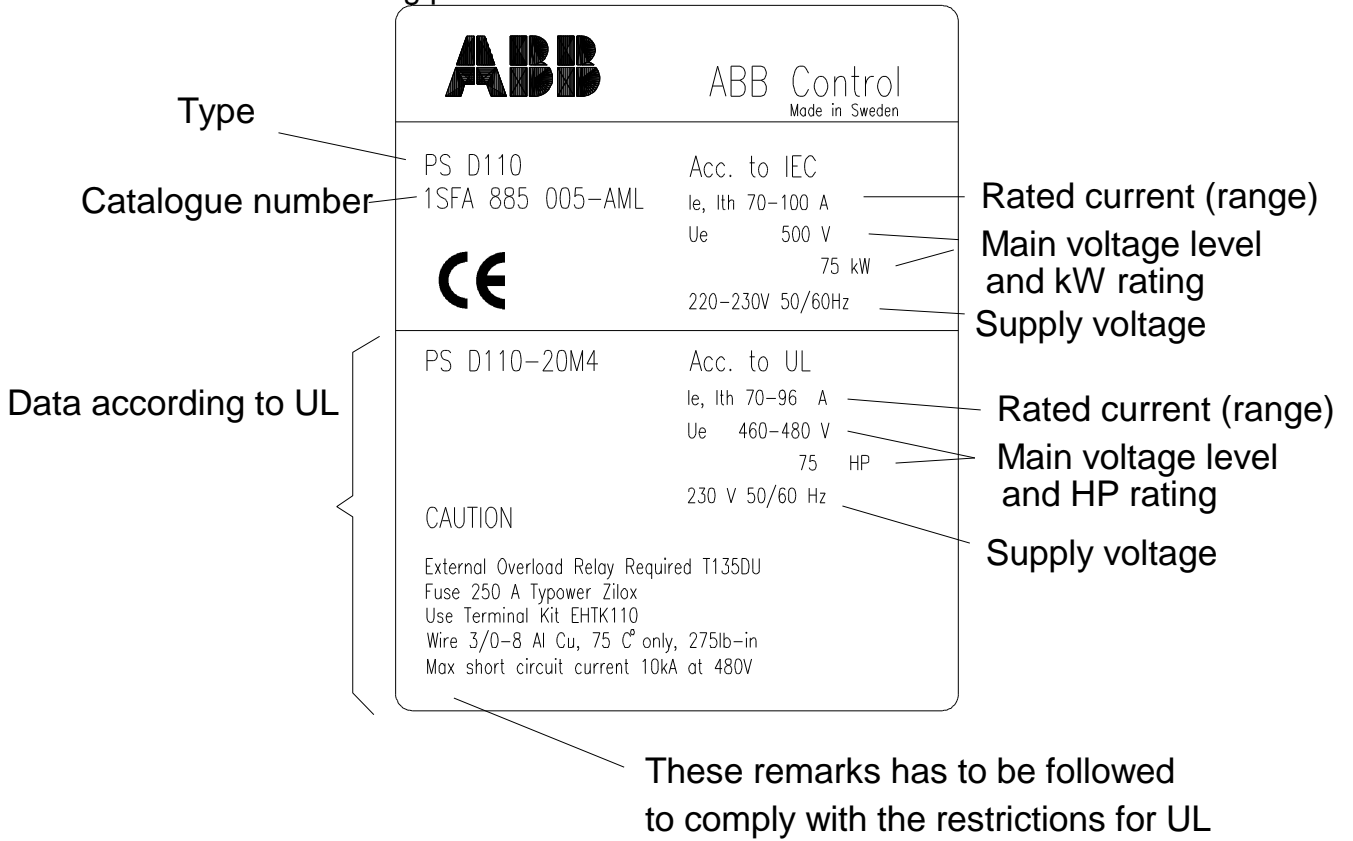


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The softstarter rated marking plate



1A. Brief instructions

(for installations that require CE-marking see chapter 1B)

PS D75 ... 840 and PS DH30 ... 720 with and without overload protection

Identify your softstarter by checking the rating plate. See enclosed information (page 2) how to read the marking plat. Then select the appropriate column.

		Softstart type <u>without</u> electronic overload	Softstart type <u>with</u> electronic overload
		PS D75 ... 840	PS D75 ... 840/ PS DH30 ... 720
Activity	Item	Instruction	Instruction
Mounting	Softstarter unit	Vertical mounting for adequate cooling	Vertical mounting for adequate cooling
	Semiconductor fuses	Not included Have to be ordered separately	Not included Have to be ordered separately
	Overload relay	Not included Use ABB type T.....DU acc. to the recommended data. See technical data in the catalogue 1SFC 18850-EN	Electronic O.L built in
Connections			
	Protective earth	Connect the earth cable	Connect the earth cable
	Main circuit	Connect supply side to terminals/ busbars 1, 3 and 5 Connect motor side to terminals/ busbars 2, 4, and 6	Connect supply side to terminals/ busbars 1, 3 and 5 Connect motor side to terminals/ busbars 2, 4, and 6
	Control circuit	Apply control voltage to terminals 1 and 2 on top of the softstarter. See page 5 Make sure that you have ordered correct control voltage. 220...240V or 110...127V. Can not be changed after delivery	Apply control voltage to terminals 1 and 2 on top of the softstarter. See page 7 Make sure that you have ordered correct control voltage. 220...240V or 110...127V. Can not be changed after delivery
	Start and stop	Connect the cables for start and stop signals to terminal 8 and 9. Connect also with a short wire terminals 7 and 10 (for PLC look at circuit diagram on page 30)	Connect the cables for start and stop signals to terminal 8 and 9. Connect also with a short wire terminals 7 and 10 (for PLC look at circuit diagram on page 30)
	Current limit	Delivered connected	Delivered connected
Settings	Potentiometers		
	I_r	Set to rated motor current See label on the Softstarters front.	Set to rated motor current. See label on the Softstarters front. This also sets the rated current for the electronic overload.
	ILIM	Set to actual need. Too low of a value, and the motor may not accelerate.	Set to actual need. To low of a value, and the motor is may not accelerate.
	UINI	30% standard value.	30% standard value.
	USD	Start with setting on 100%	Start with setting on 100%
	START	10s standard value	10s standard value
	STOP	20s standard value	20s standard value
Switches			
PF	Energy saving. (Yes or No).	Energy saving. (Yes or No).	
Kick	Voltage kick during start. (Yes or No)	Voltage kick during start. (Yes or No)	
SC	High current switch off. (Yes or No)	High current switch off. (Yes or No)	
TPF	Reaction time for energy saving function. Normal is standard. (Normal or slow)	Reaction time for energy saving function. Normal is standard. (Normal or slow)	

