Avoid exposure to excessive vibration, dust, oil or any (conductive particles or materials).

Environmental Conditions:

- Temperature:** 32...104° F (0 ... 40° C) - nominal conditions. 104...131° F (40 ... 55° C) - see table 8.2.
- Relative Air Humidity:** 5% to 90%, non-condensing.
- Maximum Altitude:** 3,300 ft (1000m) - nominal conditions. 3,300 ... 13,200 ft (1000 ... 4000m) - with 10% current reduction for each 3,300 ft (1000m) above 3,300 ft (1000m).

Pollution Degree: 2 (according to EN50178 and UL508)
(It is not allowed to have water, condensation or conductive dust/ particles in the air)



NOTE!

When Soft-Starter is installed in panels or closed metallic boxes, adequate cooling is required to ensure that the temperature around the Soft-Starter will not exceed the maximum allowed temperature. See Dissipated Power in Section 8.2.

Please meet the minimum recommended panel dimensions and its cooling requirements:

SSW-04 type	Panel Dimensions			Blower CFM
	Width	Height	Depth	
16A	600 (23.62)	1000 (39.37)	400 (15.75)	-
30A	600 (23.62)	1200 (47.24)	400 (15.75)	-
45A and 60A	600 (23.62)	1200 (47.24)	400 (15.75)	226
85A	600 (23.62)	1500 (59.05)	400 (15.75)	226

All dimensions in mm (inches)

3

INSTALLATION

3.1.2 - Location / Mounting

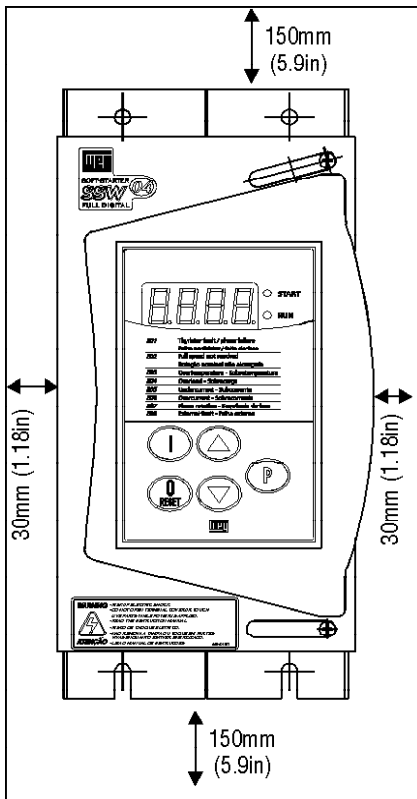


Figure 3.1 - Free space for ventilation

Install the Soft-Starter in Vertical Position:

- Allow for free space around the SSW-04, as shown in Fig. 3.1.
- Install the Soft-Starter on a flat surface.
- External dimensions, fastenings drillings, etc. according to Figure 3.2.
- First install and partially tighten the mounting bolts, then install the Soft-Starter and tighten the mounting bolts.
- Provide independent conduits for physical separation for signal conductors, control and power conductors (See Electrical Installation).

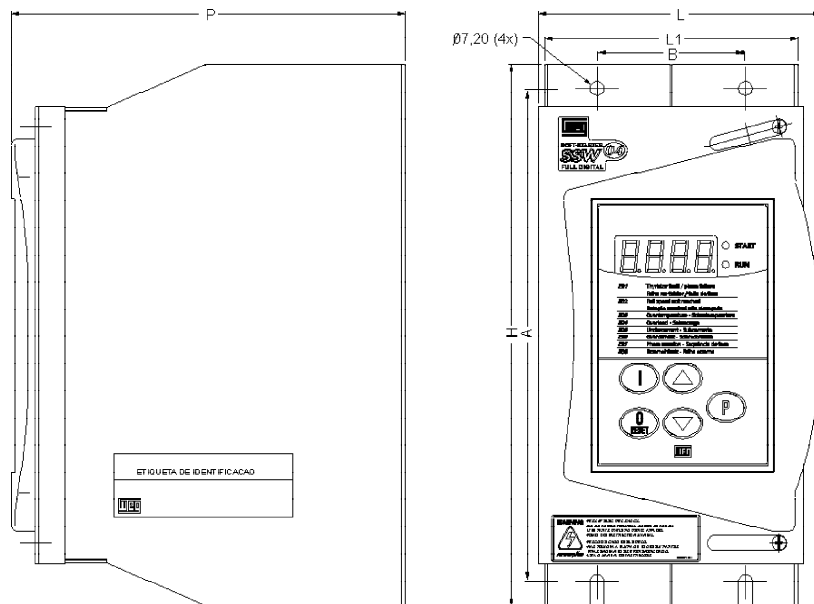


Figure 3.2 - External dimensions for the SSW-04 and its screwing drillings

Type	Width L1 mm (in)	Width L mm (in)	Height H mm (in)	Depth P mm (in)	Fasten. A mm (in)	Fasten. B mm (in)	Fasten bolt	Weight kg (lb)	Degree Protect.
16...45A	128 (5.0)	140 (5.51)	275 (10.83)	199 (7.83)	250 (9.84)	75 (2.95)	(1/4") M6	5.2 (11.46)	IP20
60A and 85A	128 (5.0)	140 (5.51)	275 (10.83)	283 (11.06)	250 (9.84)	75 (2.95)	(1/4") M6	9.0 (19.84)	IP20

3

INSTALLATION

3.2 - ELECTRICAL INSTALLATION

3.2.1 - POWER/ GROUNDING CONNECTIONS



DANGER!

AC input disconnect: provide an AC input disconnecting switch to switch OFF input power to the Soft-Starter. This device shall disconnect the Soft-Starter from the AC input supply when required (e.g. during maintenance services).



DANGER!

The AC input disconnect cannot be used as an emergency stop device.



DANGER!

Be sure that the AC input power is disconnected before making any terminal connection.



DANGER!

The information below will be a guide to achieve a proper installation. Follow also all applicable local standards for electrical installations.



ATTENTION!

Provide at least 10 in (0.25m) spacing between low voltage wiring and the Soft-Starter, line or load reactors, AC input power, and AC motor cables.

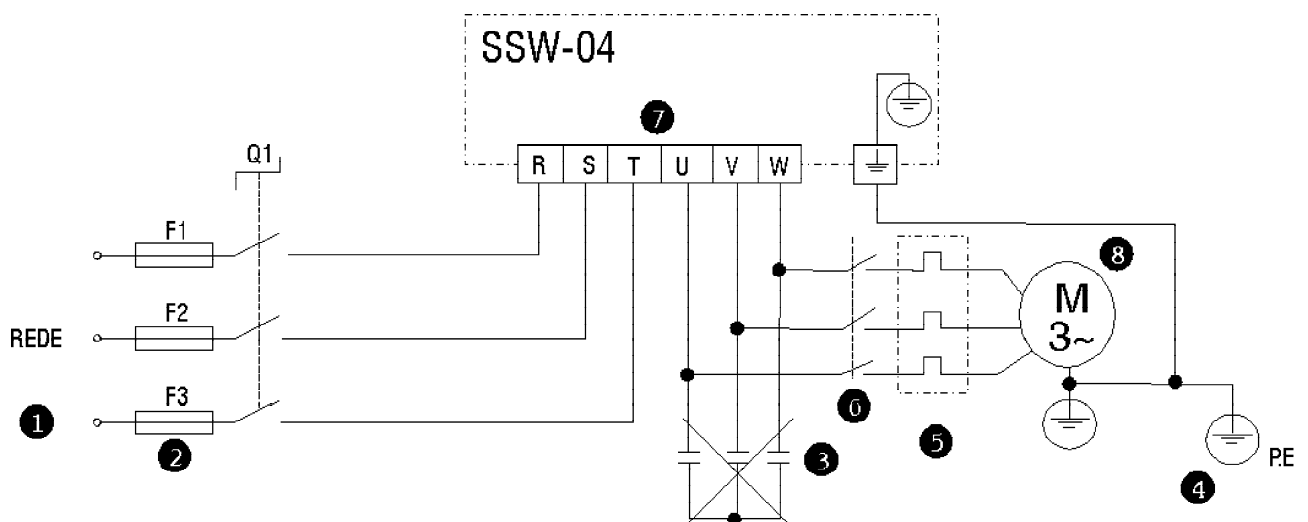


Figure 3.3 - Power and Grounding Connections

3

INSTALLATION



- ❶ The line voltage must be compatible with the rated voltage of the Soft- Starter.
- ❷ For installation use the cable cross sections and the fuses recommended in Table 3.1, maximum torque as indicated in table 3.2
- ❸ Power factor correction capacitors must never be installed on the Soft- Starter output.
- ❹ The Soft- Starters must be grounded. For this purpose use a cable with a cross section as indicated in Table 3.1. Connect it to a specific grounding bar or to the general grounding point (resistance ≤ 10 ohms). Do not share the grounding wiring with other equipment which operate at high currents (for instance, high voltage motors, welding machines, etc.). If several Soft- Starters are used together, see Figure 3.4.

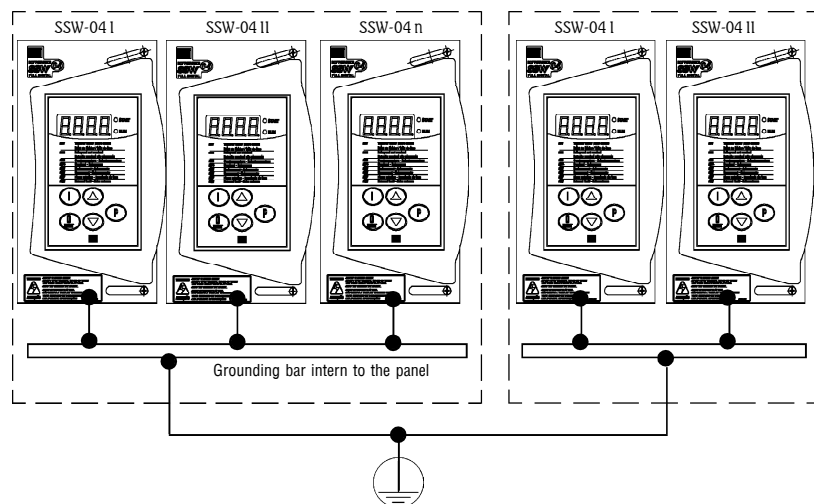


Figure 3.4 - Grounding connection for more than one Soft- Starter



Do not use the neutral conductor for grounding purpose.

- ❺ The Soft- Starter is fitted with electronic protection against motor overloads. This protection must be set according to the specific motor. When several motors are connected to the same Soft- Starter, use individual overload relays for each motor.
- ❻ If a isolating switch or a contactor is inserted in the motor supply, do not operate them with running motor or when the Soft- Starter is enabled.

3

INSTALLATION

Table 3.1 - Recommended Cables/Fuses - Use 75°C Copper Wire Only

Rated current of the SSW-04	Power Wiring mm ² (AWG)	Grounding Wiring mm ² (AWG)	Ultra fast acting Fuse for SCR's protection	I ² t of SCR (A ² s)
16A	2.5mm ² (12)	6mm ² (8)	50A	1,150
30A	6mm ² (8)	6mm ² (8)	80A	8,000
45A	8mm ² (8)	6mm ² (8)	125A	15,000
60A	16mm ² (4)	8mm ² (8)	160A	15,000
85A	25mm ² (3)	10mm ² (6)	200A	125,000

The cross sections indicated in Table 3.1 are orientative values only. For correct cables dimensioning consider the installation condition and the maximum allowable voltage drop.

The recommended fuse connected at the input side must be a ultra rapid type (UR) with I²t smaller than 75% of the value indicated in Table 3.1 (I²t of the SCR).

When a short circuit occurs the ultra rapid fuse protects the SCR.

Normal fuses can also be used, in that case the installation is protected against short circuit, but the SCR isn't protected.



- 7 Recommended torque on the power terminals:

Table 3.2 - Maximum torque

Soft-Starter Type	Grounding wiring N _m (Lb.in)	Power wiring N _m (Lb.in)
16A 30A 45A	1.2 - 1.4 (10.6-12.3)	1.2 - 1.4 (10.6 - 12.3)
60A 85A	5.0 (43.9)	2.5 - 3.0 (21.8 - 26.1)

- 8 It is Recommended to use motors with load above 30% rated motor load.



NOTE!

The rated motor current shall not be less than 30% of the soft-starter rated current, in order that the overload protection works properly.



The SSW-04 is suitable for use on a circuit capable of delivering not more than X Arms (see below) symmetrical amperes, Y volts maximum, when protected by Ultra-fast Semiconductor Fuses.

3

INSTALLATION

Type	X	Y
16 - 45A 460 - 575V	5,000	575
60 - 85A 460 - 575V	10,000	575
16 - 60A 220 - 440V	5,000	440
85A 220 - 440V	10,000	440

3.2.2 - Location of the power/grounding/fans connection

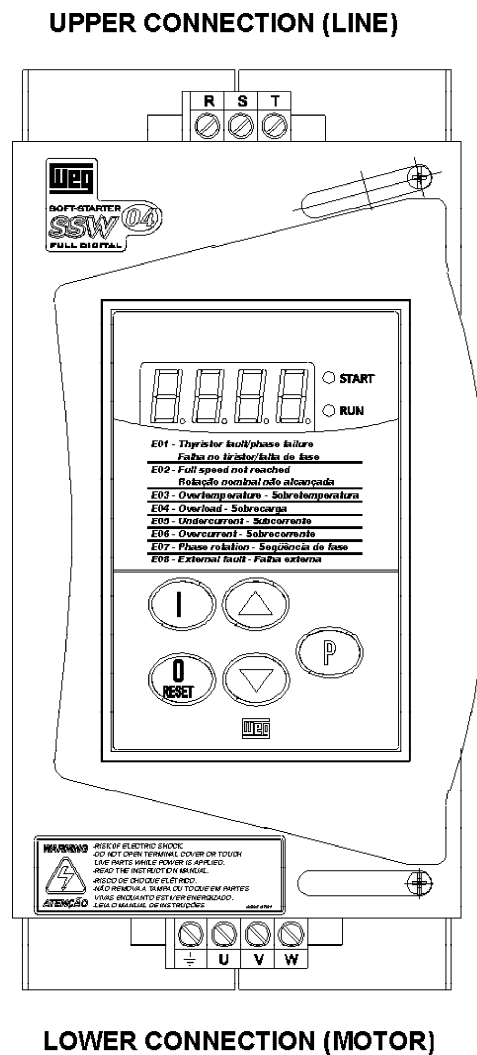


Figure 3.5- Location of the power/grounding connection

3

INSTALLATION

3.2.3 - Signal and Control Connections

The signal (digital inputs/outputs by relay) are performed through the following connectors of the Control Board CCS4.0X (see location in Figure 2.3).

X2 : Digital input and output by relay

X1 : Electronics and Fan supply

XC2 : connection to HMI-3P

X3 : connection to serial communication



NOTE!

Soft-starters types 60A and 85A the fan current pass also through the connector X1. Thus the total current is: 274.5mA for 110Vac or 140mA for 220Vac.

3

INSTALLATION

3.2.3.1 - Description of the X2 Connector

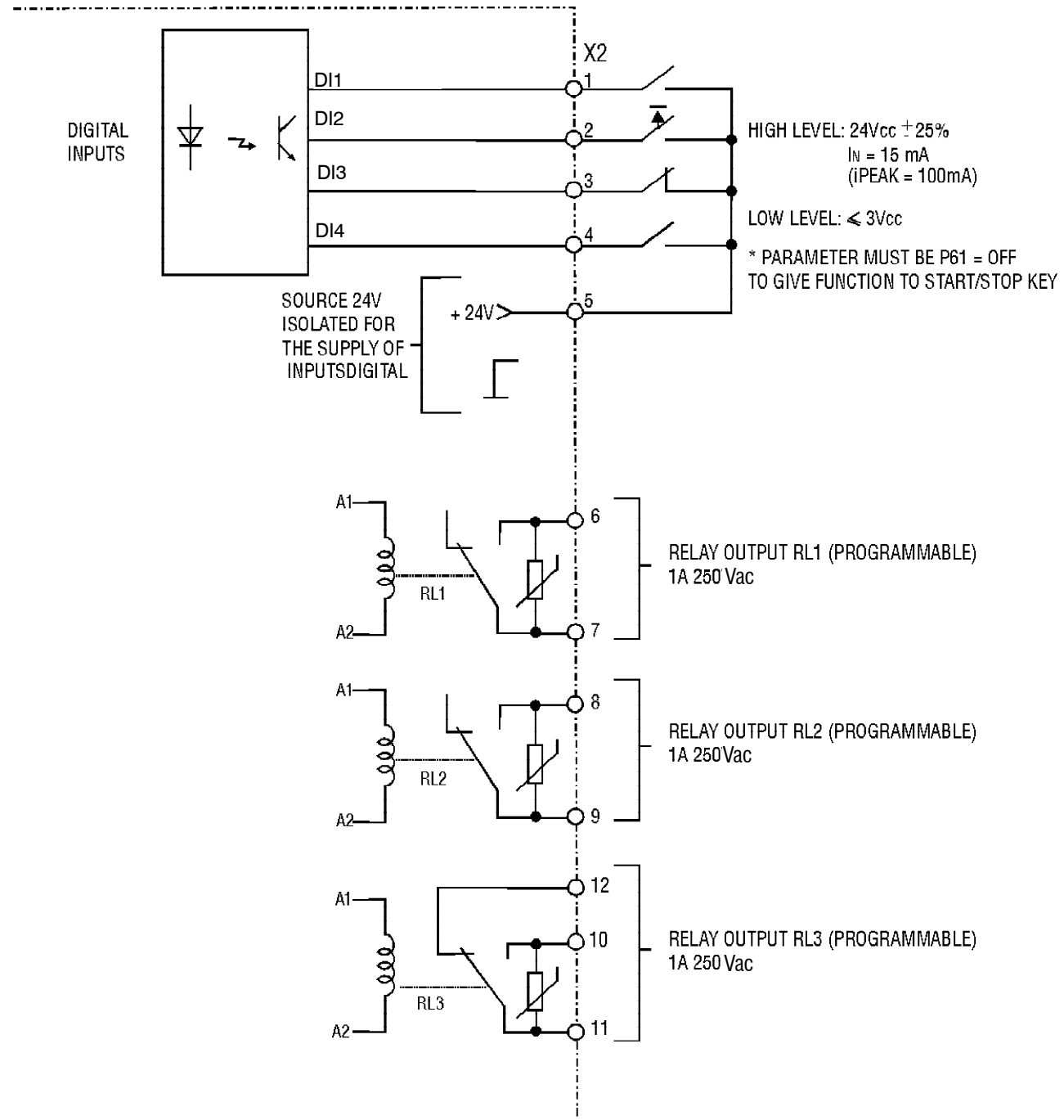


Figure 3.6 - Description of the X2 (CCS4.00 or CCS4.01 connector)

3

INSTALLATION

When installing the signal and control wiring, please note the following:

- ❶ Cable cross-section: 0.5...1.5mm²;
- ❷ Relays, contactors, solenoid valves or breaking coils installed near to Soft-Starters can generate interferences in the control circuit. To eliminate this , you must install RC supressors connected in parallel with the coils of these devices, when fed by alternate current and free wheel diodes when fed by direct current.
- ❸ When an extern HMI is used, the connection cable to the Soft-Starter should be passed through the slot at the bottom of the Soft-Starter. This cable must be laid separate from the other cables existing in the installation, maintaining a distance of 100mm (3.94in) each other.
- ❹ Max. recommended torque in the terminals X2 and X1: Maximum 0.4 Nm or 3.5lb.in.
- ❺ The control wiring (X2:1...5) must be laid separate from the power wiring.

3.2.4 - FAN CONNECTIONS

The fan connections must be done through X1:1 and X1:2 connector according to the voltage defined by the Soft-Starter code:

Ex.: SSW-04. 60/220-440/



Electronic / fan voltage:

1 = 110Vac

2 = 220Vac

3

INSTALLATION

3.2.5 - Combination drive "A" - Operation by HMI-3P

With the factory standard programming, you can operate the Soft-Starter with the minimum connection shown in Figure 3.7.

This operation mode is recommended for users who operate the Soft-Starter by first time, as initial training form.

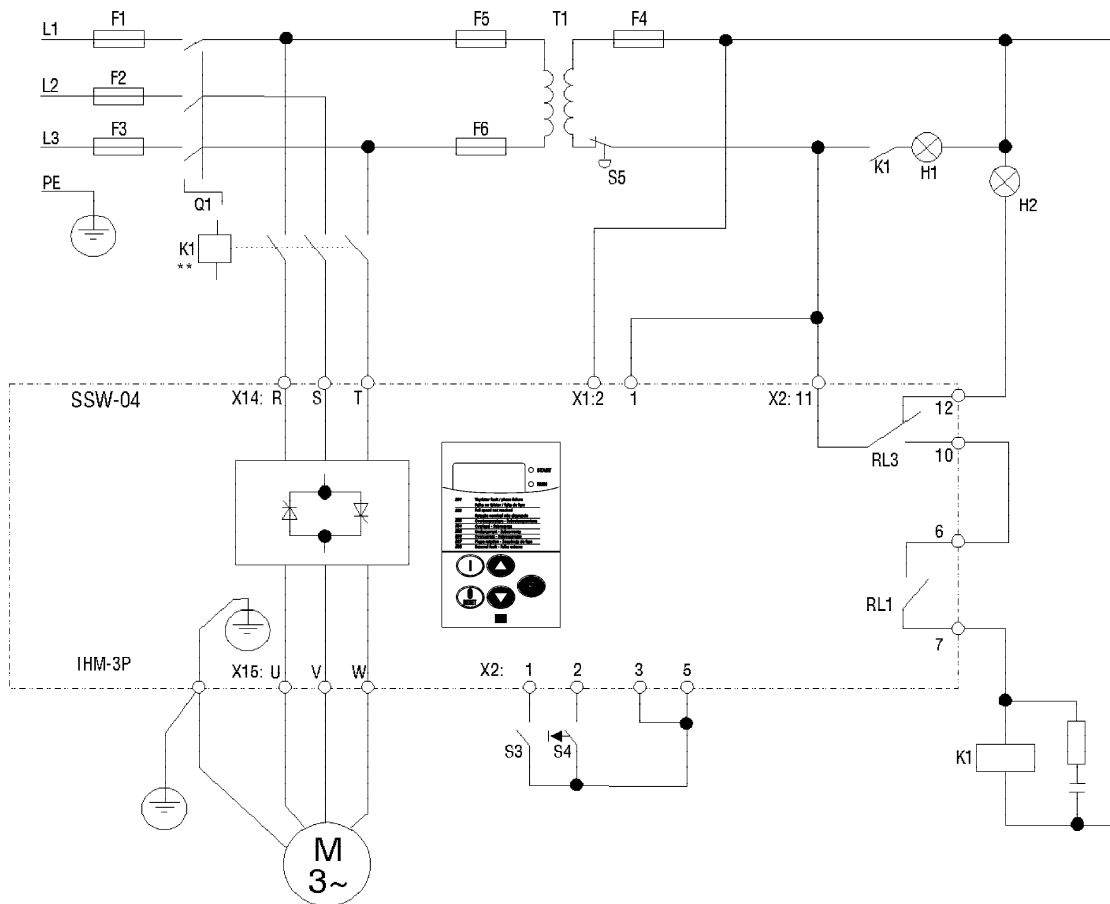


Figure 3.7 - Minimum connections for operation through HMI

Note: It's necessary to use normal fuses or breaker to protect the installation. Ultra-Rapid fuses are not necessary for the SSW-04 operation, but they are recommended for SCR protection.

The transformer "T" is optional and must be utilized when the line voltage is different than the electronics and fan voltage.

The isolation contactor "K1" is optional, and is not necessary for the SSW-04 operation. However due to protection and safety reasons it's recommended. In case

3

INSTALLATION

of maintenance the input fuses must be removed for a complete disconnection of the SSW-04 from the line. For the integral motor protection it's recommended to install one or more thermostats in the motor. If the thermostat is not used, the external input error (DI3) from SSW-04 must be connected to +Vdc.



NOTE!

Contactors "K1" is necessary to protect the motor in case there is a phase failure which is caused by damage in the SSW-04 power circuit.

For Start-up according this operation mode, follow chapter 4.

3

INSTALLATION

3.2.6 - Combination Drive "B" - Operation through Terminals

Shown in Figure 3.8 is an example of a typical combination drive circuit. For other application needs, we recommend the following:

- ☑ to analyse the application
- ☑ to study the SSW-04 programming possibilities
- ☑ to define the electrical connection diagram
- ☑ to perform the electrical installation
- ☑ to start-up (programming the Soft-Starter correctly)
- ☑ to start-up the SSW-04 in this operation mode, follow chapter 4.

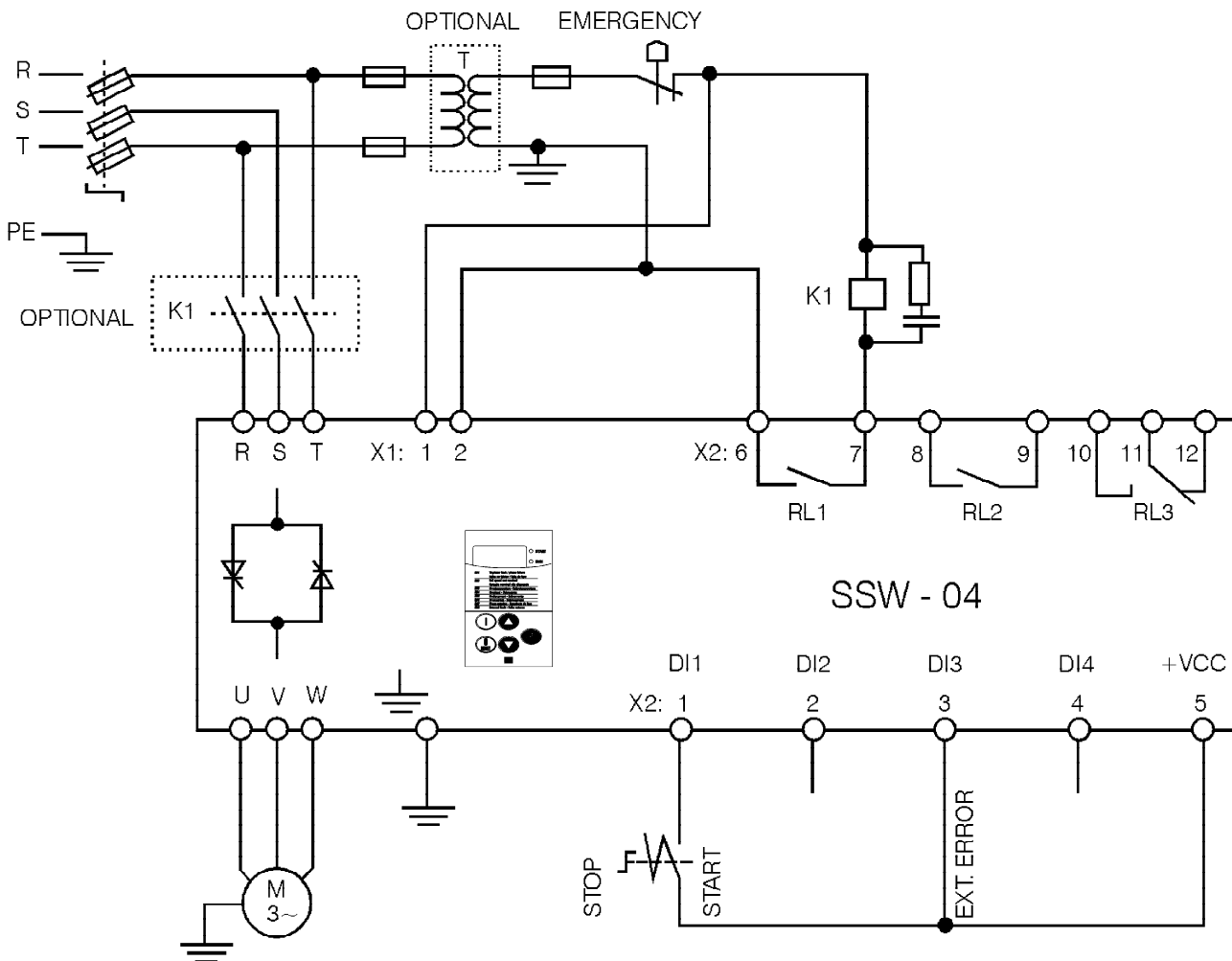


Figure 3.8- Combination Drive "B" Operation through Terminals

Note: It's necessary to use normal fuses or breaker to protect the installation. Ultra-Rapid fuses are not necessary for the SSW-04 operation, but they are recommended for SCR protection. The transformer "T" is optional and must be utilized when the line voltage is different to the electronics

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INSTALLATION

and fan voltage.

The isolation contactor "K1" is optional, and is not necessary for the SSW-04 operation. However due to protection and safety reasons it's recommended. In case of maintenance, the input fuses must be removed for a complete disconnection of the SSW-04 from the line.

For the integral motor protection it's recommended to install one or more thermostats in the motor. If the thermostat is not used, the external input error (DI3) from SSW-04 must be connected to +Vdc.



NOTE!

Contactors "K1" is necessary to protect the motor in case there is a phase failure which is caused by damage in the SSW-04 power circuit.

Programm P61 to "OFF" for operation through terminals.

3

INSTALLATION

3.3 - INSTALLATION OF OPTIONAL DEVICES

3.3.1 - HMI-3P AT THE PANEL DOOR

3.3.1.1 - Mechanical installation

When installed on the panel door, the following is recommended:

- ☑ temperature within the range of 0°C to 55°C (32°F to 131°F).
- ☑ environment free of corrosive vapour, gas or liquids.
- ☑ air free of dust or metallic particles.
- ☑ avoid to exposing the key pad to direct sunlight, rain or moisture.

For mounting, see Figure 3.9.

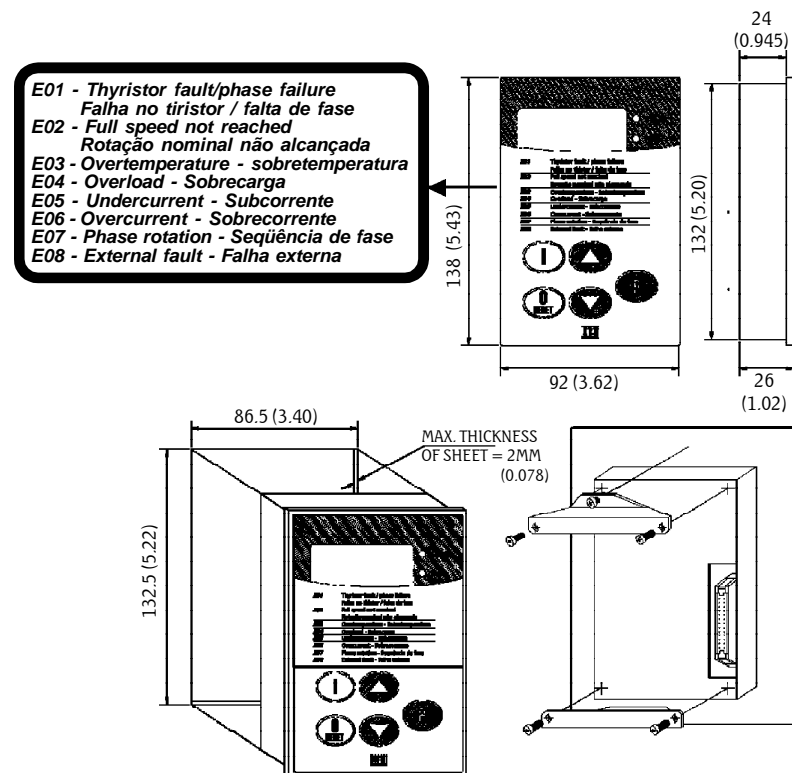


Figure 3.9 - Dimensions/Fastening of the HMI-3P
All dimensions in mm (inches)

3

INSTALLATION

3.3.1.2 - Electrical installation

The connection of the HMI-3P to the Soft-Starter is made through shielded flat cable connected to XC2 on the CCS4.0X control board. The shielding must be connected through a Faston type terminal near to XC2, as shown in Figure 3.10.

This cable must be laid separately from the other wirings at a minimum distance of 100mm (3.94in).

OPTIONS:

- HMI-3P + 1m (3.28ft) cable
- HMI-3P + 2m (6.56ft) cable
- HMI-3P + 3m (9.84ft) cable

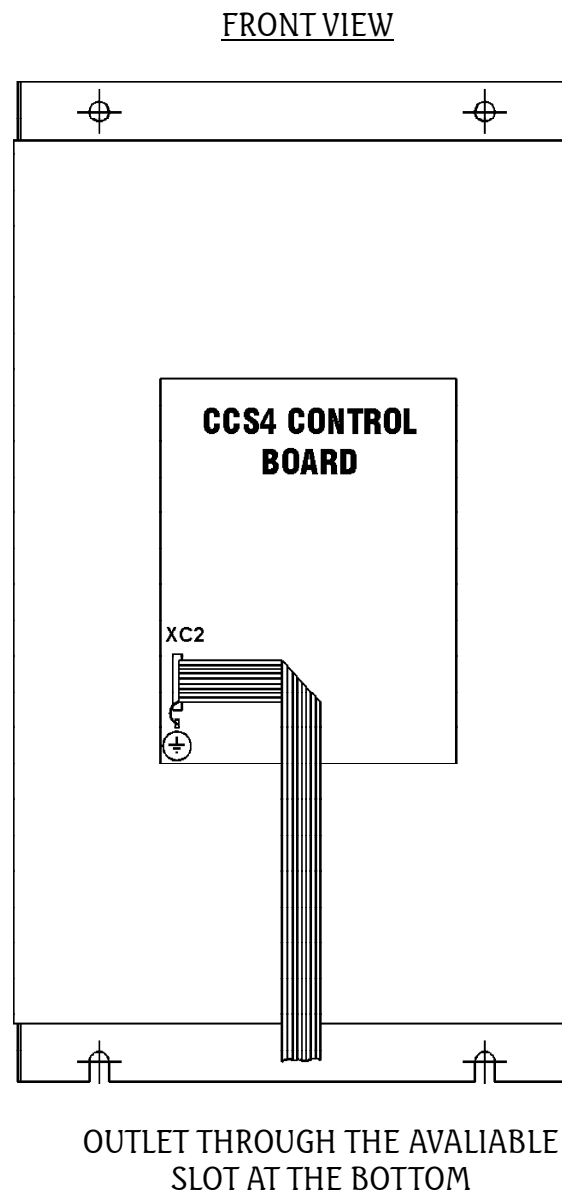


Figure 3.10 - HMI-3P Cable Connection

This Section deals with the following:

- ☑ How to check and prepare the Soft-Starter before power-up.
- ☑ How to power-up and check if the power-up has been successful.
- ☑ How to operate the soft-starter according to the combination drives "A" and "B" after it has been installed. (See Electrical Installation).

The Soft-Starter shall be installed according to the Section 3 - Installation. If the driving design is different from the suggested combination drives "A" and "B", you must follow the procedures below:

4.1 - POWER-UP PREPARATIONS



DANGER!

Disconnect always the power system before making any connection

- 1) **Check all connections**
Check if all power, grounding and control connections are correct and well tightened.
- 2) **Clean the inside of the Soft-Starter**
Remove all material residues from inside of the Soft-Starter.
- 3) **Check the motor**
Check all motor connections and verify if its voltage, current and frequency meet the Soft-Starter ones.
- 4) **Mechanically decouple the load from the motor**
If the motor can not be decoupled, be sure that the direction of rotation (forward, reverse) can not cause damage to the machine or person.
- 5) **Close the Soft-Starter covers**

4

POWER-UP/COMMISSIONING

4.2 - POWER-UP

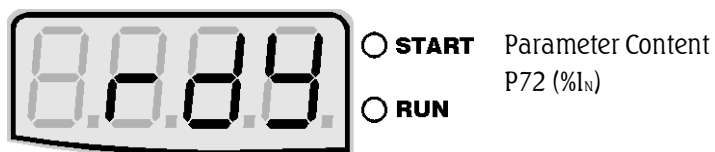
After the Soft-Starter has been prepared it can now be powered-up:

- 1) **Check the supply voltage:**
Measure the line voltage and check if it is within the permitted range (rated voltage + 10% / -15%).
- 2) **Power-up the input and switch on the control voltage:**
Close the input circuit breaker.
- 3) **Check if the power-up has been successful:**

The HMI-3P display will show:



Now the Soft-Starter will run some self-diagnosis routines and if there is no problem, the display will show:



This means that the Soft-Starter is rdy=ready to be operated.

- 4) **Follow the commissioning procedures**
For combination drive "A" - Operation by HMI-3P - follow Item 4.3.2.
For combination drive "B" - Operation by terminals - follow Item 4.3.3.
For other configurations that require the change of several parameters (different standards), read first Chapter 6 - Detailed description of the parameters.

4.3 - COMMISSIONING

This Section describes the commissioning of the two characteristic combination drives describe above:

- Combination drive "A" - Operation through HMI-3P
- Combination drive "B" - Operation through Terminals

4

POWER-UP/COMMISSIONING

4.3.1 - Preparation



DANGER!








Even after disconnecting the supply, high voltage can be present.

Wait at least 3 minutes after switching OFF the equipment to allow full discharge of the capacitors.

- The Soft-Starter must be installed and powered up as described in section 3 and 4.
- The user must have read Section 5 and 6 and be acquainted with the use of the HMI-3P and with the parameter organization.
- The user must also understand how to localize and to change the parameters.

4.3.2 - Commissioning and operation via HMI-3P

Connections according to Figure 3.7.
























ACTION	RESULT	INDICATION
	<input checked="" type="checkbox"/> Soft-Starter powered-up	 ○ START ○ RUN
Press 	<input checked="" type="checkbox"/> Motors starts	 ● START ● RUN
	<input checked="" type="checkbox"/> After start time has been	 ● START ● RUN
Press 	<input checked="" type="checkbox"/> Switching Off by ramp provided P04 is set by parameter EX: P04 = 20; P03 = 80	 ○ START ● RUN
	<input checked="" type="checkbox"/> Soft-Starter energized	 ○ START ○ RUN

4

POWER-UP/COMMISSIONING





4.3.3. - Commissioning and Operation via Terminals

Connections according to figure 3.8.

ACTION	RESULT	INDICATION
Power-up the driving Start/Stop = open	<input checked="" type="checkbox"/> Soft-Starter realizes self-diagnosis Soft-Starter ready to be programmed.	 <input type="radio"/> START <input type="radio"/> RUN
Press 		 <input type="radio"/> START <input type="radio"/> RUN
Press 	<input checked="" type="checkbox"/> It permits changing of parameters	 <input type="radio"/> START <input type="radio"/> RUN
Press 		 <input type="radio"/> START <input type="radio"/> RUN
Press 		 <input type="radio"/> START <input type="radio"/> RUN
Press 		 <input type="radio"/> START <input type="radio"/> RUN
Press 	<input checked="" type="checkbox"/> To program operation via terminal	 <input type="radio"/> START <input type="radio"/> RUN
Press 		 <input type="radio"/> START <input type="radio"/> RUN
Press 	<input checked="" type="checkbox"/> To change the parameters, it is necessary to set P00 = ON	 <input type="radio"/> START <input type="radio"/> RUN
Press 		 <input type="radio"/> START <input type="radio"/> RUN
Press 	<input checked="" type="checkbox"/> Reading parameter of the current in percentage (%I _N)	 <input type="radio"/> START <input type="radio"/> RUN
Press 	<input checked="" type="checkbox"/> Soft-Starter ready to be operated	 <input type="radio"/> START <input type="radio"/> RUN

4

POWER-UP/COMMISSIONING

ACTION	RESULT	INDICATION
Close X2:1-5	<input checked="" type="checkbox"/> Motor starts	 ● START ● RUN
	<input checked="" type="checkbox"/> After starting time has been	 ● START ● RUN
Open X2:1-5	<input checked="" type="checkbox"/> Switch Off by ramp provided P04 is set by parameters. P04 = 20s; P03 = 80%	 ○ START ● RUN
	<input checked="" type="checkbox"/> Soft-Starter is powered up.	 ○ START ○ RUN



NOTES:

- 1) Symbol of the LEDs Start/Run
 - LED ON
 - ◐ LED Flashing
 - LED OFF
- 2) If the direction of rotation of the motor is not correct, switch OFF the Soft-Starter and change two output cables of the Soft-Starter.