Ready for start

1B. Brief instructions for installations that require CE-marking

Mandatory requirement by the European Union (EU)

All electrical installations that are to be used within EU must comply with the requirements to all relevant EU Directives, including the EMC directive (89/336/EEC). The OEM, panelbuilder or installer/contractor is responsible for that the requirements are fulfilled, and verified as well as to give the equipment the CE mark.

In principle the EMC directive states that no apparatus, equipment or systems are allowed to disturb or be disturbed by surrounding apparatus, equipment or systems. In order to meet this requirement the product cannot exceed maximum emission levels nor be below minimum immunity levels

The required levels differs upon where the system or equipment is installed, if it is made in a industry (environment 1) or in a public low voltage network (environment 2). In the Industry higher levels of emissions are allowed. At the same time these installations require a higher grade of immunity compared to the installations in public network. If there is a doubt in how to classify the installation the local utility can be asked or the owners of the transformer.

How do you fulfil the requirements?

There are several methods to verify that a system meets the set requirements.

- One way is to use CE-marked equipment and to install these according to the installation manual that is provided by the manufacturer. No further testing or verification is then needed as the manufacturer already has done the necessary work. This is the way ABB has chosen in order to simplify the usage of softstarters for systems and in other equipment.

- A more complicated way is to use non CE-marked apparatus, and then to verify and test each system separately. The manufacturer of the system and/or the assembled equipment is then responsible for the verification.

The following guidelines are to simplify and ensure that all installations always fulfil the above mentioned requirements acc to the EMC and LVD requirement. There is then no need to separately verify the system or assembly.

ABB's solution for installation that require CE-mark

Installations of softstarters type PSD(H) in industrial network:

In softstarters PSD(H) thyristors and microprocessors are used that can cause emission during operation. This emission can be reduced by using a by-pass contactor, that ensures that the system fulfils the compatibility requirement. Another advantage by using a by--pass contactor is that the total powerloss is reduced, and thus it is not needed to have extra fans for cooling if the softstarter is enclosed.

• **By-pass contactor:** When a by-pass contactor is used the softstarter is by-passed at continues operation, The by-pass contactor is connected in parallel to the softstarter that is only active during start and stop of the motor. The operation is simplified if the built in signal relay K5 (top of ramp / TOR) is used to control the by-pass contactor. The by-pass contactor is automatically in operation after completed start and will remain so during continuous operation. The Softstarter can still be in active status but no current will pass through it, instead all current will pass through the by-pass contactor.

For connection of the by-pass contactor, please see section 2.

• **Function PF** (Energy saving at low motor load): Can not be activated during operation with a by-pass contactor included.

• **Earthing:** The Softstarter has to be connected to earth.

Installation of Softstarters type PSD(H) in public network:

In softstarters PSD(H) thyristors and microprocessors are used that can cause emission/disturbances during operation. In public network the requirements only allow for low emission levels. In order to fulfil this requirement some actions must be taken.

Mounted in any metal enclosure with a by-pass contactor and using screened cables outside the enclosure the system fulfils the compatibility requirement. Another advantage by using a by-pass contactor is that the total powerloss is reduced, and thus it is not needed to have extra fans for cooling.

Below you will find closer description of each action;

- **By-pass contactor:** When a by-pass contactor is used the softstarter is by-passed at continuous operation, The by-pass contactor is connected in parallel to the softstarter that is only active during start and stop of the motor. The operation is simplified if the built in signal relay K5 (top of ramp / TOR) is used to control the by-pass contactor. The by-pass contactor is automatically in operation after completed start and will remain so during continuous operation. The Softstarter can still be in active status but no current will pass through it, instead all current will pass through the by-pass contactor.

For connection of the by-pass contactor, please see section 2.

- **Function PF** (Energy saving at low motor load): can not be activated during operation with a by-pass contactor included.

- **Earthing:** The Softstarter has to be connected to earth.