4.4 - SETTINGS DURING THE COMMISSIONING

Although the factory standard parameters are chosen in such a way to meet most application conditions, even so can be necessary to make some parameters settings during the commissioning.

Follow the Parameter Quick Reference Table, checking the need to set each of the parameters. Make the setting according to the specific application and record the last value in the corresponding column for the User's Setting.

These remarks can be important to clear up any questions.



Minimum Parameters to be set

P11 - Current Limitation:
Select the current limitation during the starting
Standard: OFF (inactive)

P21 - Motor Current Setting:

Motor overload protection (Standard: OFF)



This setting is set OFF at factory. This means that it is disabled and there is no motor overload protection. For an efficient motor protection, set as described in Section 6.5.1 of this manual.

P25 - Thermal classes of the overload protection:

Selects the class of the overload protection suitable for the motor application (Factory Setting: 30)



According to the thermal class curves in Section 6.5.2. Class 30 takes the longest time to activate the motor overload protection.

To achieve a correct setting of this thermal class, proceed as follows:

1. Verify the motor data sheet the locked rotor time and the starting current (I_p/I_n) for DOL starting. Select a thermal class that in this condition trips in a time shorter (Section 6.5.2 - Figure 6.10) than the indicated motor data.

Check also, if the selected thermal class, as described above, allows to start with reduced current. In this case, the actuation time, according to chart in Figure 6.10 - Item 6.5.2 - must be longer than the starting time of this motor with soft-starter.

P26 - Motor service factor:

Also applied for motor overload protection (Standard: 1.00), obtained from motor nameplate.

This Section describes the Human-Machine Interface (HMI-3P) and the programming mode of the Soft-Starter, giving the following information:

- ☑ General description of the HMI-3P
- ☑ Use of the HMI-3P
- ☑ SSW-04 Parameter Organization
- ☑ Access to the parameters of the Soft-Starter
- ☑ Parameter changing (programming)
- ☑ Description of the Status and Signalling Indications

5.1 - DESCRIPTION OF THE HMI-3P INTERFACE

The HMI-3P consists in 4 digits, seven segment LED display, 2 signalling LEDs and 5 keys. Figure 5.1 describes the HMI-3P.

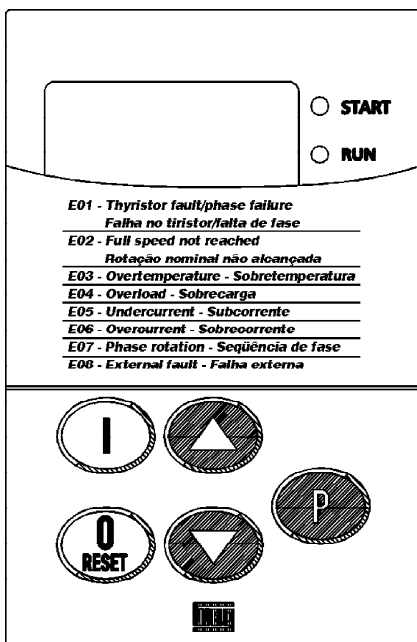


Figure 5.1 - HMI-3P Description

START Indicates that the Soft-Starter has received a start or stop command. (motor driven)

RUN Indicates the switch status; if at acceleration / deceleration ramp or at rated voltage.

I Enables motor via ramp.

0 RESET Disables the Soft-Starter via ramp (when programmed). Resets the Soft-Starter after an error has occurred.

P Changes display between the parameter number and its value.

▲ Increments the number of the parameter or its value.

▼ Decrements the number of the parameter or its value.

5

USE OF THE HMI

5.2 - USE OF THE HMI-3P

The HMI-3P is a simple interface which permits the operation and the programming of the Soft-Starter. It permits the following functions:

- ☑ Display of the Soft-Starter operation status, as well as the main variables
- ☑ Error display
- ☑ Display and changing of the adjustable parameters
- ☑ Soft-Starter operation through the keys ON ("I") and OFF ("O")

5.2.1 - Use of the HMI-3P for operation

All functions relating to the Soft-Starter operation (enabling (ON - "I") disabling (OFF "O")); increment/decrement (values/parameters) can be performed through the HMI-3P. This is made through standard factory programming of the Soft-Starter. These functions ON, OFF and Reset can also be executed individually by means of digital inputs. So it is necessary to program the parameters relating to these correspondent functions and inputs.

Find below the key description of the HMI-3P used for operation, when the Soft-Starter is Standard factory programmed:

When programmed P61 = ON

It functions as "I" (ON), "O" (OFF) the motor



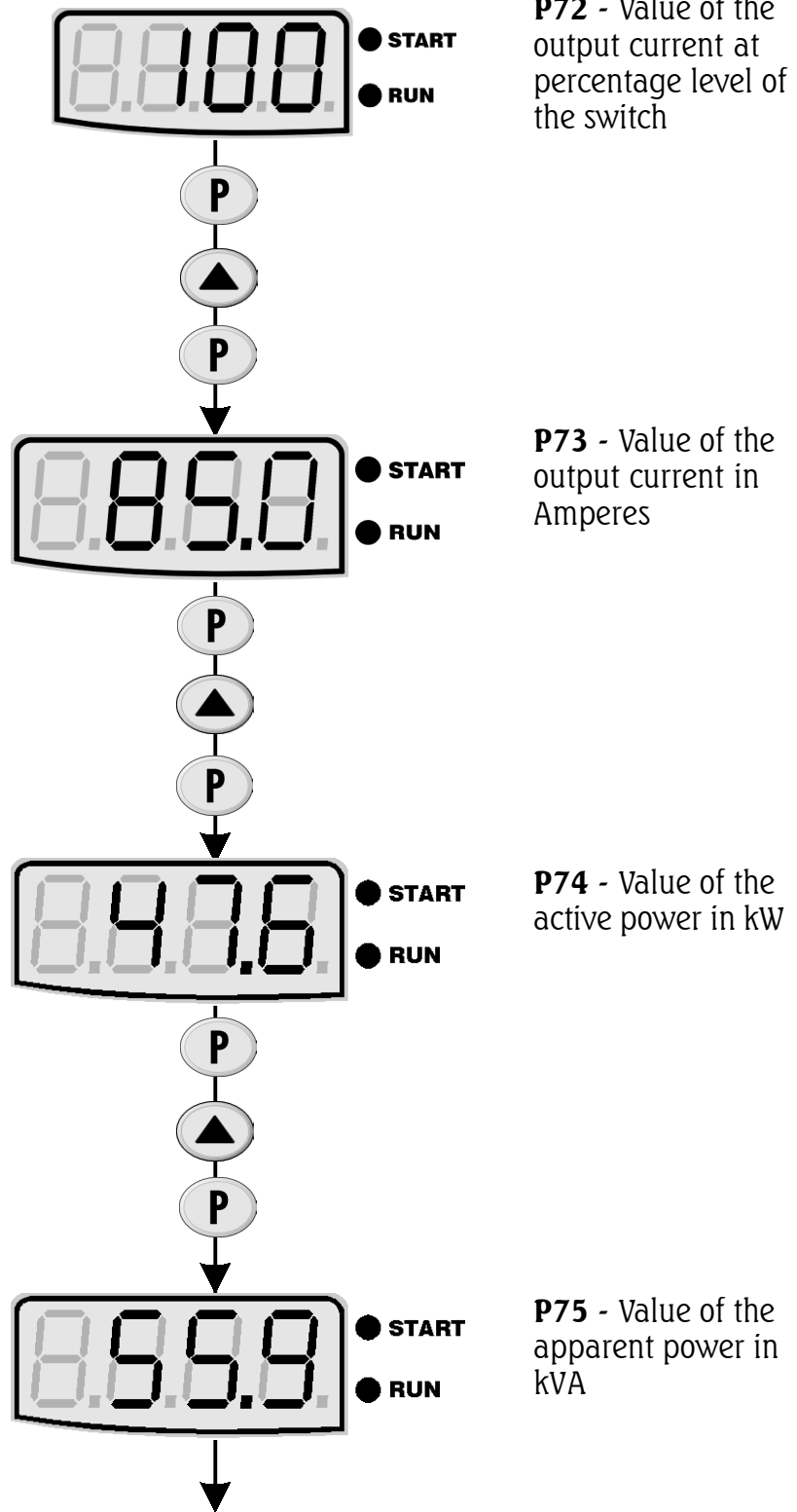
The motor accelerates and decelerates according to the set ramps.

5

USE OF THE HMI

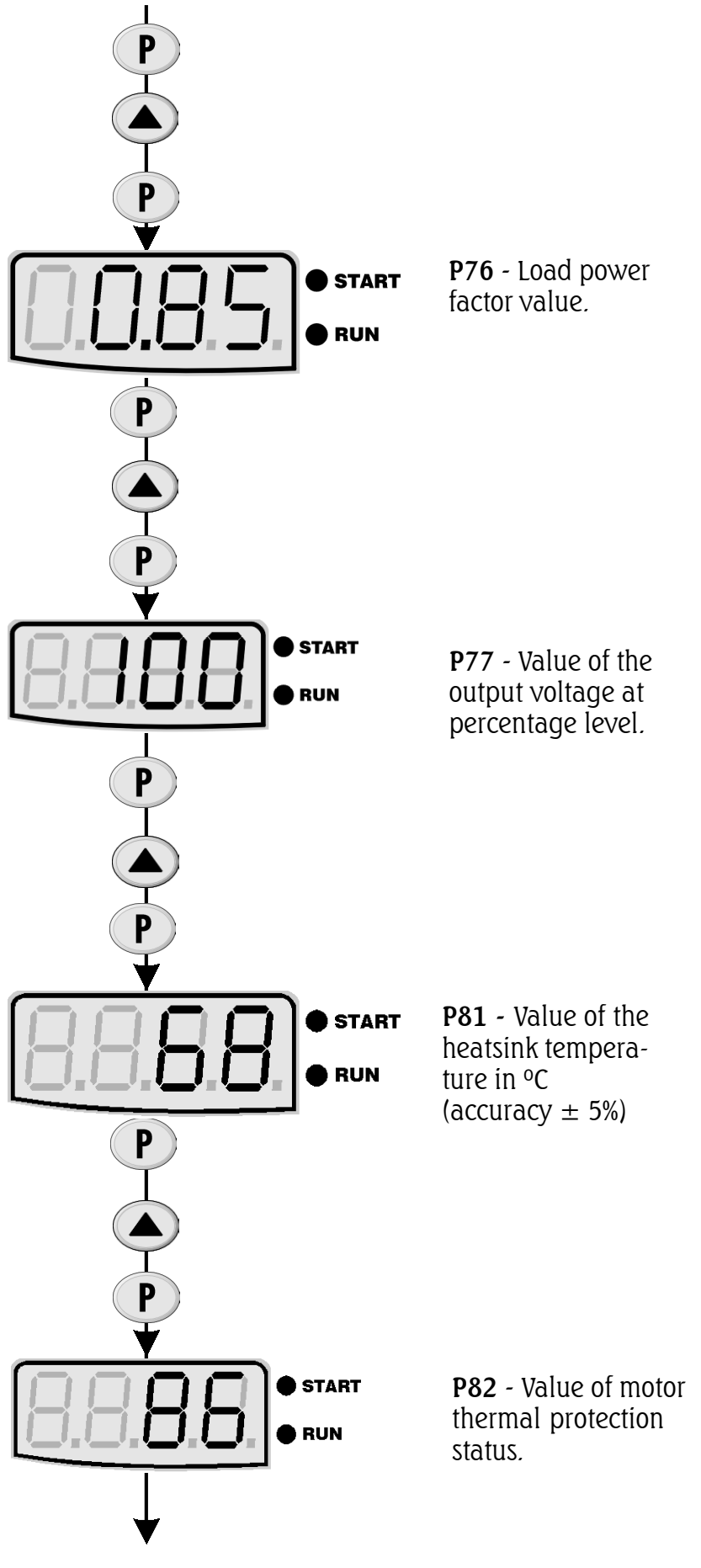
5.2.2 - Signalling/ Indications of the HMI-3P (Display)

a) Monitoring Variables:



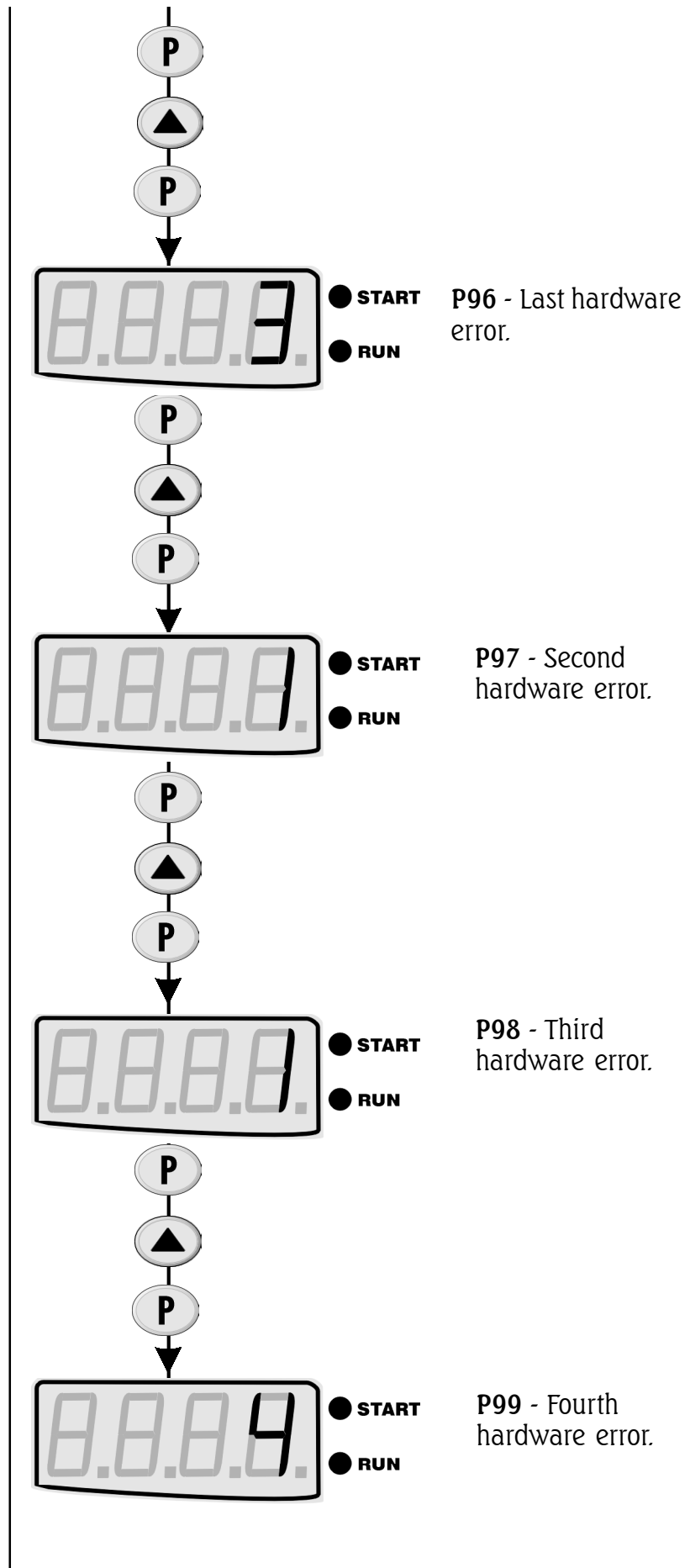
5

USE OF THE HMI



5

USE OF THE HMI



5.3 - PARAMETER CHANGING

b) Flashing Display

Display flashes in the following conditions:

- Changing attempt of one non permitted parameter (see Item 5.3.1)
- Soft-Starter in fault condition (see Section: Maintenance)

All information exchange between the Soft-Starter and the user is made through parameters. The parameter are shown on the display through the letter "P" followed by a number:



Each parameter is related to a numeric value or a function.

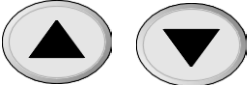











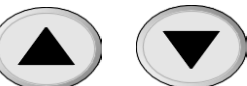



The parameter values define the Soft-Starter programming or the value of a variable (for instance, current, voltage, power).

To programm the Soft-Starter you must change the parameter(s) content(s).

5

USE OF THE HMI

5.3.1 - Selection/Changing Parameters

ACTION	DISPLAY	COMMENTS
Use the keys 	 <input type="radio"/> START <input type="radio"/> RUN	Localize the parameter P00
Press key 	 <input type="radio"/> START <input type="radio"/> RUN	Numeric value associated with the parameter
Press key 	 <input type="radio"/> START <input type="radio"/> RUN	Permit changing the parameters value
Press key 	 <input type="radio"/> START <input type="radio"/> RUN	
Use the keys 	 <input type="radio"/> START <input type="radio"/> RUN	Localize the desired parameter
Press key 	 <input type="radio"/> START <input type="radio"/> RUN	Numeric value associated with the parameter
Use the keys 	 <input type="radio"/> START <input type="radio"/> RUN	Adjust the new desired value *1
Press Key 	 <input type="radio"/> START <input type="radio"/> RUN	*1,*2

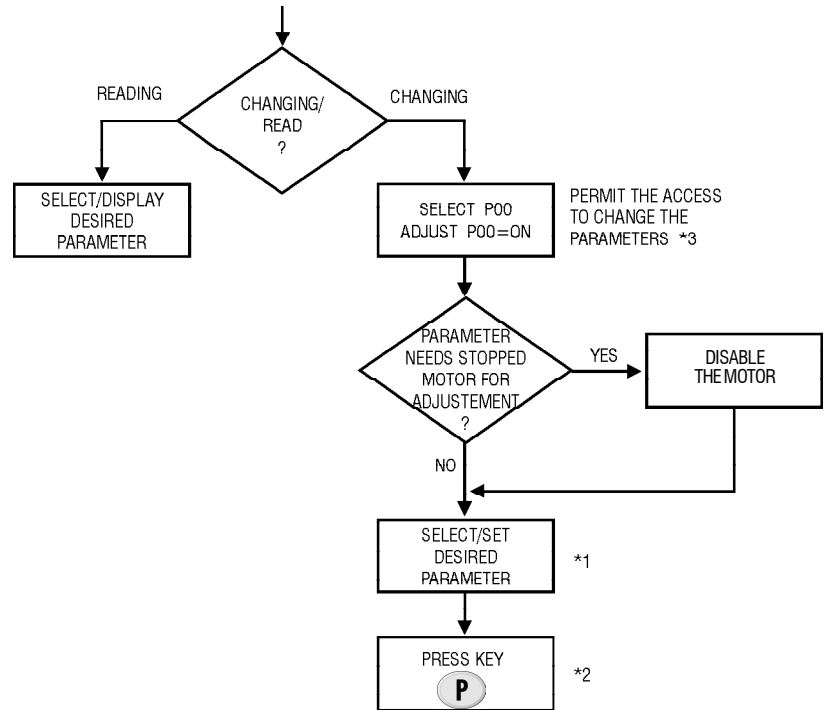


Figure 5.2 - Flowchart for read/changing of parameters

- *1 The parameters which can be changed with a running motor, the Soft-Starter begins to use the new set value immediately, after pressing key **P** .
The parameter, which can be changed with stopped motor only, the motor must be disabled, now set the new parameters and press the key **P** .



NOTE!

If it is not possible to change a parameter with running motor, the display will indicate the parameter content by flashing.

- *2 By pressing the key **P** after the adjustment, the last adjusted value will be stored automatically and this value will remain stored until new changes are made.
- *3 The disabling of the parameter changing access is made by setting P00 at "OFF" or de-energizing/energizing the soft-starter electronics.

6

DETAILED PARAMETER DESCRIPTION

This section describes in detail all the Soft-Starter parameters. In order to facilitate the description, the parameters were grouped by characteristics and functions.

Read Parameters	Variables which can be seen on the display, but they can not be changed by the user.
Regulation Parameters	They are adjustable values and used according to the Soft-Starter function.
Configuration Parameters	They define the Soft-Starter characteristics, the functions to be executed, as well as the input/output functions.
Motor Parameters	It defines the rated motor characteristics.

6.1- STANDARD PARAMETER SET AT FACTORY



The standard factory parameters are predefined values, with which the Soft-Starter is programmed at factory. The set of values is so selected to meet most applications, thus reducing the reprogramming during the start-up. If necessary, the user can change each parameter individually according to this application. At any time the user can return to the standard parameter set at factory, adopting the following procedures:

All set parameters will be lost (replaced by the factory standard)

- 1) Disabling the Soft-Starter
- 2) Setting P00 = ON
- 3) Setting P46 = ON
- 4) Pressing Key **P**
- 5) The display indicates "EPP" in the time of the "default" values are loading.

6

DETAILED PARAMETER DESCRIPTION

6.2- READ PARAMETERS - P71...P77, P81, P82, P96...P99

6.2.1 - P71 - Software Version

- ☑ It indicates the Software Version contained in the CPU (integrated circuit D1 CCS4.0X).

6.2.2 - P72 - Motor Current

- ☑ It indicates the output current of the Soft-Starter in percentage of the switch (IN-%). (Accuracy of $\pm 10\%$).

6.2.3 - P73 - Motor Current

- ☑ It indicates directly the Soft-Starter current in Ampere. (Accuracy of $\pm 10\%$).

6.2.4 - P74 - Active Power

- ☑ It indicates the active power required by the load, values in kW. (Accuracy of $\pm 10\%$).



NOTE!

OFF will be displayed when by-pass contactor or energy save is used.

6.2.5 - P75 - Apparent Power

- ☑ It indicates the apparent power required by the load, values in kVA. (Accuracy of $\pm 10\%$).

6.2.6 - P76 - Load power factor

- ☑ It indicates the load power factor, without by considering the harmonic currents generated the load switching.



NOTE!

OFF will be displayed when by-pass contactor or energy save is used.

6.2.7 - P77 - Output voltage

- ☑ It indicates the Soft-Starter output voltage about the load, without carrying the Back-EMF from the motor.



NOTE!

When the contactor by-pass is used for current or apparent power reading, the current transformer must be connected externally after the by-pass connection.

6.2.8 - P81- Heatsink temperature

- ☑ It indicates the Heatsink temperature from the thyristors in °C. Overtemperature protection actuate in 90°C (194°F).

6.2.9 - P82 - Motor thermal protection status

- ☑ It indicates the status from motor thermal protection in percentage (0 ... 250).
Note: 250 is the value of the motor thermal protection tripping, and display indicates E04.

6

DETAILED PARAMETER DESCRIPTION

6.2.10 - Last errors

- P96 - Last hardware error
- P97 - Second hardware error
- P98 - Third hardware error
- P99 - Fourth hardware error
- ☑ They indicate the codes of the last, second, third and fourth error. The register indicates the last 4 Soft-Starter errors or faults.
- ☑ Register systematic:
 $E_{XX} \leftrightarrow P96 \leftrightarrow P97 \leftrightarrow P98 \leftrightarrow P99 \leftrightarrow$ The former content of P99 is lost

6.3 - REGULATION PARAMETERS - P00... P15,P22...P42, P45, P47

6.3.1 - P00-Parameter access

- ☑ It releases the access to change the parameters.

P00	ACCESS
OFF	Reading of Parameter
ON	Changing of Parameter

6.3.2 - P01- Initial Voltage (% U_N)

- ☑ It adjusts the initial voltage value (% U_N) which will be applied to the motor according to Figure 6.1.
- ☑ This parameter must be set at the minimum value that starts the motor.

	min.	Range	max.	Factory Standard
P01 - Initial Voltage	25% U_N	<div style="text-align: center;"> </div>	90% U_N	30

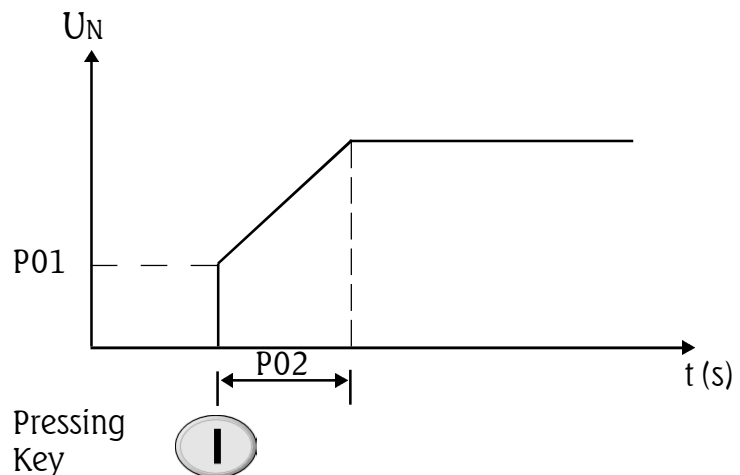


Figure - 6.1- Acceleration Ramp

6

DETAILED PARAMETER DESCRIPTION

6.3.3 - P02-Time of the Acceleration Ramp

- ☑ If defines the time of the voltage ramp, as shown in figure 6.1, provided the soft-starter does not enter in current limitation (P11).
- ☑ When in current limitation, P02 acts as protection time against locked rotor.

	min.	Range	max.	Factory Standard
P02 - Time of the Acceleration Ramp	1s		240s	20



NOTE!

When motors are run without load or with small loads, the acceleration time will be shorter than the time programmed at P02, due to the back-emf generated by the motor.

6.3.4 - P03 - Voltage steps during Deceleration (%UN)



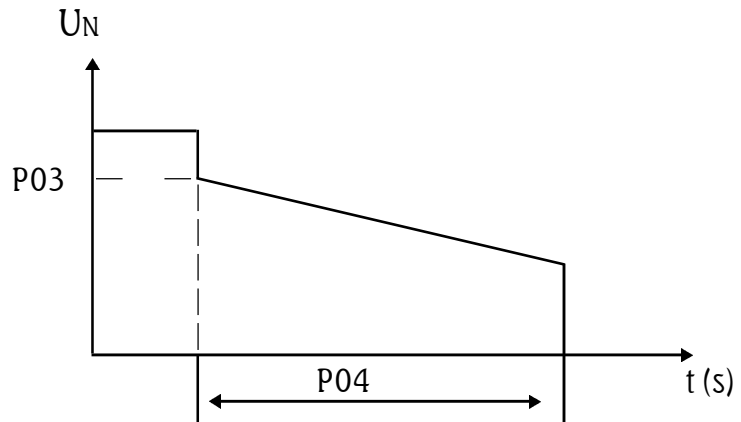
NOTE!

In order to enable this function, P04 must be set by parameter at time according to Figure 6.2.

	min.	Range	max.	Factory Standard
P03 - Voltage step during deceleration	100%UN		40%UN	100

6

DETAILED PARAMETER DESCRIPTION



Pressing Key



Figure - 6.2 - Deceleration Ramp

6.3.5 - P04-Time of the deceleration ramp

- It defines the time of the deceleration ramp that will be effected at the level set at P03 up to the thyristor locking voltage which is approx. 30% of the U_N . As shown in Figure 6.2, this ramp is mainly beneficial for pump application.



NOTE!

This function is used to lengthen the normal load deceleration time and not to force a time shorter than that imposed by the load.

	min.	Range	max.	Factory Standard
P04 - Time of the deceleration ramp	OFF, 2s	<div style="text-align: center;"> ← shortest step → ← 1s → </div>	240s	OFF

6.3.6 - P11 - Current Limitation (% I_N of the switch)



It sets the max.current value that will be supplied to the motor (load) during the acceleration.

The current limitation is used for loads with high or constant starting torque.

The current limitation must be set at a level that permits the motor acceleration, otherwise the motor will not start.

6

DETAILED PARAMETER DESCRIPTION



NOTE!

- 1) If the full voltage is not reached at the end of the acceleration ramp time (P02), the error E02 will be displayed and the motor will be disabled.
- 2) The thermal thyristor protection, inclusive during the current limitation, is carried through thermistor NTC of the Soft-Starter.

	min.	Range	max.	Factory Standard
P11 - Current limitation	OFF, 150%I _N	<div style="text-align: center;"> \longleftrightarrow shortest step 1% \longleftrightarrow </div>	500%I _N	OFF

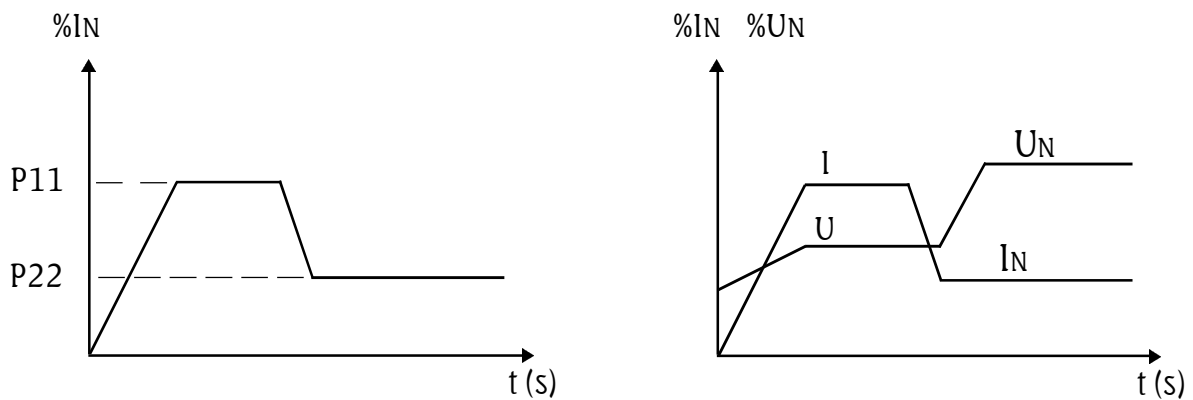


Figure - 6.3 - Current Limitation

P11- Calculation example for setting of current limitation

- To limit the current at 2.5 x I_N of the motor

I_N of the switch = 60A

I_N of the motor = 52A

I_{LIM} = 250% of the I_N of the motor

2.5 x 52A = 130A

$$\frac{130A}{I_N \text{ of the switch}} = \frac{130A}{60A} = 2.17 \times I_N \text{ of the switch}$$

P11 = 217% of the I_N of the switch = 2.5 x I_N of the motor.

6

DETAILED PARAMETER DESCRIPTION



Note:

This function (P11) does not active when the voltage pulse is enabled during the start (P41).

6.3.7- P12- Immediate overcurrent (%I_N of the switch)

- It adjusts the instantaneous overcurrent level that the Soft-Starter permits during a time preset at P13, after then the switch is switched Off, indicating E06, as shown in Figure 6.4.



NOTE!

This function is activated only at full voltage after the motor has started.

	min.	Range	max.	Factory Standard
P12 - Immediate Overcurrent	32%I _N	<div style="text-align: center;"> ← shortest step → ← 1% → </div>	200%I _N	120

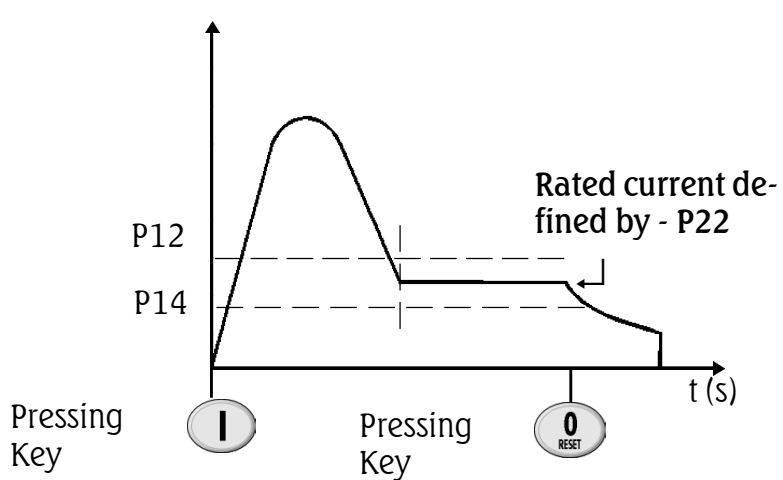


Figure - 6.4 - Protection against over/undercurrent at duty

6

DETAILED PARAMETER DESCRIPTION

P12- Calculation example for setting of immediate overcurrent.

- ☑ Maximum Current equal to 1.4 x I_N of the motor

I_N of the switch = 60A

I_N of the motor = 52A

$$1.4 \times 52A = 72.8A$$

$$\frac{72.8A}{I_N \text{ of the switch}} = \frac{72.8A}{60A} = 1.21 \times I_N \text{ of the switch } 60A$$

P12 = 121% of the I_N of the switch = 140% of the I_N of the motor

6.3.8 - P14- Immediate undercurrent (%I_N of the switch)

- ☑ It adjust the minimum undercurrent level that the equipment (load) can operate without problems. This protection actuates when the current of load (Figure 6.4) goes to value lower than set in P14; and for a time equal or higher than preset in P15, indicating error E05.



NOTE!

This function is activated only at full voltage after the motor has started.

	min.	Range	max.	Factory Standard
P14 - Immediate undercurrent	20%I _N		190%I _N	70

P14- Calculation example for setting of immediate undercurrent (%I_N of the switch)

- ☑ Minimum Current equal to 70% of the I_N of the motor

I_N of the switch = 60A

I_N of the motor = 52A

$$70\% \text{ of the } 52A = 0.7 \times 52A = 36.4A$$

$$\frac{36.4A}{I_N \text{ of the switch}} = \frac{36.4A}{60A} = 0.61 \times I_N \text{ of the switch } 60A$$

P14 = 61% of the I_N of the switch = 70% of the I_N of the motor

6

DETAILED PARAMETER DESCRIPTION

6.3.9 - P13 - Immediate Overcurrent Time(s)

- This parameter determines the maximum time that the load can operate with overcurrent, as set in P12.

	min.	Range	max.	Factory Standard
P13 - Immediate Overcurrent Time	OFF, 1s		20s	OFF

6.3.10 - P15 - Immediate undercurrent Time(s)

- Through this parameter is determined the maximum time that the load can operate with undercurrent, as set in P14. Typical application for this function is in pumping systems that benefit when they are dry operated.

	min.	Range	max.	Factory Standard
P15 - Immediate undercurrent Time	OFF, 1s		30s	OFF

6.3.11 - P22 - Rated current of the Soft-Starter (A)

- Its function is to adjust the Software to certain conditions of the hardware, being used as base of the following functions: starting current limitation (P11); immediate overcurrent (P12) at duty; undercurrent at duty (P14).

	Possible Values	Factory Standard
P22 - Rated current of the Soft-Starter	16, 30, 45, 60, 85A	According to the type

6

DETAILED PARAMETER DESCRIPTION

6.3.12 - P23 - Rated voltage of the Soft-Starter (V)

The function is to calculate the power supplied to the load.

	Possible Values	Factory Standard
P23 - Rated voltage of the Soft-Starter	220, 230, 240, 380, 400, 415, 440, 460, 480, 525, 575V	380

6.3.13 - P31 - Phase rotation (ON = RST; OFF = any sequence)

This function can be enabled or disabled, but when enabled its function is to protect the loads that can not be driven in both direction of rotation.



NOTE!

The phase sequence is only detected at the first time when the power part is activated after the electronic part has been energized. Thus a new phase sequence can only be detected when the electronic part is switched OFF or reset.

	Possible Values	Factory Standard
P31 - Phase rotation	OFF, ON	OFF

6.3.14 P33 - Voltage level of the JOG function

This parameter realizes the acceleration ramp up to the set value of the JOG voltage during the time at which the digital Input (DI4) is closed. After opening, DI4 realizes the deceleration via ramp, provided this function has been enabled at P04.



NOTE!

- 1) The maximum activation time of the JOG function is determined by the time set at P02. After the elapsing this time, it disables the thyristor firing and indicates the Error "E02".
- 2) Thus P55 = 4.

	min.	Range	max.	Factory Standard
P33 - JOG voltage level	25% U _N		50% U _N	25

6

DETAILED PARAMETER DESCRIPTION

6.3.15 -P34 - DC braking time (s)



- ☑ This parameter sets the DC braking time, provided P52=3. This function is only possible with the aid of a contactor that must be connected according to Item 9.6 - Typic DC braking connection diagram.
- ☑ This function must be used when reduction of the deceleration time imposed by the load to the system is desired.

NOTE!

Wherever this function is used, you must consider a possible thermal overload on the motor windings. The protection against SSW overload does not operate at DC braking.

	min.	Range	max.	Factory Standard
P34 - DC braking time	OFF, 1s		10s	OFF

6.3.16 - P35 - DC-braking voltage level (%U_N)

- ☑ This parameter sets the AC line voltage, that is converted directly into DC-voltage and applied on the motor terminals during the braking time.

	min.	Range	max.	Factory Standard
P35 - DC braking voltage level (%U _N)	30%U _N		50%U _N	30

6.3.17 - P41 - Voltage pulse time at the start (Kick Start)



- ☑ The voltage pulse at the start, when enabled, defines the time during which this voltage pulse (P42) will be applied to the motor, so that the motor succeeds to accelerate the initial moment of inertia of the load coupled to its shaft, as shown in Figure 6.5.

NOTE!

Use this function only for specific applications, where break away torque is needed.

6

DETAILED PARAMETER DESCRIPTION

	min.	Range	max.	Factory Standard
P41 - Voltage pulse time at the start (Kick Start)	OFF, 0.2s	<div style="text-align: center;"> \longleftrightarrow shortest step \longleftrightarrow \longleftrightarrow 0.1s \longleftrightarrow </div>	2s	OFF

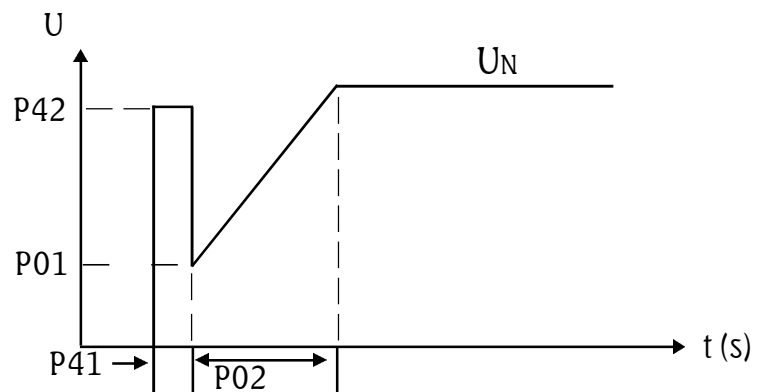


Figure - 6.5 - Voltage pulse at the start

6.3.18 - P42 - Voltage pulse level at the start (Kick Start).

- This function determines the voltage level applied to the motor, so it is able to accelerate the inertia process of the load, as shown in Figure 6.5.