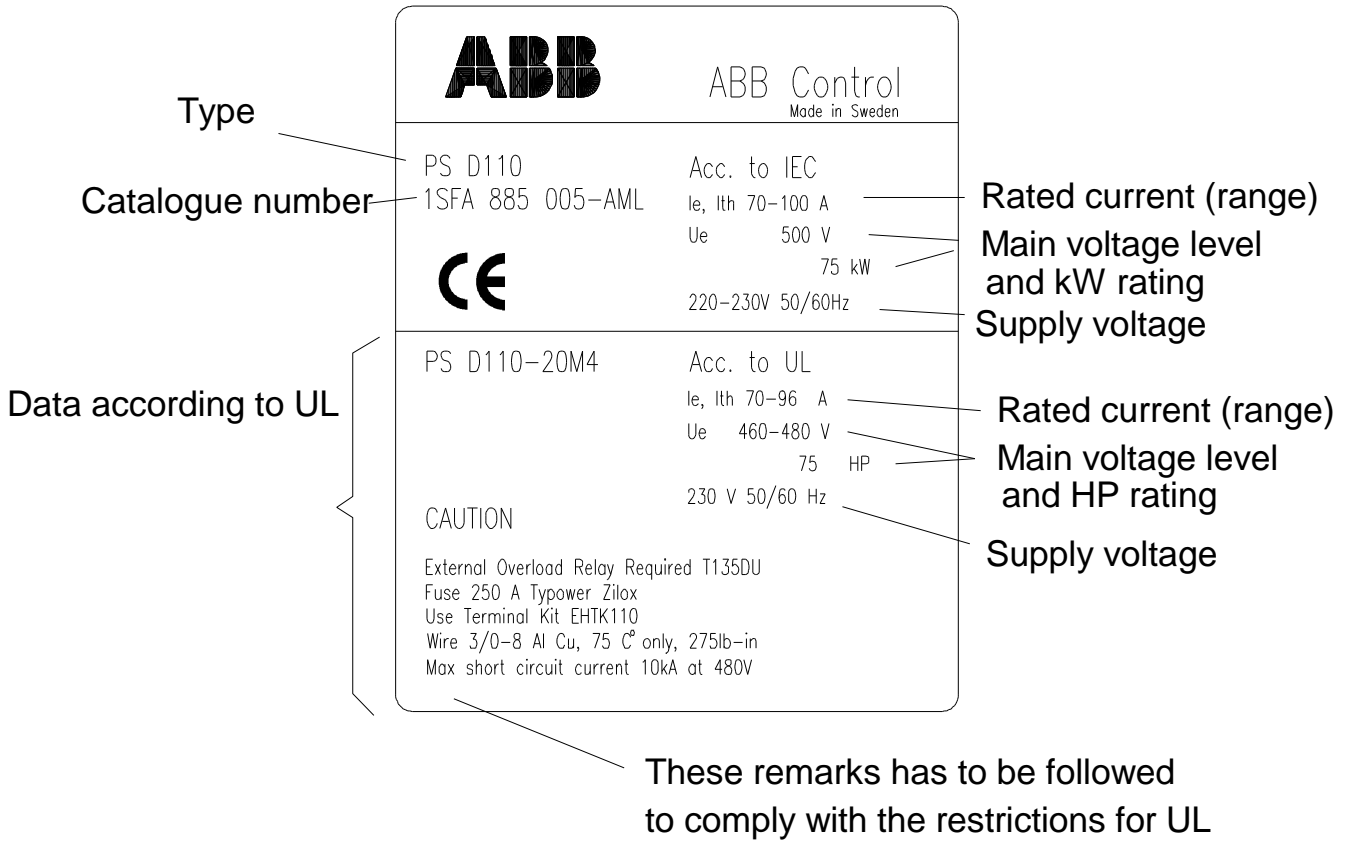
- **Enclosure:** Use any type of metal enclosure. Our recommendation is that you ensure that all details like door, box and assembly plate have a good earthing.

- **Cables:**

- Control cables** : Use so called pair twisted signal cable where the connections are to be made to the softstarter. This type of cable always has a screen that shall be connected to earth.

- Power cables:** Use a collectively (360°) screened / shielded power cable for feeding the motor, and when the softstarter is installed in a separate enclosure, also for the cable feeding the softstarter. Ensure that the screen is connected to earth. It is not necessary to use a special high frequency screened cable. Any type of conducting screen will do.

The softstarter rated marking plate



PS D75 ... 840 and PS DH30 ... 720 with and without overload protection

Identify your softstarter by checking the rating plate. See enclosed information (page 6) how to read the marking plate. Then select the appropriate column.

		Softstart type	Softstart type with Electronic O.L
		PS D75 ... 840	PS D75 ... 840/ PS DH30 ... 720
Activity	Item	Instruction	Instruction
Mounting	Softstarter unit	Vertical mounting for adequate cooling	Vertical mounting for adequate cooling
	Semiconductor fuses	Not included Have to be ordered separately	Not included Have to be ordered separately
	Overload relay	Not included Use ABB type T.....DU acc. to the recommended data. See technical data in the catalogue 1SFC 18850-EN	Electronic O.L built in. For PSD 175...840 and PSDH145...720 the cables for the CT's feeding the over load has long cables which makes it possible to mount them in the main circuit where they are connected also when running with bypass contactor.
Connections	To comply with the EMC directive, see also instructions above		
	Protective earth	Connect the earth cable	Connect the earth cable
	Main circuit	Connect supply side to terminals/ busbars 1, 3 and 5 Connect motor side to terminals/ busbars 2, 4, and 6	Connect supply side to terminals/ busbars 1, 3 and 5 Connect motor side to terminals/ busbars 2, 4, and 6
	Control circuit	Apply control voltage to terminals 1 and 2 on top of the softstarter. See page 5 Make sure that you have ordered correct control voltage. 220...240V or 110...127V. Can not be changed after delivery	Apply control voltage to terminals 1 and 2 on top of the softstarter. See page 7 Make sure that you have ordered correct control voltage. 220...240V or 110...127V. Can not be changed after delivery
	Start and stop	Connect the cables for start and stop signals to terminal 8 and 9. Connect also with a short wire terminals 7 and 10 (for PLC look at circuit diagram on page 30)	Connect the cables for start and stop signals to terminal 8 and 9. Connect also with a short wire terminals 7 and 10 (for PLC look at circuit diagram on page 30)
	Current limit	Delivered connected	Delivered connected
Settings	Potentiometers		
	I_r	Set to rated motor current See label on the Softstarters front.	Set to rated motor current. See label on the Softstarters front. This also sets the rated current for the electronic overload.
	ILIM	Set to actual need. Too low of a value, and the motor may not accelerate.	Set to actual need. To low of a value, and the motor is may not accelerate.
	UINI	30% standard value.	30% standard value.
	USD	Start with setting on 100%	Start with setting on 100%
	START	10s standard value	10s standard value
	STOP	20s standard value	20s standard value
Switches			
PF	Energy saving. (Yes or No). Has to be switched off to comply with EMC directive, see instructions above	Energy saving. (Yes or No). Has to be switched off to comply with EMC directive, see instructions above	
Kick	Voltage kick during start. (Yes or No)	Voltage kick during start. (Yes or No)	
SC	High current switch off. (Yes or No)	High current switch off. (Yes or No)	
TPF	Reaction time for energy saving function. Normal is standard. (Normal or slow)	Reaction time for energy saving function. Normal is standard. (Normal or slow)	

Ready for start

2. Mounting

Softstarter unit:

The softstarter must be mounted so that the cooling air passes vertically over the heat sink. It must also be placed so that the cooling capacity is not decreased due to pollution or similar.

Open type softstarters are to be mounted in a cubicle or other enclosure. Hole configuration according to information given on the dimension prints.

For installations there is a need to ventilate the enclosure

When a "sealed" enclosure is requested and when not using a by-pass contactor, the size must be such that the heat generated by the thyristors can be carried off from the enclosure surface without the enclosure's inside temperature becoming too high.

Ventilated enclosures can be considerably smaller. The size depends entirely on the ventilation and must be determined for each individual case.

Type	Rittal type	B	H	P	Air flow capac. fan 2)
PS D75...145	AE1376	600	760	350	105m ³ /h/90CFM
PS DH30...110	AE1376	600	760	350	105m ³ /h/90CFM
PS D175...300	AK1648	800	1200	400	285m ³ /h/105CFM
PS DH145...250	AK1648	800	1200	400	285m ³ /h/105CFM
PS D370...570	PS4804	800	2000	400	285m ³ /h/105CFM
PS DH300...470	PS4804	800	2000	400	285m ³ /h/105CFM
PS D720...840	PS4804	800	2000	400	570m ³ /h/270CFM
PS DH570...720	PS4804	800	2000	400	570m ³ /h/270CFM

The ambient temperature outside the softstarter must not exceed 50°C.

The losses generated in a softstarter, at rated operational current, are given in the technical data, see section 7.

Semiconductor fuses

The semiconductor fuses are not delivered built in the starter unit.

Use the recommended fuses given in the technical data. The combination fuse size and softstarter allows the maximum use of starting time and current given for each softstarter without tripping.

Two alternatives are listed; Bussmann and Ferraz. See technical data, section 7.

Overload relays

The PS D version is possible to buy without built-in electronic overload relay. For this version we recommend you to use the ABB T...DU relays. This relay will protect both the motor and the softstarter from over-heating during start and continuous run.

Recommended relay, see technical data, section 7.

By-pass


By-pass contactors are not delivered built in the softstarter unit. We recommend you to use the ABB type contactors. The by-pass contactor can be selected according to data for AC-1, using the rated motor current used, if the making and breaking capacity is higher than locked rotor current for the used motor, if it is a maincontactor selected according to data for AC-3. The signal relay T.O.R (K5) built in the softstarter can be used to operate the by-pass contactor. The contactor will then be closed during continuous run and no current will pass through the softstarter even if the softstarter is still running. When stopping the softstarter, the by-pass contactor will open and the softstarter takes over and makes a soft stop. See diagram for connections in chapter 3.

When using a by-pass contactor bigger than EH300 we recommend to use a relay contactor between the signal relay K5 and the coil of the by-pass contactor.

3. Installation

3.1 PS D75 ... 840 without built-in electronic overload protection.

Protective earth

Connect the protective earth at terminal marked 

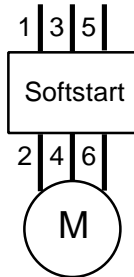
The terminal is placed on the right hand side on smaller units and directly on the mounting plate for medium and larger sizes.

Main circuits

The supply side of the softstarter has terminals marked 1, 3, 5.

The motor side is marked 2, 4, 6.

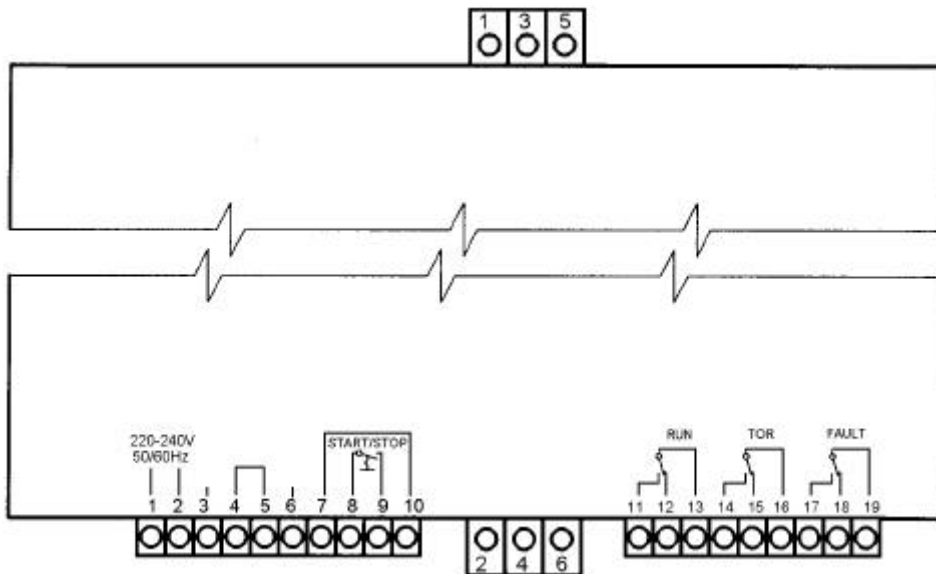
Note: Softstart PS D is not phase sequence sensitive.