NOTE: This function, when enabled, does not permit the activation of the current limitation during the start.

	min.	Range	max.	Factory Standard
P42 - Voltage pulse level at the start	70%UN	<div style="text-align: center;"> \longleftrightarrow shortest step \longleftrightarrow \longleftrightarrow 1% \longleftrightarrow </div>	90%UN	70

6.3.19 - P45 - Pump Control

- Weg has developed for a special algorithm for application with centrifugal pumps. This special algorithm is used to minimize pressure overshoots in the hydraulic pipeline that can cause ruptures or excessive wear.

- ☑ When P45 set at "On" and key "P" is pressed, the display indicates "PuP" and the following parameters will be set automatically:

P02 = 15 s (acceleration time)

P03 = 80% U_N (voltage step during deceleration)

P04 = 15 s (deceleration time)

P11 = OFF (Current Limit)

P14 = 70% I_N (switch undercurrent)

P15 = 5s (Undercurrent Time)

The other parameters continue with their previous values.



NOTE!

Although the values that are set automatically meet the most applications, they can be improved to meet the requirements of your application.

Please find below a procedure to improve the performance of the control of pumps.

End setting of the pump control function:



NOTE!

This setting must be used only to improve the performance of the pump control and when the pump is already installed and able to operate at full-load.

1. Set P45 (Pump control) at "On".
2. Set P14 (undercurrent) or set P15 (Undercurrent Time) at "OFF" until the set has finished. After then, program it again.
3. Check the correct direction of rotation of the motor, as indicated ON the pump frame.
4. Set P01 (initial voltage - % U_N) to the level so the motor starts to run without vibration.
5. Set P02 (Acceleration Time [s]) to the starting time required by the load. With the manometer in the pipeline, check the pressure increase that must be continuous until the max. required level is reached without overshoots. If overshoots occur, increase the acceleration time to reduce this pressure overshoots at maximum.
6. P03 (Deceleration voltage ramp - % U_N) use this function to cause an immediate pressure drop or a more linear pressure drop during the motor deceleration.

6

DETAILED PARAMETER DESCRIPTION

7. P04 (deceleration time) during the motor deceleration check with manometer the pressure drop that must be continuous until the minimum level is reached without the presence of hydraulic ram when the non-return valve is closed. If this occurs, increase the deceleration time until the oscillations are reduced at maximum.



NOTE!

If no manometer is installed in the pipelines, the hydraulics ram can be observed through the pressure relief valves.



NOTE!

Excessive acceleration or deceleration times can cause motor overheating. Program them for your application as short as possible.

	Possible Values	Factory Standard
P45 - Pump Control	OFF, ON	OFF

6.3.20 P47 - Auto-Reset Time (s)

- When an error occurs, except E01, E02 and E07 or E2x, the Soft-Starter can realize an automatic reset after the programmed time at P47 has been elapsed. If P47=OFF, the Auto-Reset will not occur. After the Auto-Reset time has been elapsed and the same error occurs three consecutive times (*), the Auto-Reset Function will be disabled. Thus, if an error occurs four consecutive times, this error remains on the display (and the Soft-Starter will be disable).

(*) an error will be considered consecutive, if it occurs within 60 seconds after has been executed the last Auto-Reset.

	min.	Range	max.	Factory Standard
P47 - Auto-Reset Time	OFF, 10s		600s	OFF

6

DETAILED PARAMETER DESCRIPTION

6.4 - CONFIGURATION PARAMETERS - P43, P44, P46, P50... P55, P61, P62

6.4.1 - P43 - By-Pass relay



- This function, when enabled, permits activates full voltage indication by means of RL1 or RL2 (P51 or P52) in order to energise a by-pass contactor.
- The main function of the Soft-Starter By-Pass is to eliminate the losses in the form of heat generated by the Soft-Starter.

NOTE!

- 1) This function must always be programmed when a by-pass contactor is used.
- 2) To keep the protections relating to motor current reading, use external current transformers. See item 9.5.
- 3) When P43 is set to "On", the parameters P74 and P76 become inactive "OFF".

	Possible Values	Factory Standard
P43 - By-Pass relay	OFF, ON	OFF

6.4.2 - P44 - Energy Save



- This function can be enabled or disabled. When enabled, its function is to reduce the losses in the motor air gap when motor runs without load or only drives a partial load.

NOTE!

- 1) The total energy save depends on the load which is driven by the motor.
- 2) This function generates undesired harmonic currents in the network due to the conduction angle for the voltage reduction.
- 3) When P44=ON, the parameters P74 and P76 are disabled "OFF".
- 4) Not possible to enable with by-pass (P43 = ON).
- 5)Run led is flashing when energy save is enabled.

6

DETAILED PARAMETER DESCRIPTION

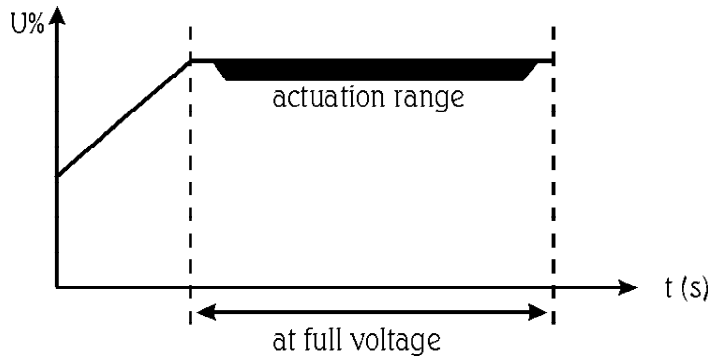


Figure 6.6 - Energy save

	Possible Values	Factory Standard
P44 - Energy save	OFF, ON	OFF

6.4.3 - P46 - Default values (it loads factory parameters)

- When this function is enabled, it resets the parameters to the factory default values, excepting parameter "P22" and "P23".

	Possible Values	Factory Standard
P46 - default values	OFF, ON	OFF

6.4.4 - P50 - Function of the Relay RL3

- It enables the Relay RL3 to operate according to the parameters set below:
 - 1 - The N.O. contact from RL3 is closed when the SSW-04 does not have a fault condition.
 - 2 - The N.O. contact from RL3 is closed when the SSW-04 have a fault condition.

	Possible Values	Factory Standard
P50 - Programming of the Relay RL3	1, 2	1

6

DETAILED PARAMETER DESCRIPTION

6.4.5 - P51 - Function of the relay RL1

It enables the Relay RL1 to operate according to the parameters set below:

- 1 - Function "Operation", the relay is switched ON instantaneously with the order Switch ON of the Soft-Starter, switching Off only when the Soft-Starter receives an order of general switching Off, or by ramp when the voltage reaches 30% of the rated voltage, as shown in Figure 6.6.
- 2 - Full voltage Function, the relay is only switched On after Soft-Starter has reached 100% of U_N , and switched Off when the Soft-Starter receives a command for general switching Off, or by ramp, as shown in Figure 6.7.



NOTE!

The function of full voltage is used to activate the by-pass contactor, the parameter P43 must be set at "On".

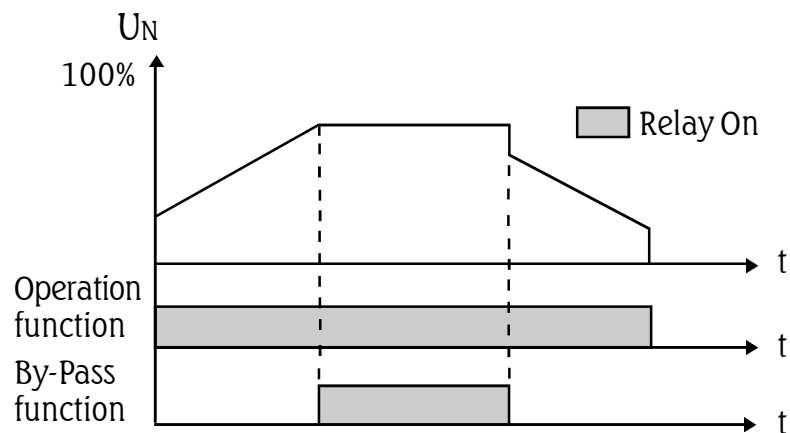


Figure 6.7 - Functioning of the relays RL1 and RL2

- 3 - Function direction of rotation. The relay is ON when digital input (DI3) is closed, and OFF when digital input is open (DI3).

The relay controls a contactor that must be connected at the SSW-04 output, which reverse the direction of rotation by inverting two motor phases - See Item 9.7 - Typical Application with Reversal.



NOTE!

For this function, the parameter P54 must be programmed at 4.

6

DETAILED PARAMETER DESCRIPTION

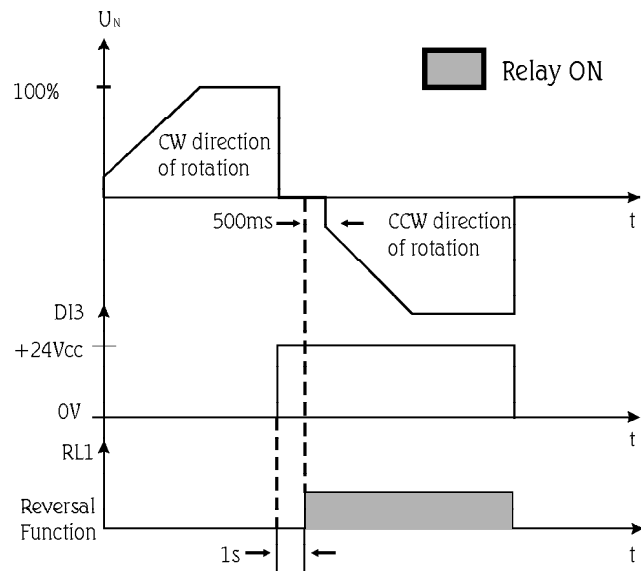


Figure 6.8 - Functioning of the reversal relay RL1

	Possible Values	Factory Standard
P51 - Function of the relay RL1	1, 2, 3	1

6.4.6 - P52 - Function of the relay RL2

It enables the Relay RL2 to operate according to the parameters set below:

1-2 - Enables the Relay RL2 to operate according to the parameters described in Item 6.4.5.

3 - Function DC braking. The relay is ON when the Soft-Starter receives an OFF command. For this function an additional contactor must be used. See item 9.6 - Typical diagram for DC braking.

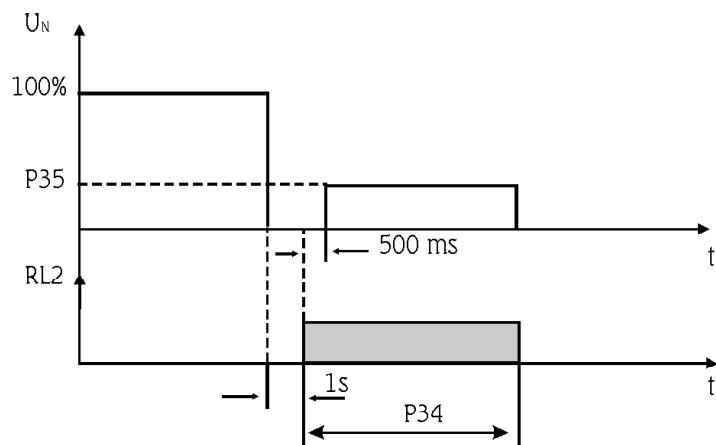


Figure 6.9 - Operating mode of the RL2 for the DC braking

6

DETAILED PARAMETER DESCRIPTION



NOTE!

Before starting programming, make all needed external connections.

	Possible Values	Factory Standard
P52 - Function of the relay RL2	1, 2, 3	2

6.4.7 - P53 - Programming of the Digital Input 2

- Enable the digital input 2 (terminal X2:2) to operate according to described codes:
OFF = without function
- 1 - Error Reset = it reset an error status every time the DI2 input is at +24Vdc (X2:5).
- 2 - External Error = can be used as additional load protection. It acts when the input is open.
Ex.: thermal protection for the motor by means of dry contact (without voltage) of a protection relay (thermostat).
- 3 - General Enabling = X2:2 must be connected to +24Vdc (X2:5) for the Soft-Starter to operate. If it is not connected, the SCR's firing pulses are disabled.
- 4 - Three Wire Control = allows control of the Soft-Starter through digital inputs: DI1 (X2:1) start input and DI2 (X2:2) stop input. According to item 9.3.

	Possible Values	Factory Standard
P53 - Programming of the Digital Input 2 (DI2)	OFF, 1, 2, 3, 4	1

6

DETAILED PARAMETER DESCRIPTION

6.4.8 - P54-Programming of the digital input 3

- ☑ This parameter enables the digital input 3 (terminal X2:3) to operate according to the describe codes:
OFF = without function
- 1 - "Error Reset" (As described in item 6.4.7).
- 2 - "Extern Error" (As described in Item 6.4.7).
- 3 - "General Enabling" (As described in Item 6.4.7).
- 4 - "Direction of rotation". It enables the digital Input 3 (DI3), when connected to +24Vdc (X2:5), it drives the relay RL1 (as described in item 6.4.5) and realizes the reversal of the motor direction of rotation with the Soft-Starter. See Item 9.7 - Typic Application with Reversal.



NOTE!

For this function, the parameter P51 must be programmed to "3".

	Possible Values	Factory Standard
P54 - Programming of the Digital Input 3 (DI3)	OFF, 1, 2, 3, 4	2

6.4.9 - P55 - Programming of the digital input 4

- ☑ This parameter enables the digital input 4 (terminal X2:4) to operate according to the described codes:
OFF = Without Programming
- 1 - "Error Reset" (As described in Item 6.4.7).
- 2 - "Extern Error" (As described in Item 6.4.7).
- 3 - "General Enabling" (As described in Item 6.4.7).
- 4 - "JOG Function". It enables the Digital Input 4 (DI4), when connected to +24Vdc (X2:5), and enables the SSW-04 to apply the JOG voltage (P33) to the motor (as described in Item 6.3.14).

	Possible Values	Factory Standard
P55 - Programming of the Digital Input 4 (DI4)	OFF, 1, 2, 3, 4	OFF

6

DETAILED PARAMETER DESCRIPTION

6.4.10 - P61 - Control enabling

Table 6.1 - Command that depend on the P61 adjust

Comands	P61 = OFF	P61 = ON		Description
	Digital Input	HMI	Serial	
I/O	X	X	X	Digital Input or HMI/Serial
JOG Function	X		X	Digital input 4 (DI4) or Serial
Direction of rotation	X		X	Digital input 3 (DI3) or Serial
General Enabling	X		X	Digital inputs 2, 3, 4 or serial

- I/O (Start/Stop): When P61 = OFF, it enables via digital inputs (DI1 or DI1 and DI2) the motor start/stop. When P61 = ON, it enables the motor start/stop via HMI-3P and serial. When P61 = ON, the digital input "DI1" is without function.



NOTE!

To make the selection through HMI-3P/serial or digital input, the motor must be locked, inclusive when the change is HMI-3P/serial to digital input (DI1), it must be open. If the digital input (DI1) is closed, the parametrization can not be processed and the display flashes.

- JOG Function: This function can be programmed at the Digital Input (DI4) if P61=OFF; or P61=ON it operates via serial input.
- Function of the change of the Direction of Rotation: This function can be programmed at the Digital Input (DI3) if P61=OFF, or P61=ON it operates via serial.
- General Enabling: This function can be used as "Emergency Stop" and it can be programmed for any of the following Digital Inputs DI2, DI3 or DI4 and also via serial (provided P61=ON). If more than one Digital Input is programmed for this function, the first that opens will be the emergency stop. If the command is also enabled for serial operation (P61=ON), all Digital Inputs programmed to General Enabling must be closed.

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DETAILED PARAMETER DESCRIPTION

Table 6.2 - Controls that do not depend on the setting of P61

Commands	Digital Input	HMI	Serial	Description
Extern Error	X			Only at the Digital Input 2, 3 or 4.
Error Reset	X	X	X	available at any.

- External Error: It can be programmed for any Digital Input DI2, DI3 or DI4. If there is no external error, there is also no actuation. If more than one digital Input has been programmed for "External Error", any input will actuate, when disconnected from +24Vdc (X2:5).
- Error Reset: The Error Reset is accepted via HMI-3P, serial and Digital Inputs DI2, DI3 or DI4, when so programmed. If more than one Digital Input if programmed, any one can reset the error status, requiring only the receipt of a +24Vdc (X2:5) pulse.

	Possible Values	Factory Standard
P61 - Command Enabling	OFF, ON	ON

6.4.11 - P62 - Address of the Soft-Starter at the communication network

- This parameter defines the address of Soft-Starter on the communication network. This is for use with the superdrive software.

	min.	Range	max.	Factory Standard
P62 - Address of the Soft-Starter on the Communication Network	1		30	1

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DETAILED PARAMETER DESCRIPTION

6.5 - MOTOR PARAMETERS - P21, P25, P26, P27

6.5.1 - P21 - Motor Current Setting (% I_N of the switch)

- ☑ Sets the motor current value percentually relating to rated switch current.
- ☑ Monitors the overload condition according to the thermal class curve selected at P25, and protects the motor against overloads applied on the shaft. When the overload time is exceeded as defined by the thermal class protection, the firing will be disabled and the HMI-3P display will show error E04.
- ☑ Parameter P21, P25, P26 and P27 are part of the thermal protection.
- ☑ To disable the thermal protection, set P21=OFF.

Ex: How to set P21:

I_N of the switch = 60A

I_N of the motor = 52A

$$\frac{52A}{60A} = 0.867$$

P21 = 86.7%



NOTE: The error E04, motor overload, remains in the memory, even if the CPU is reset, and when the CPU is switched Off, the last value is stored. The value is only decremented with the switch On and the motor Off.

	min.	Range	max.	Factory Standard
P21 - Adjust of the motor current	OFF, 30.0%I _N	<div style="text-align: center;"> <p>shortest step 1%</p> </div>	200.0%I _N	OFF

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DETAILED PARAMETER DESCRIPTION

6.5.2 - P25 - Thermal Class of the Motor Protection

P25	Action
5	Class 5
10	Class 10
15	Class 15
20	Class 20
25	Class 25
30	Class 30

Table 6.3 - Thermal Classes

- ☑ The Soft-Starter SSW-04 is fitted with a Thermal Protection. This protection is very efficient for the motor protection. All Soft-Starter SSW-04 models are fitted with this protection and always it is activated, error E04 is displayed and the motor is switched off.
- ☑ This thermal protection has curves that simulate the motor heating and cooling. The calculation is performed through a sophisticated software that estimates the motor temperature by means of the current that is supplied to the motor.
- ☑ The actuation curves of the motor Thermal Protection are according to IEC 60947-4-2 standard.
- ☑ The motor heating and cooling curves are based on long experience of the company with its motors. These curves adopt a standard three-phase motor with IP55 degree of protection. These curves also consider if the motor is cooled during operation or not.
- ☑ The cooling time of the thermal image depends on the motor power, i. e., for each power, a different cooling time is considered. If a different cooling time is required, this setting can be made at P27.
- ☑ The estimated value for the motor temperature is saved in non-volatile memory always the control board is switched off. Thus, always the control board is switched on, the last saved value will be returned.