Control circuit

Apply control voltage at terminals marked 1 and 2. See below, "Power Supply"
Make sure that the ordered version corresponds to your rated voltage.

It is not possible to change the control voltage of the softstarter.



Power supply

110-127V, 50-60 Hz Connect terminals no. 3 with no. 4 and no. 5 with no. 6
Supply at terminals no. 1 and no. 2

220-240V, 50-60 Hz Connect terminal no. 4 with no. 5
Supply at terminals no. 1 and no. 2

Start/Stop signal: 24V, 10mA differential optocoupler input

Alt. 1. Internal supply (e.g.. push-button, relay); Connect terminal no. 7 with no. 10 and connect the push-button or relay between terminals no. 8 and no. 9.

Alt. 2. External supply (e.g.. +24V from PLC); Connect the external 0V to terminal no. 10 and connect the control signal to terminal no. 9.

Note: No link between 7 and 10.

Relay outputs

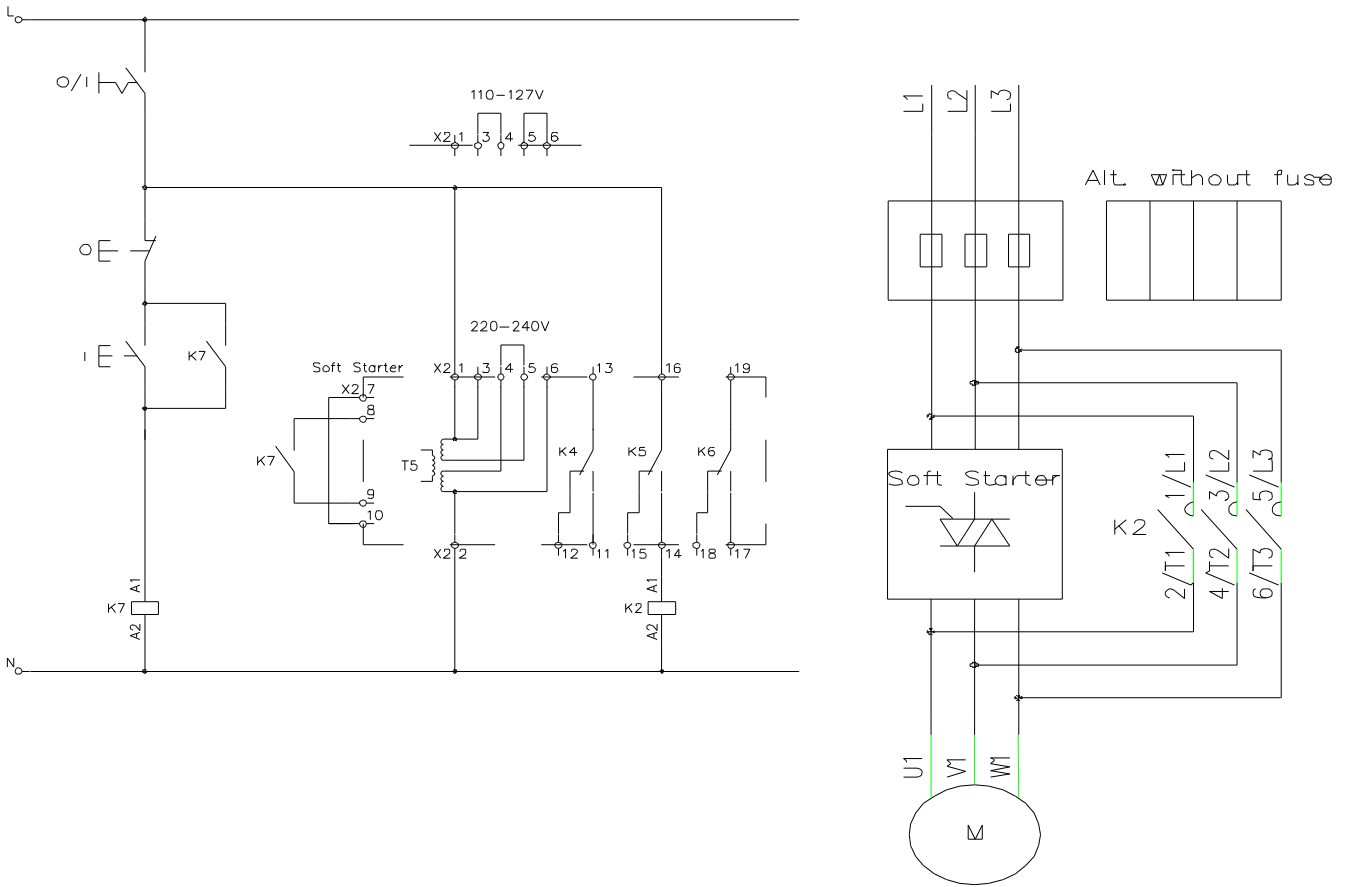
Switch over contacts for Run, TOR and Fault (terminals no. 11 - 19).

If the softstarter shall be by-passed the "TOR" signal shall be used for this purpose.

When using a by-pass contactor

The PF switch has to be switched off.


Circuit diagram when using a by-pass contactor operated via the built in signal relay K5 (T.O.R)



3.2 PS D75 ... 840 / PS DH30 ... 720 with built-in electronic overload protection.

To comply with the EMC-directive 89 / 336 / EEC see instructions on page 3:

Protective earth

Connect the protective earth at terminal marked 

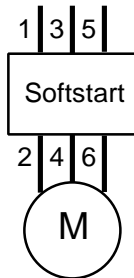
The terminal is placed on the right hand side on smaller units and directly on the mounting plate for medium larger sizes.