6

DETAILED PARAMETER DESCRIPTION

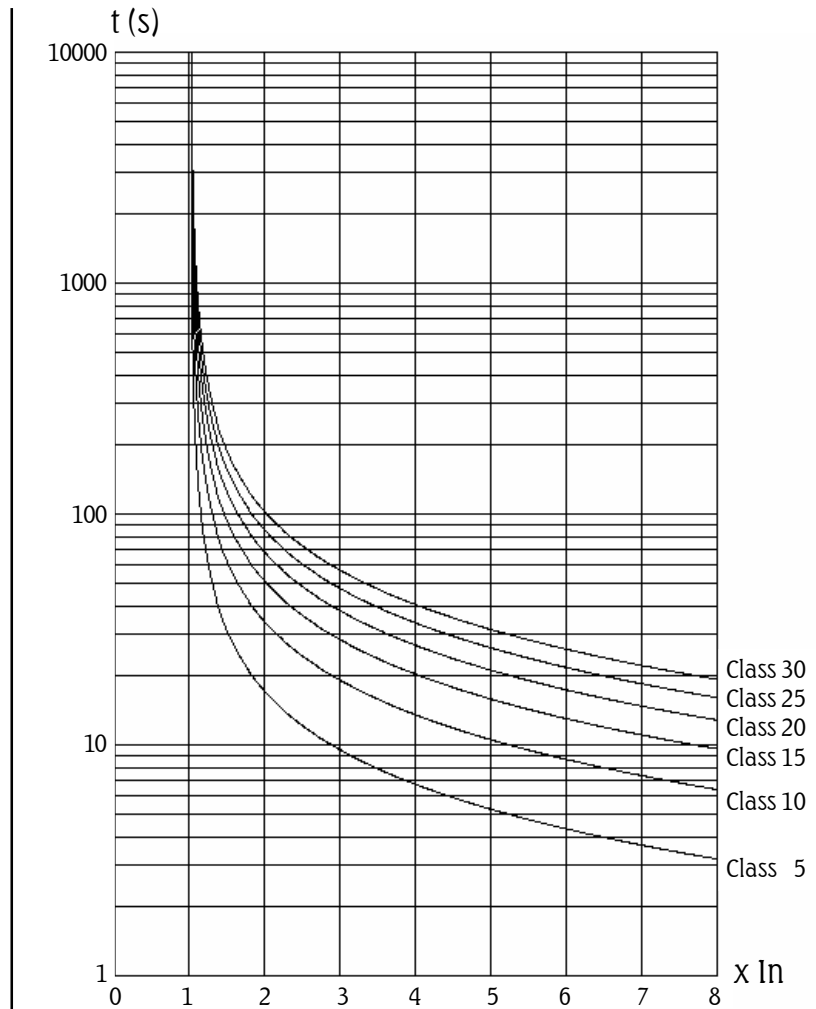


Figure 6.10 - Thermal Classes for Cold Motor Protection

- If a Service Factor different from 1.00 is used, the nominal current for the chart (figure 6.10) has to be corrected by the S.F.. For example: a motor of $I_n=50A$ and $S.F.=1.15$ has $1 \times I_n=57.5A$.

6

DETAILED PARAMETER DESCRIPTION

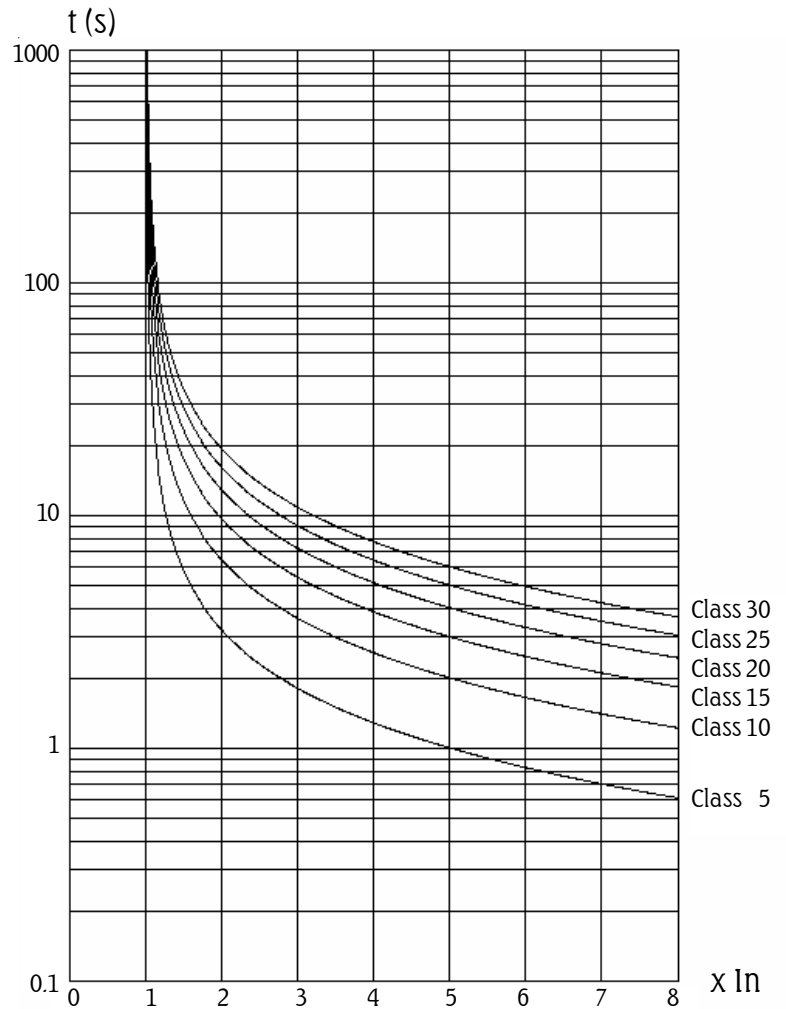


Figure 6.11 - Thermal Classes for Hot Motor Protection

To determine the actuation times for applications inbetween no load and full load condition a multiplication factor dependent on the percentage of the motor current has to be applied.

Current %In	Factor
0%	1
20%	0.84
40%	0.68
60%	0.51
80%	0.35
100%	0.19

Table 6.4 - Multiplication factor for the corrected Thermal Class times



☑ **EXAMPLE:**

Correction of the actuation time:

A motor operating at 80% I_n is switched off and switched on immediately.

The starting duty is $3xI_n @ 25s$. The selected Thermal Class is Class 20 with $39s @ 3xI_n$.

The correction factor for 80% I_n in the table 6.4 is 0.35.

The corrected actuation time is: $0.35 \times 39s = 13.7s$, the actuation time is reduced from 39s at cold condition to 13.7s. This means that an immediate start is not possible before the thermal image of the motor has been cooled down.

NOTE!

For programming correctly the Thermal Class that should protect the motor against overheating, you must consider the allowed hot locked rotor time. This data is available in the catalog of the motor manufacturer.

☑ **EXAMPLE:**

Suggestions on how to program the Thermal Class correctly:

Motor data:

Power: 60hp

Voltage: 380V

Rated current (I_n): 84.5A

Service factor (S. F.): 1.00

I_p/I_n : 7.2

Locked rotor time: 20s at hot (Standard catalog information)

Speed: 1775rpm

Data about the motor + load Starting:

Starting by Voltage Ramp, average starting current:

$3 \times$ the rated motor current during 25s ($3 \times I_n @ 25s$).

1) In the cold chart Figure 6.10, we can find the minimum required Thermal Class that allows motor start with reduced voltage:

For $3 \times I_n @ 25s$, we select the next higher class: 15

2) In the hot chart Figure 6.11, we can find the maximum Thermal Class that the motor will withstand due to the hot locked rotor time:

For $7.2 \times I_n$ @ 20s, we select the next lower Class: 30

Now it is known that Thermal Class 15 allows cold start and Thermal Class 30 is the upper limit. Thus you must select a Thermal Class between these two Thermal Classes by considering the number of starts per hour and the time interval between motor On-Off procedures.

With a smaller Class selected, the motor protection will increase but, less starts per hour are allowed and longer time intervals between motor On-Off procedures are required.

On the other hand with a higher Class selected, the motor might be operated closer to the limit, thus more starts per hour are allowed and shorter time intervals between motor On-Off procedures can be used.

If you are not sure which Thermal Class should be adopted between these two limits, adopt the lowest Thermal Class firstly, and only during practical tests at full load operation select the Class that is more suitable to your requirements, without exceeding the upper limit.



NOTE!

If several Thermal Classes can be applied, program one that is most suitable for your application, protecting your motor according to your duty requirements.



NOTE!

If the motor is equipped with a temperature sensor (PTC or Thermostat) which is used for thermal protection, the thermal class of the SSW-04 can be disabled by setting P21 = Off.

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DETAILED PARAMETER DESCRIPTION

6.5.3 - P26 - Motor Service Factor

- It sets the Motor Service Factor (SF) according to the motor nameplate data. The value defines the load that the motor can drive.

	min.	Range	max.	Factory Standard
P26 - Motor Service Factor	0.80	<div style="text-align: center;"> ← shortest step → ← 0.01 → </div>	1.50	1.00

6.5.4 - P27 - Auto-reset of the Thermal motor image

- It sets the time for the auto-reset of the thermal motor image. The thermal decrement of the thermal motor image simulates the motor cooling time with load and without load, ON and OFF. The algorithm that realizes this simulation is based on tests applied on WEG. IP55 is standard according to your power programmed in the soft-starter parameters. In application, where several starts per hour are required, you can use the auto-reset of the thermal image.

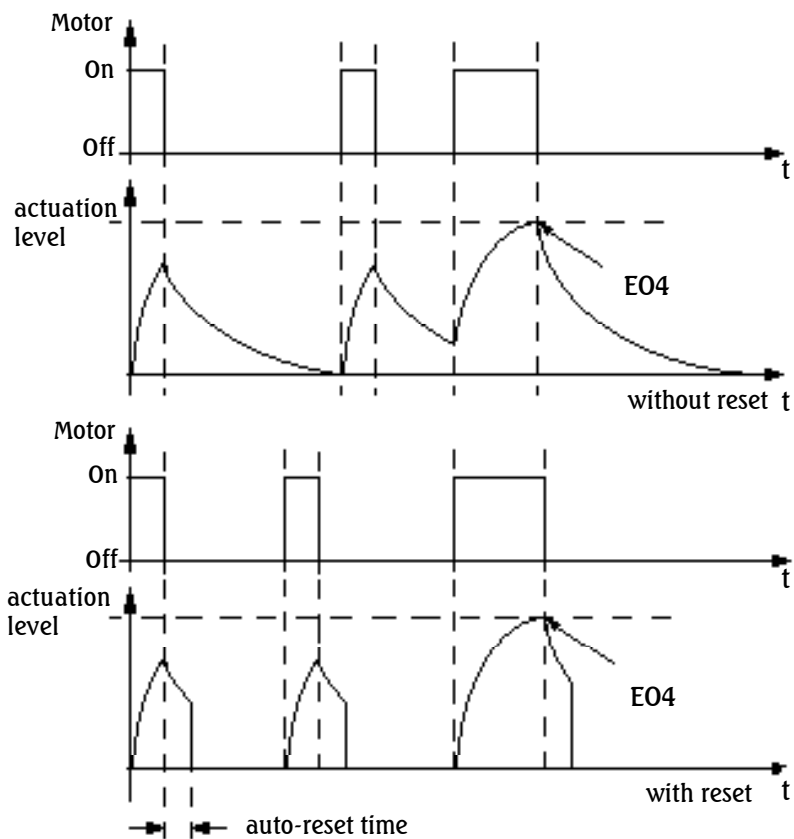


Figure 6.12- Auto-reset of the thermal memory

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DETAILED PARAMETER DESCRIPTION



NOTE!

Please note that every time you use this function you can reduce the winding life of your motor.

	min.	Range	max.	Factory Standard
P27 - Auto-reset of the thermal memory	OFF, 1	<div style="text-align: center;"> <p>shortest step</p> <p>1s</p> </div>	600s	OFF

7.1 - ERROR AND POSSIBLE CAUSES

7.1.1 - Programming error (E24)

- ☑ The Soft-Starter can indicate an error of incorrect programming (E24), serial errors (E2X) and Hardware errors (E0X).

- ☑ The error of incorrect programming (E24) does not permit that the value, changed incorrectly, be accepted. This error occurs when any parameter is changed with the motor OFF and under the following incompatibility conditions between the parameters.

- P11 current limiting with P41 kick start.
- P41 kick start with P55=4 at Jog.
- P43 by-pass with P44 energy saving.
- P61 at Off with ED1 driven or P55 Jog driven.

To abandon this error condition, press keys P, I, O.

7.1.2 - Serial communication error

- ☑ Serial communication errors (E2X) do not permit the changing of the value or that the incorrectly transmitted value be accepted.

For further info, see please Serial Communication Manual - SSW-04.

To abandon this error condition, press keys P, I, O.

7.1.3 - Hardware errors (E0X)

- ☑ Hardware errors (E0X) disable the Soft-Starter. To abandon this error condition, switch OFF the equipment and switch it again ON, or press RESET key. Before doing this you must eliminate the source of the error.



NOTE!

Long connection cables between the Soft-Starter and the motor (longer than 150m (492ft)) or shielded cables can show a high reactance. This may cause error "E01".

Solution:

Connect a three-phase reactance in series with the motor supply line. In this case, contact the manufacturer.




Note: Actuation form of the errors:

All errors E01...E08 switch Off the relay RL3 and disable the thyristor firing and indicate the error on the display.

Error Led in the control board card CCS4.00 or CCS4.01 flashes.

Table 7.1- Hardware errors

ERROR	RESET	POSSIBLE CAUSE
E01	<ul style="list-style-type: none"> ☑ Switch OFF/ON the electronics ☑ Or through key  	<ul style="list-style-type: none"> ☑ Phase-fault in the three-phase network ☑ Short-circuit or fault in the thyristor ☑ Motor is not connected ☑ Supply frequency with oscillation higher than 10%.
E02	<ul style="list-style-type: none"> ☑ Or through digital input for reset 	<ul style="list-style-type: none"> ☑ The time of the ramp acceleration is shorter than the actual acceleration time since the function of the current limitation is activated.
E03	<ul style="list-style-type: none"> ☑ Or through serial 	<ul style="list-style-type: none"> ☑ Ambient temperature higher than 40°C and current too high. ☑ Starting time with current limitation higher than specified by switch. ☑ Too many of successive starts. ☑ Fan is locked or defective.
E04		<ul style="list-style-type: none"> ☑ Set of P21, P25 and P26 too low relating to the used motor ☑ Load on the motor shaft too high ☑ Too many of successive starts
E05		<ul style="list-style-type: none"> ☑ Pump is dry operating ☑ Load decoupled from the motor shaft
E06		<ul style="list-style-type: none"> ☑ Short-circuit between phases ☑ Motor shaft is locked
E07		<ul style="list-style-type: none"> ☑ Network phase sequence inverted at the input
E08		<ul style="list-style-type: none"> ☑ Terminal board X2.3 and X2.5 is open (not connected to +24Vdc)

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MAINTENANCE

Table 7.2- Hardware errors and possible solutions

PROBLEM	POINT TO BE CHECKED	CORRECTIVE ACTION					
Motor does not run	<input checked="" type="checkbox"/> Wiring not correct	1. Check all power and control connections. For instance, check the digital input of extern error that must be connected to +24V.					
	<input checked="" type="checkbox"/> Wrong programming	1. Check if the parameter are correct programmed for the application.					
	<input checked="" type="checkbox"/> Error	1. Check if the Soft-Starter is not disabled due to a detected error condition (see table above).					
Motor speed changes (oscillates)	<input checked="" type="checkbox"/> Loose connections	1. Disable the Soft-Starter, switch OFF the suply voltage and tighten all connections. 2. Check if all intern Soft-Starter connections are tightened.					
Motor speed too high or too low	<input checked="" type="checkbox"/> Motor nameplate data	1. Check if the motor is used according to its application					
Display OFF	<input checked="" type="checkbox"/> HMI connections	1. Check the HMI connections to the Soft-Starter (control board CCS4.0X)					
	<input checked="" type="checkbox"/> Check the supply voltage X1.1 and X1.2	1. The rated values must meet the following requirements: <table style="display: inline-table; vertical-align: middle;"> <tr> <td>For 220-230Vac</td> <td>For 110-120Vac</td> </tr> <tr> <td>- Min.: 187V</td> <td>- Min.: 93.5Vac</td> </tr> <tr> <td>- Max. 253V</td> <td>- Max. 132Vac</td> </tr> </table>	For 220-230Vac	For 110-120Vac	- Min.: 187V	- Min.: 93.5Vac	- Max. 253V
For 220-230Vac	For 110-120Vac						
- Min.: 187V	- Min.: 93.5Vac						
- Max. 253V	- Max. 132Vac						
Jerk during deceleration	<input checked="" type="checkbox"/> Soft-Starter programming	1. Decrease the deceleration time setting on the parameter P04.					

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MAINTENANCE

Table 7.3 - Periodical Inspections after the commissioning

COMPONENT	PROBLEM	CORRECTIVE ACTION
Terminals, connectors	Loose screws	Tighten them (2).
	Loose connectors	
Fans ⁽¹⁾ / cooling System	Fans are dirt	Clean them.(2)
	Abnormal acoustic noise	Replace the fan.
	Abnormal vibration	
	Dust in the air filter	Clean or replace it.(3)
Printed circuit boards	Dust, oil, moisture accumulation, etc.	Clean them.(2)
	Smell	Replace them.
Power Module/ Power Connections	Dust, oil, moisture accumulation, etc.	Clean them.(2)
	Connection screws are loose	Tighten them (2).
Power Resistors	Discoloration	Replace them.
	Smell	

Note:

- (1) We recommend to replace the fans after each 40,000 hours of operation.
- (2) Every 6 months.
- (3) Twice per month.

7.2 - PREVENTIVE MAINTENANCE



DANGER!

Disconnect always the supply voltage before attempting to service any electric component of the Soft-Starter.

Even after switching OFF the Soft-Starter, during a certain time high voltages may be present. Thus wait 3 minutes to allow a complete discharge of the power capacitors. Always connect the equipment frame to the grounding (P.E) at the suitable point.



ATTENTION!

The electronic boards are fitted with components sensitive to electrostatic discharges. Never touch the components or connectors directly. If this is necessary, touch before on the metallic frame or use a suitable grounding bracelet.

**Never apply a high voltage test on the Soft-Starter!
If this is necessary, contact the manufacturer.**

In order to avoid operation problems caused by unfriendly ambient conditions, such as high temperature, moisture, dirt, vibration or aging of the components, make periodical inspections on the Soft-Starter and installations.

7.2.1 - CLEANING INSTRUCTIONS

When it is necessary to clean the Soft-Starter follow these guidelines:

a) Cooling system:

- Switch OFF Soft-Starter power supply.
- Remove all the dust located on the ventilation openings of the enclosure using a plastic brush or flannel.
- Remove all the dust accumulated on the heatsink fins and fans using compressed air.

b) Printed circuit boards (PCBs):

- Switch OFF Soft-Starter power supply.
- Remove all the dust or moisture accumulated on the board using an anti-static brush and/or a compressed air ion gun (ex: charger buster ion gun (non-nuclear) Ref. A6030-6 from DESCO). If necessary remove PCBs from the Soft-Starter.

7.3 - CHANGING SUPPLY FUSE



1. Disconnect power supply of the Soft-Starter.

DANGER!

Disconnect always the supply voltage before attempting to service any electric component of the Soft-Starter.

Even after switching OFF the Soft-Starter, during a certain time high voltages may be present. Thus wait 3 minutes to allow a complete discharge of the power capacitors.

2. Open the enclosure of the Soft-Starter.
3. Find the fuse on the board CCS4 and replace it by the type specified in the spare parts list.
4. Close the Soft-Starter.