Main circuits

The supply side of the softstarter have terminals marked 1, 3, 5.

The motor side is marked 2, 4, 6.

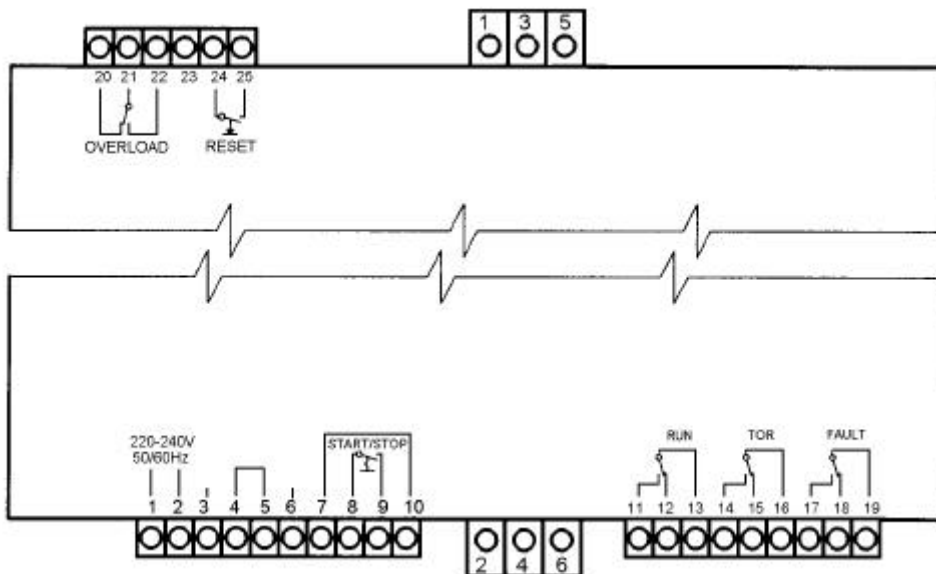
Note: Softstart PS D and PS DH is not phase sequence sensitive.



Control circuit

Apply control voltage at terminals marked 1 and 2. See below, "Power Supply"

Make sure that the ordered version correspond to your rated voltage. It is not possible to change the control voltage of the softstarter.



Power supply

110-127V, 50-60 Hz Connect terminals no. 3 with no. 4 and no. 5 with no. 6
Supply at terminals no. 1 and no. 2

220-240V, 50-60 Hz Connect terminal no. 4 with no. 5
Supply at terminals no. 1 and no. 2

Start/Stop signal (24V, 10mA differential optocoupler input)

Alt. 1. Internal supply (e.g.. push-button, relay); Connect terminal no. 7 with no. 10 and connect the push-button or relay between terminals no. 8 and no. 9.

Alt. 2. External supply (e.g.. +24V from PLC); Connect the external 0V to terminal no. 10 and connect the control signal to terminal no. 9.

Note: No link between 7 and 10.

External reset signal (24V, 20mA optocoupler input.)

Connect a switch between terminals no. 24 and no. 25.

Relay outputs

Switch over contacts for Run, TOR, Fault and Overload (terminals no. 11 - 22).

If the softstarter shall be by-passed the signal "TOR" shall be used for this purpose.

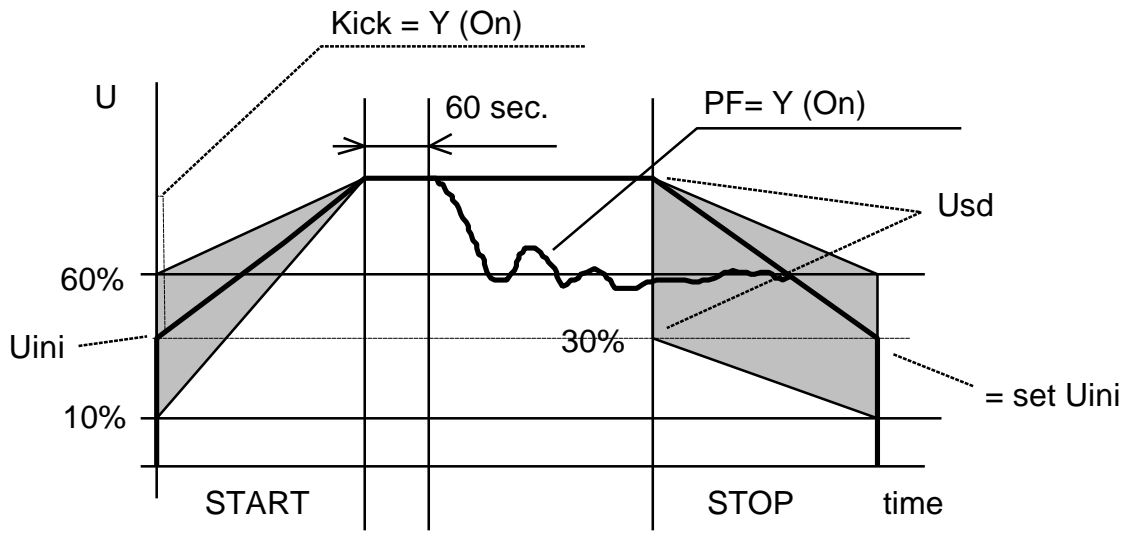
NOTE. If the softstarter is by-passed during continues running, a separate overload relay must be used for PS D75...145 and PS DH30...110. For the other the current transformers can be moved outside the by-pass circuit.

4. Description, settings, signals

General

PS D75 ... 840 are made for normal starting conditions for starting pumps, short conveyor belts, compressors, etc. It is possible to buy this version with a built-in electronic overload with tripping class 10. See technical data for starting capacity.

PS DH30 ... 720 have higher starting capacity allowing longer starting times for starting up big fans crushers, mills, etc. This versions have always a built-in electronic overload with tripping class 30. See technical data for starting capacity.



Rated Current

Selection of the motors rated current can be done from 70 - 100% of the softstarters rated current.
This will also set the tripping level for the electronic overload when enclosed.

Knob = I_r

Soft Start

Separately adjustable linear ramp with adjustable initial voltage.

Time: Adjustable from 0.5 - 60 sec.

Knob = START

Initial voltage Adjustable from 10 - 60 % of full voltage.

Knob = U_{INI}

(If the current limit will always override the initial voltage)

Kick start 90 % of full voltage during 0.5 sec, selectable yes/no

Switch = Kick

Soft Stop

Separately adjustable linear ramp with adjustable step-down voltage.

End voltage = Initial voltage (U_{INI}).

Time: Adjustable from 0 till 4 min (240 sec)

Knob = STOP

Step-down Adjustable from 30 - 100 % of full voltage.

Knob = U_{SD}

Current Limit

Adjustable from 200 - 500% of the motors rated current

Knob = I_{LIM}

The current limit is active during the start ramp.

Energy Saving

To comply with the EMC-directive 89 / 336 / EEC see instructions on page 3

Switch = PF

Selectable yes/no, it is activated 60 sec after the start ramps end.

High Current Switch Off

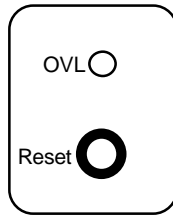
Selectable yes/no, if the current limit is overridden during more than 200 ms after "top of ramp", the softstarter turns off. Reset via a stop signal.

Switch = SC

Time constant of energy saving function

Selectable time constant, normal/slow.

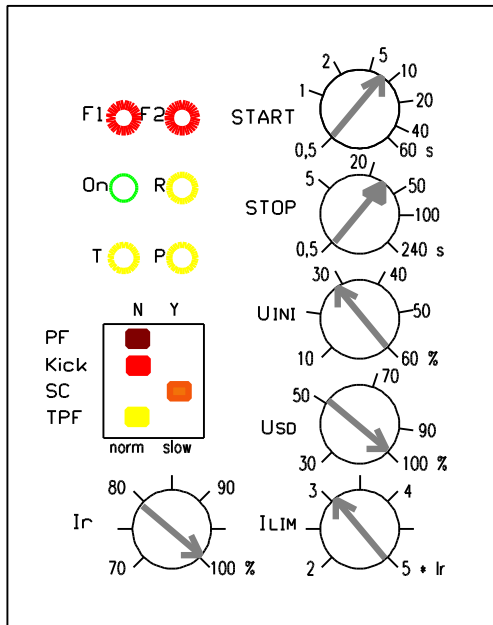
Switch = TPF



Signal lamps indicating
OVL Overload

Buttons-
Reset Reset button for overload

Settings
 I_r The rated motor current is set via potentiometer I_r



Signal lamps indicating
F1 Fault
F2 Fault
On Supply voltage
R Running
T Completed start ramp
P Active energy saving function

Potentiometers for setting -
START Ramp time during start
STOP Ramp time during stop
UINI Initial voltage
USD Step down voltage
ILIM Current limit at start
 I_r Rated current of motor in % of I_e

Switches for selection of -
PF Energy saving function, Yes/No
Kick Kick start, Yes/No
SC High current switch-off, Yes/No
TPF Reaction time for energy saving function, Normal/Slow

4.1 PS D75.. 840 without built-in electronic overload protection

LED's

F1: (red)	Fault signal for Phase loss, Thyristor fault, High current switch off.
F2: (red)	Fault signal for Over temperature, Fault on circuit board, Thyristor fault
On: (green)	Supply voltage. Illuminates when softstarter has control power.
R: (yellow)	Motor is running. Illuminates when the motor is energised from the softstarter.
T: (yellow)	Top of ramp. Start ramp is finished and stop ramp hasn't begun.
P: (yellow)	Energy saving is active

Fault codes

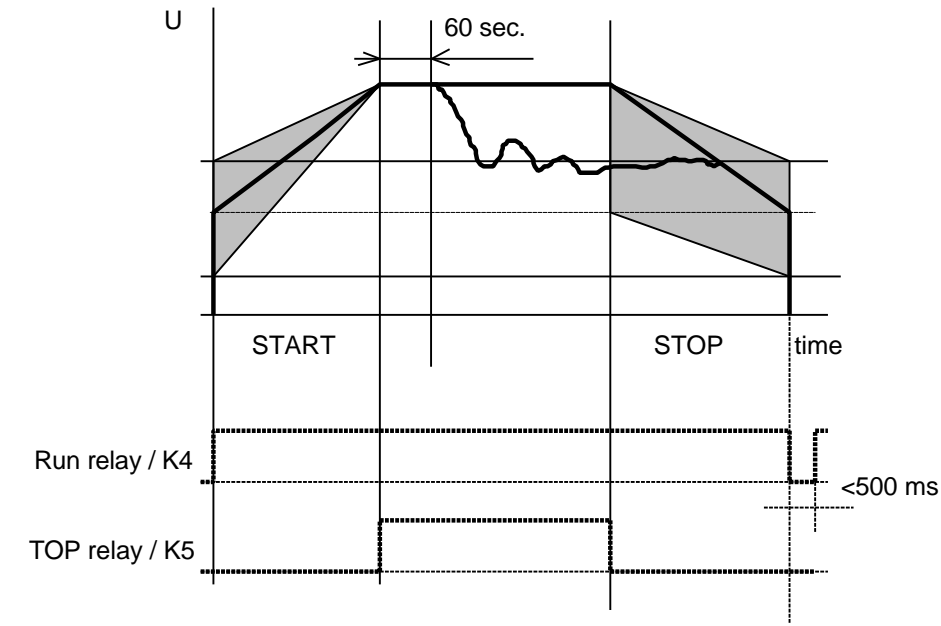
F1	Phase loss, High current switch off.
F2	Over temperature, Fault on circuit board,
F1 + F2	Thyristor fault (short circuit or open circuit)