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MAINTENANCE

7.4 - SPARE PART LIST

Name	Item N°	Specification	Types (Amper) 220...440 Vac				
			16	30	45	60	85
			Units per Soft-Starter				
Thyristor Module	0303.7541	Thyristor module 25A 1200V	3				
	0303.8106	Thyristor module 56A 1200V		3			
	0303.7495	Thyristor module 90A 1200V			3	3	
	0303.8238	Thyristor module 160A 1200V					3
* Fan	0400.2571	Fan 120x120mm 110 Vac				1	1
	0400.1494	Fan 120x120mm 220 Vac				1	1
Source Fuse	0305.5175	Glass Fuse 2A / 250V	1	1	1	1	1
HMI-3P	4160.0497	Human/Machine Interface HMI-3P	1	1	1	1	1
CCS4.00	4160.0942	Control Board	1	1	1	1	1
Current Transformer	0307.2673	CT 200/1A 1VA	2	2	2		
	0307.2681	CT 400/1A 1VA				2	2

Name	Item N°	Specification	Types (Amper) 460...575 Vac				
			16	30	45	60	85
			Units per Soft-Starter				
Thyristor Module	0303.9918	Thyristor module 25A 1600V	3				
	0303.9900	Thyristor module 56A 1600V		3			
	0303.9896	Thyristor module 90A 1600V			3	3	
	0303.9617	Thyristor module 160A 1600V					3
* Fan	0400.2571	Fan 120x120mm 110 Vac				1	1
	0400.1494	Fan 120x120mm 220 Vac				1	1
Source Fuse	0305.5175	Glass fuse 2A / 250V	1	1	1	1	1
HMI-3P	4160.0497	Human/Machine Interface HMI-3P	1	1	1	1	1
CCS4.01	4160.0950	Control Board	1	1	1	1	1
Current Transformer	0307.2673	CT 200/1A 1VA	2	2	2		
	0307.2681	CT 400/1A 1VA				2	2

- * **Note:** a) The 220V fan is used in the SSW-04.XX/YYY-YYY/2
b) The 110V fan is used in the SSW-04.XX/YYY-YYY/1

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TECHNICAL CHARACTERISTICS

8.1 - POWER DATA

- Line Voltage
 - ⇒ Voltage: + 10%, -15% (with motor power loss)
 - ⇒ Frequency: 50/60Hz±10%
 - ⇒ Start Duty: 3xI_N for 20sec. 10 starts per hour.
- Overvoltage category III (EN61010/UL508).
- Transient voltages according to overvoltage category III.

8.2 - POWER / CURRENT TABLE

Type	40°C			Rated dissipated power	40°C									
	Rated Current (3xI _N @ 20s.)	Rated Current (4.5xI _N @ 20s.)	Maximum Current for Continuous Duty*		220V		380V		440V		525V		575V	
					HP	kW	HP	kW	HP	kW	HP	kW	HP	kW
SSW-04.16	16A	11A	17.6A	73W	6	4.5	10	7.5	12.5	9.2	15	11	15	11
SSW-04.30	30A	20A	33A	123W	10	7.5	20	15	20	15	30	22	30	22
SSW-04.45	45A	30A	49.5A	177W	15	11	30	22	30	22	40	30	40	30
SSW-04.60	60A	40A	68A	250W	20	15	40	30	50	37	60	45	60	45
SSW-04.85	85A	57A	96A	340W	30	22	60	45	75	55	75	55	75	55

Type	55°C			Rated dissipated power	55°C									
	Rated Current (3xI _N @ 20s.)	Rated Current (4.5xI _N @ 20s.)	Maximum Current for Continuous Duty*		220V		380V		440V		525V		575V	
					HP	kW	HP	kW	HP	kW	HP	kW	HP	kW
SSW-04.16	16A	11A	17.6A	73W	6	4.5	10	7.5	12.5	9.2	15	11	15	11
SSW-04.30	27A	18A	29.7A	112.8W	10	7.5	15	11	20	15	25	18.5	25	18.5
SSW-04.45	38A	26A	41.8A	151.8W	12.5	9.2	25	18.5	30	22	30	22	30	22
SSW-04.60	52A	35A	58.9A	221.2W	20	15	30	22	40	30	50	37	50	37
SSW-04.85	80A	55A	90.3A	322W	30	22	50	37	60	45	75	55	75	55

* Note: It's the maximum current that the Soft-Starter can have in continuous duty. For this current the Soft-Starter can only have 1 start per hour.



8.3 - MECHANICAL DATA

- NOTE:**
The maximum indicated power above refer to WEG IV pole standard motors.
- See figure
 - Finish: - Electrostatic Epoxy Powder Paint
 - Colour: Cover - light-gray - RAL 7032
 - Cabinet - dark-gray - RAL 7022

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TECHNICAL CHARACTERISTICS

8.4 - ELECTRONICS DATA / GENERAL

Control	Method	<input checked="" type="checkbox"/> Voltage variation under load
Inputs	Digital	<input checked="" type="checkbox"/> 04 Galvanically isolated input (optocoupled), 24Vdc <input checked="" type="checkbox"/> Programmable functions
Outputs	Relay	<input checked="" type="checkbox"/> 02 relays, NO contact, 250V/1A <input checked="" type="checkbox"/> Programmable functions <input checked="" type="checkbox"/> 01 relay, REV contact - 250V/1A specific for faults.
Safety	Protections	<input checked="" type="checkbox"/> Under/Overcurrent at the output of the Soft-Starter <input checked="" type="checkbox"/> Phase fault for the supply <input checked="" type="checkbox"/> Motor phase fault (motor non connected) <input checked="" type="checkbox"/> Mains frequency with $\pm 10\%$ oscillation <input checked="" type="checkbox"/> Thyristor fault <input checked="" type="checkbox"/> Inverted phase sequence (programmable) <input checked="" type="checkbox"/> Overtemperature at the power stage <input checked="" type="checkbox"/> Overload at the output (I^2t). <input checked="" type="checkbox"/> Extern fault <input checked="" type="checkbox"/> CPU Error <input checked="" type="checkbox"/> Programming error <input checked="" type="checkbox"/> Error the serial interface
Communication	Serial Interface	<input checked="" type="checkbox"/> RS 232
Human Machine Interface	HMI-3P (Detachable)	<input checked="" type="checkbox"/> 05 keys: ON, OFF, parameter content / increase, parameter / content / decrease, parameter / content. <input checked="" type="checkbox"/> 04 Displays - 7 segment LEDs <input checked="" type="checkbox"/> Permits access / changing of all parameters <input checked="" type="checkbox"/> Display accuracy - Current: $\pm 10\%$ - Power: $\pm 5\%$ <input checked="" type="checkbox"/> Types for extern mounting: - HMI-3P.1 - 1 m (3.28ft) cable - HMI-3P.2 - 2 m (6.56ft) cable - HMI-3P.3 - 3 m (9.84ft) cable
Fulfilled Standards	UL 508 EN60947-4-2	<input checked="" type="checkbox"/> Industrial Control Equipment. <input checked="" type="checkbox"/> Low voltage switchgear - AC. motor controllers

9.1 CONFORMITY

9.1.1 EMC and LVD Directives



9.1.2 Requirements for conforming Installations

9.1.2.1 EMC Directive

The SSW-04 line, all models listed in this manual with 220-440V rated voltage were tested to meet the following:

EMC Directive 89/336/EEC (Electromagnetic Compatibility), using a Technical Construction File and the following standards:

EN60947-4-2: Low-voltage switchgear and controlgear Part 4, contactors and motor-starters Section 2. AC semiconductor motor controllers and starters.

Low Voltage Directive (LVD) 73/23/EEC

ATTENTION!

The SSW-04 line has been designed for class A equipment. Use of the products in domestic environments may cause radio interference, in which case the user may be required to employ additional mitigation methods.

NOTE!

The conformity of the Soft-Starter to any standard does not guarantee that the entire installation will conform. Many other factors can influence the total installation. Only direct measurements can verify total conformity.

The following items are required for CE conformance:

1. The Soft-Starters must be installed into closed metallic boxes or panels that have a door only able to be opened with a tool. A suitable cooling must be provided to ensure that the temperature will be within the allowed range. See item 3.1.1.
2. Filters as called on table 9.1.
3. Output cables (motor cables) must be armored, flexible armored or installed inside a metallic conduit or trunking with equivalent attenuation.
4. Control (I/O) and signal wiring must be shielded or installed inside a metallic conduit or trunking with equivalent attenuation.
5. The remote keypad (External HMI-3P) cable must be shielded or installed inside a metallic conduit or trunking with equivalent attenuation.
6. Grounding as stated in this Manual item 3.2.1.

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APPENDIX

9.1.2.2 Low Voltage Directive (LVD)

The following items are required for CE conformance:

1. The same as item 1 above.
2. The installation must provide a supply disconnecting (isolation) device. A hand-operated supply disconnecting device must be provided for each income supply and be near to the equipment. This device must disconnect the Soft-Starter from the supply when required (e. g. during work on the electrical equipment). See EN60204-1, 5.3. Specify the current and voltage of this disconnecting device according to the data given in the item 8.1 and 8.2.



DANGER!

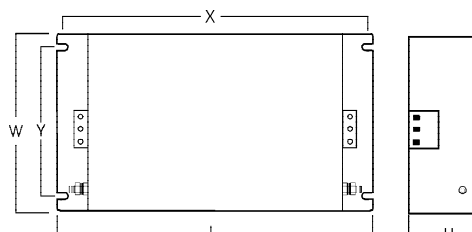
This equipment must not be used as an emergency stop mechanism (See EN60204, 9.2.5.4).

Table 9.1 - Types of Soft-Starters and filters

SSW-04 Model no	Filter			
	Power		Control	
	Model (WEG number)	Case Style	Model (WEG number)	Case Style
16/220-440	RF3020-DLC (0208.1881)	D	RF103-1M (0208.1962)	M1
30/220-440	RF3040-DLC (0208.1903)			
45/220-440 60/220-440	RF3070-DLC (0208.1920)	F		
85/220-440	RF3100-DLC (0208.1938)	G		

Case Dimensions (mm)

Case Style	L	W	H	X	Y	Mount
D	270	140	60	238	106	M6
F	350	180	90	338	146	M6
G	420	200	130	408	166	M6
M1	88	58	40	78	44	



9.1.3 Filter Installation



DANGER! Filter grounding.

Using the line filter may result in relatively high ground leakage currents.

Ensure the following:

- The filter must be permanently installed and solid grounded (bonded).
- Grounding must not rely on flexible cables and should not include any form of plug or socket that would permit inadvertent disconnection.

Make sure to fulfill the requirements of the local security standards.

1. The filter must be connected between the incoming AC supply line and the Soft-Starter input terminals. See Fig 9.1.
2. The Soft-Starter and filter must be mounted to a common backplane with a positive electrical bond and in close proximity to one another.
3. The length of the wiring among filter and Soft-Starter inputs and must be kept as short as possible.

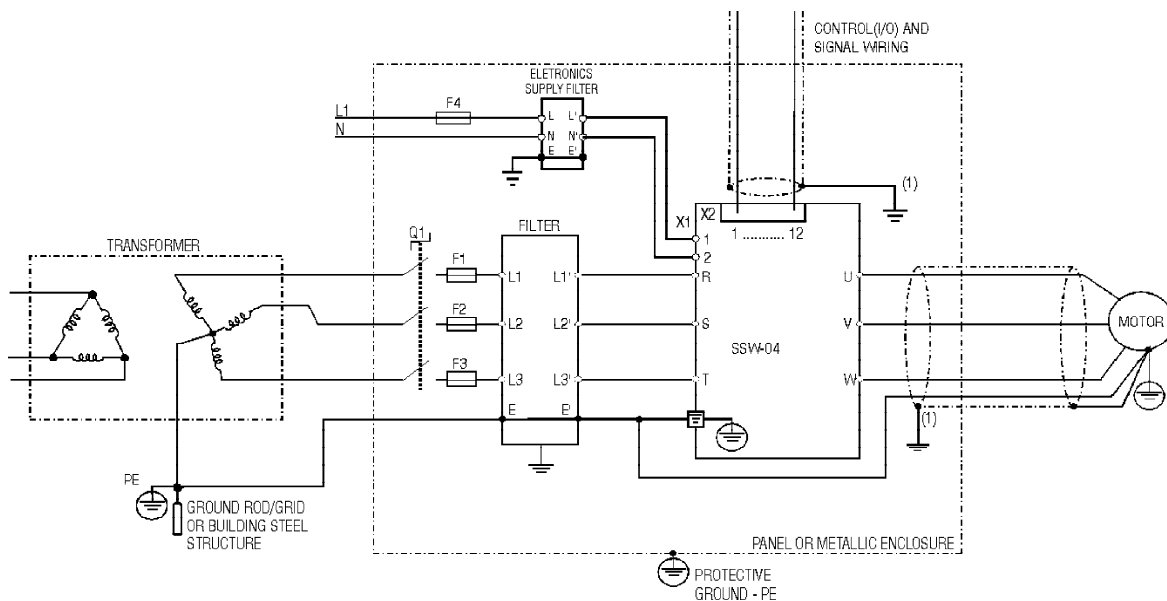
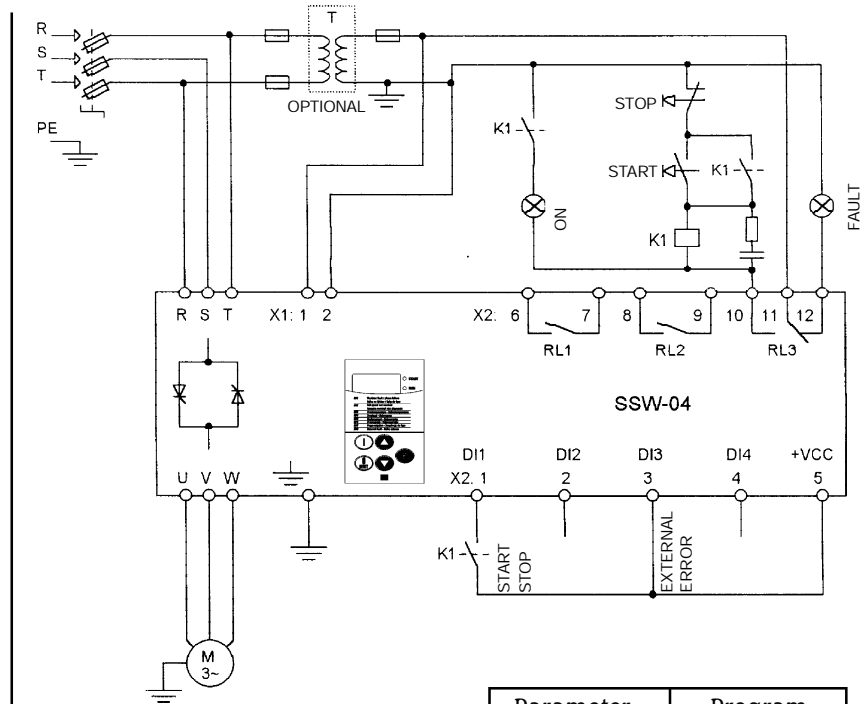


Figure 9.1 - Filter connection

- (1) The cables shielding must be solidly connected to the common backplane, using preferably a bracket. The backplane must be electrically conductive (have no paint).

9.2 - RECOMMENDED APPLICATION WITH TERMINALS FOR TWO WIRE CONTROL



Parameter	Program
P53	1
P54	2
P55	OFF
P61	OFF

Obs.: It's necessary to use normal fuses or breaker to protect the installation. Ultra-Fast fuses are not necessary for the SSW-04 operation, but they are recommended for SCR protection.

The transformer "T" is optional and must be utilized when the line voltage is different than the electronics and fan voltage.

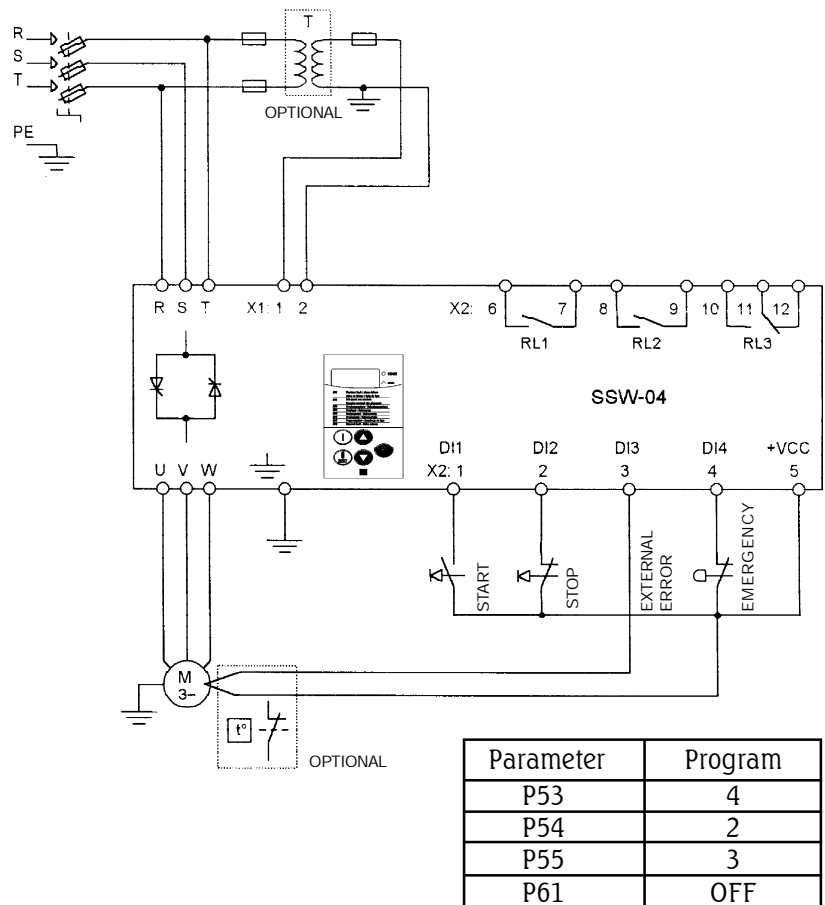
For the integral motor protection it's recommended to install one or more thermostats in the motor. If the thermostat is not used, the external input error (DI3) from SSW-04 must be connected to +Vdc.



NOTE!

A contactor in the mains input (see 9.4) is necessary to protect the motor in case there is a phase failure which is caused by damage in the SSW-04 power circuit.

9.3 - RECOMMENDED APPLICATION WITH TERMINALS FOR THREE WIRE CONTROL



Obs.: It's necessary to use normal fuses or breaker to protect the installation. Ultra-Fast fuses are not necessary for the SSW-04 operation, but they are recommended for SCR protection.

The transformer "T" is optional and must be utilized when the line voltage is different than the electronics and fan voltage.

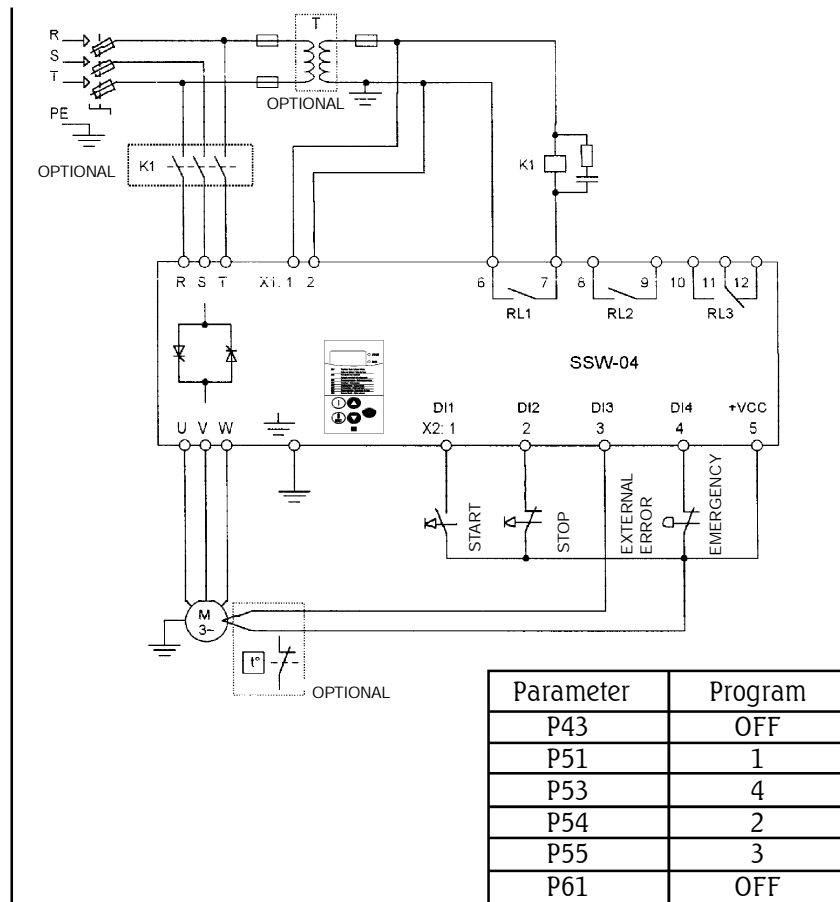
For the integral motor protection it's recommended to install one or more thermostats in the motor. If the thermostat is not used, the external input error (DI3) from SSW-04 must be connected to +Vdc.



NOTE!

A contactor in the mains input (see 9.4) is necessary to protect the motor in case there is a phase failure which is caused by damage in the SSW-04 power circuit.

9.4 - RECOMMENDED APPLICATION WITH TERMINALS FOR THREE WIRE CONTROL AND POWER ISOLATION CONTACTOR



Obs.: It's necessary to use normal fuses or breaker to protect the installation. Ultra-Fast fuses are not necessary for the SSW-04 operation, but they are recommended for SCR protection.

The transformer "T" is optional and must be utilized when the line voltage is different than the electronics and fan voltage.

The isolation contactor "K1" is optional, and is not necessary for the SSW-04 operation. However due to protection and safety reasons it's recommended. In case of maintenance the input fuses must be removed for a complete disconnection of the SSW-04 from the line.

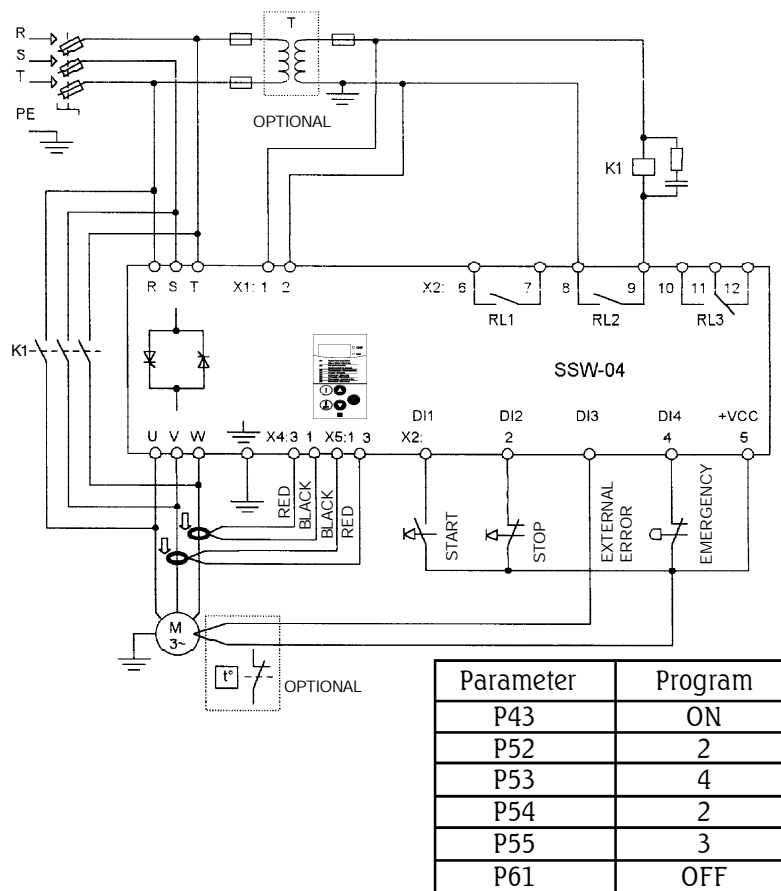
For the integral motor protection it's recommended to install one or more thermostats in the motor. If the thermostat is not used, the external input error (DI3) from SSW-04 must be connected to +Vdc.



NOTE!

Contactor "K1" is necessary to protect the motor in case there is a phase failure which is caused by damage in the SSW-04 power circuit.

9.5 - RECOMMENDED APPLICATION WITH TERMINALS FOR THREE WIRE CONTROL AND BY-PASS CONTACTOR



Obs.: It's necessary to use normal fuses or breaker to protect the installation. Ultra-Fast fuses are not necessary for the SSW-04 operation, but they are recommended for SCR protection.

The transformer "T" is optional and must be utilized when the line voltage is different than the electronics and fan voltage.

For the integral motor protection it's recommended to install one or more thermostats in the motor. If the thermostat is not used, the external input error (DI3) from SSW-04 must be connected to +Vdc.

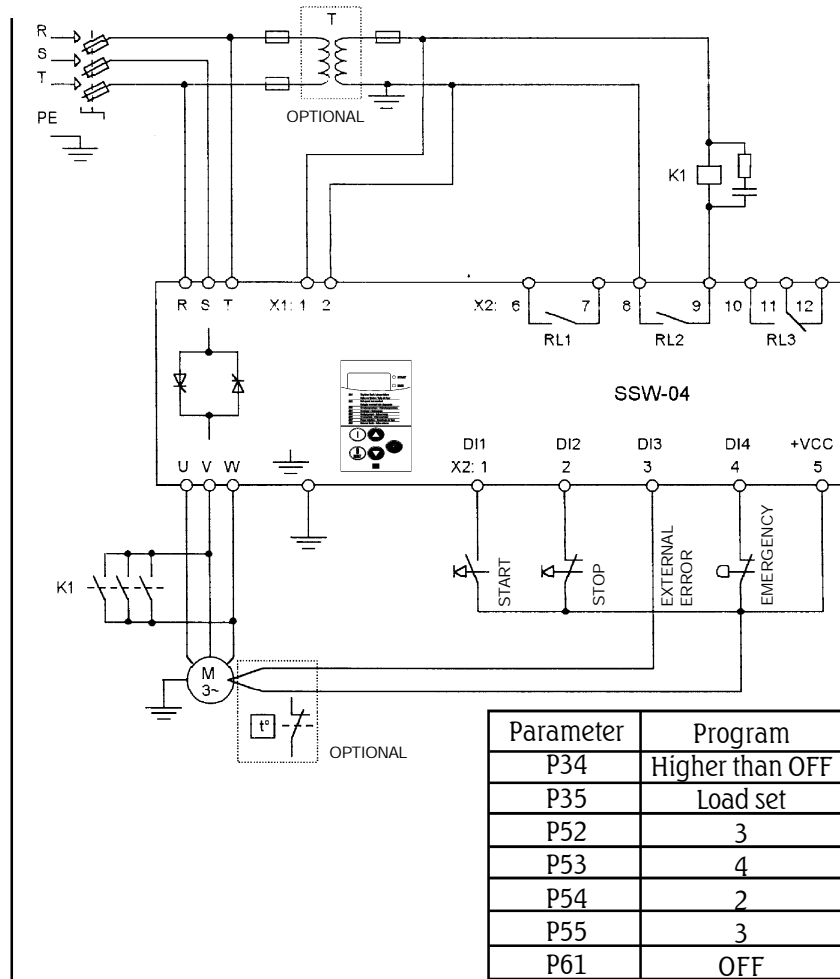


NOTE!

A contactor in the mains input (see 9.4) is necessary to protect the motor in case there is a phase failure which is caused by damage in the SSW-04 power circuit.

To maintain motor thermal protection after the Soft-Starter is by-passed, the Current Transformers (CT) must be connected in conformity with the diagram above.

9.6 - RECOMMENDED APPLICATION WITH TERMINALS FOR THREE WIRE CONTROL AND DC BRAKING



Obs.: It's necessary to use normal fuses or breaker to protect the installation. Ultra-Fast fuses are not necessary for the SSW-04 operation, but they are recommended for SCR protection.

The transformer "T" is optional and must be utilized when the line voltage is different than the electronics and fan voltage.

For the integral motor protection it's recommended to install one or more thermostats in the motor. If the thermostat is not used, the external input error (DI3) from SSW-04 must be connected to +Vdc.



NOTE!

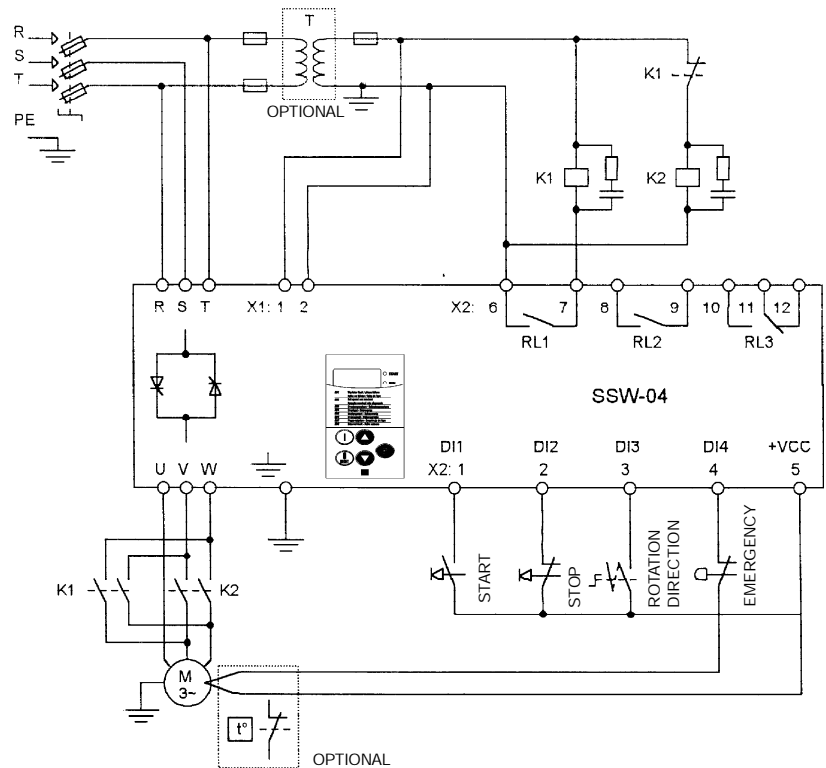
A contactor in the mains input (see 9.4) is necessary to protect the motor in case there is a phase failure which is caused by damage in the SSW-04 power circuit.

For DC braking you can select the contactor "K1" to use the three contacts in parallel.

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9.7 - RECOMMENDED APPLICATION WITH TERMINALS FOR THREE WIRE CONTROL AND MOTOR SPEED REVERSAL



Parameter	Program
P04	OFF
P51	3
P53	4
P54	4
P55	3
P61	OFF

Obs.: It's necessary to use normal fuses or breaker to protect the installation. Ultra-Fast fuses are not necessary for the SSW-04 operation, but they are recommended for SCR protection.

The transformer "T" is optional and must be utilized when the line voltage is different than the electronics and fan voltage.

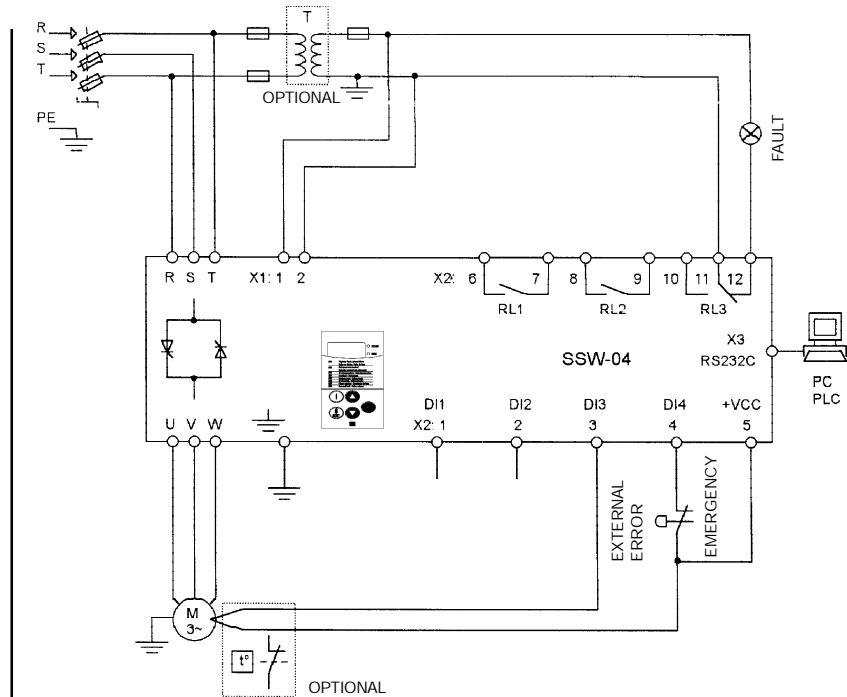
For the integral motor protection it's recommended to install one or more thermostats in the motor. If the thermostat is not used, the external input error (D13) from SSW-04 must be connected to +Vdc.



NOTE!

A contactor in the mains input (see 9.4) is necessary to protect the motor in case there is a phase failure which is caused by damage in the SSW-04 power circuit.

9.8 - RECOMMENDED APPLICATION WITH PC OR PLC COMMAND



Parameter	Program
P54	2
P55	3
P61	ON
P62	ADDRESS

Obs.: It's necessary to use normal fuses or breaker to protect the installation. Ultra-Fast fuses are not necessary for the SSW-04 operation, but they are recommended for SCR protection.

The transformer "T" is optional and must be utilized when the line voltage is different than the electronics and fan voltage.

For the integral motor protection it's recommended to install one or more thermostats in the motor. If the thermostat is not used, the external input error (DI3) from SSW-04 must be connected to +Vdc.

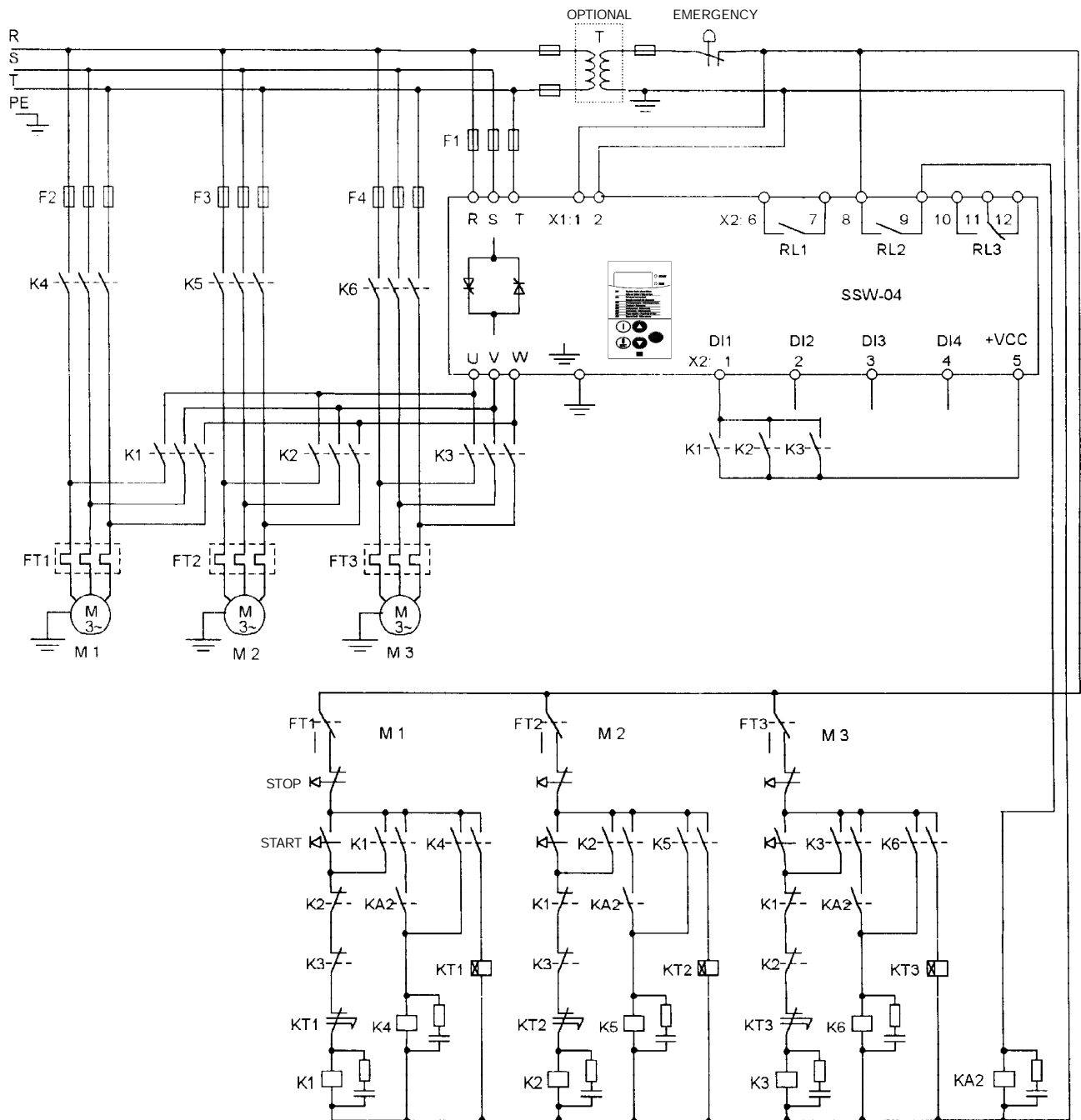


NOTE!

A contactor in the mains input (see 9.4) is necessary to protect the motor in case there is a phase failure which is caused by damage in the SSW-04 power circuit.

Connect the PC or PLC to control board via connector X3 (RS 232C).

9.9 - RECOMMENDED APPLICATION WITH TERMINALS FOR THREE WIRE CONTROL FOR SEVERAL MOTORS



Obs.: It's necessary to use normal fuses or breaker to protect the installation. Ultra-Fast fuses are not necessary for the SSW-04 operation, but they are recommended for SCR protection. The transformer "T" is optional and must be utilized when the line voltage is different than the electronics and fan voltage.

For the integral motor protection it's recommended to install one or more thermostats in the motor. If the thermostat is not used, the external input error (DI3) from SSW-04 must be connected to +Vdc.

Motor fuses are normal.

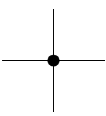

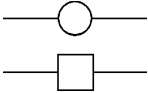
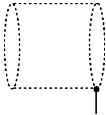
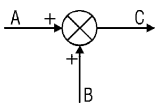


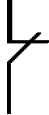

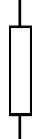
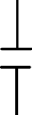
Install one overload relay to each motor.



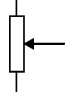
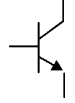
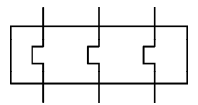
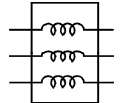
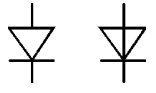
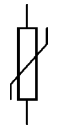
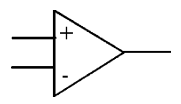
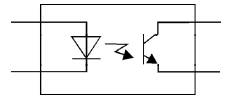
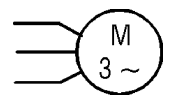
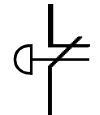
The Soft-Starter must be selected for a complete start cycle.

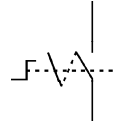
9

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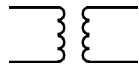
9.10 - SYMBOLS

	Electrical Connection between two signals
	Boundary Equipment
	Terminals for Connection
	Signal Shielding
	$A + B = C$
	Coil - relay, contactor
	Normally Open Contact (NO)
	Normally Closed Contact (NC)
	Indicator light
	Resistor
	Capacitor

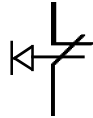
	Fuse
	Thyristor/SCR
	Potentiometer
	Bipolar Transistor
	Thermal Relay
	Three-Phase Reactor
	Diode
	Varistor (MOV)
	Operational Amplifier
	Optocoupler
	Three-Phase Motor
	Emergency button



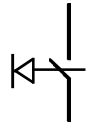
Reversible switch



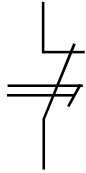
Transformer



Normally closed pushbutton



Normally open pushbutton



Delay time contact