Relay Signals

Run / K4	Motor is running. The motor is energised from the softstarter
TOR / K5	Top of ramp. Start ramp is finished and stop ramp hasn't begun. Can be used as a bypass signal.
Fault / K6	Phase loss, Thyristor fault, Over temperature, High current switch off, Fault on circuit board,

Input

Start/Stop	Start when closed, stop when open, 24V, 20mA optocoupler differential input. +24V and 0V can be supplied from the board if no external supply is used.
------------	--



4.2 PS D75 .. .840 / PS DH30 ... 720 with built-in electronic overload protection

LED's

F1: (red)	Fault signal for Phase loss, Thyristor fault.
F2: (red)	Fault signal for Over temperature, Fault on circuit board, Thyristor fault, High current switch off
On: (green)	Supply voltage. Illuminates when softstarter has control power.
R: (yellow)	Motor is running. Illuminates when the motor is energised from the softstarter
T: (yellow)	Top of ramp. Start ramp is finished and stop ramp hasn't begun.
P: (yellow)	Energy saving is active
OVL: (yellow)	Overload

Fault codes

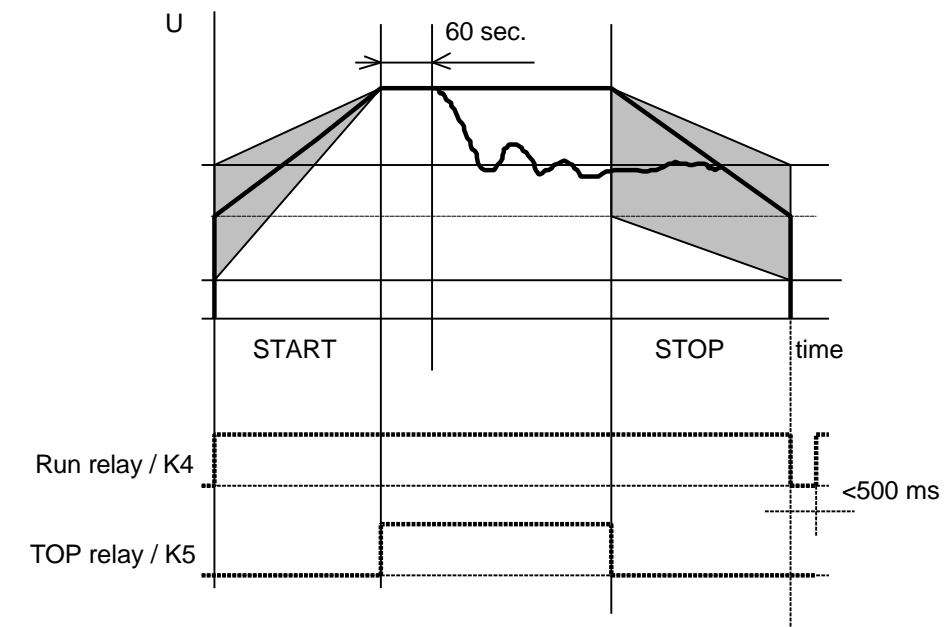
F1	Phase loss.
F2	Over temperature, Fault on circuit board, High current switch off
F1 + F2	Thyristor fault (short circuit or open circuit)
OVL	Overload

Relay Signals

Run / K4	Motor is running. The motor is energised from the softstarter
TOR / K5	Top of ramp. Start ramp is finished and stop ramp hasn't begun. Can be used as a by-pass signal.
Fault / K6	Phase loss, Thyristor fault, Over temperature, High current switch off, Fault on circuit board,
OVL / K3	Over load

Input

Start/Stop	Start when closed, stop when open, 24V, 20mA optocoupler differential input. +24V and 0V can be supplied from the board if no external supply is used.
Reset	Reset of overload and short circuit detection. 24V, 20mA optocoupler input.



5. Operation and function

5.1 PS D75 ... 840 without built-in electronic overload protection

Power on

When the softstarter is supplied with power the green LED "On" is illuminated and the board executes a self check routine. If there are faults, the LED's "F1" and "F2" indicate these.

Start

When the start/stop input is supplied with 24V (switch is closed) the soft start routine is executed and an increasing linear time-voltage ramp is applied to the motor,

Start voltage is selectable while the end voltage is always full voltage.

LED "R" and relay "Run" will indicate that a start has begun.

LED "T" and relay "TOR" will indicate that the start ramp has finished.

A 0,25 sec. pulse with voltage up to the current limit setting is applied to the motor at the beginning of the ramp if the switch 'kick' is in position "YES".

A soft start can be done with a shorted thyristor if the switch "PF" is in position "No" (LED's F1 and F2 will be illuminated, and relay "Fault" will be activated).

Stop

When the start signal is removed from the start/stop input the soft stop routine is executed and a decreasing linear time-voltage ramp is applied to the motor. Start and stop voltages are selectable (end voltage = initial voltage for start ramp).

LED "T" and relay "TOR" are switched off when the stop begins.

LED "R" and relay "RUN" are switched off when the stop ramp is finished

Current limit

(Start sequence) If the motor current reaches the level of the current limit, no higher voltage is applied to the motor unless the current decreases below the limit.

During a start sequence the softstarter can't limit the current for more than 240 sec.

When the start routine is finished (ramp time + max. 240 sec) the following will occur if the current hasn't decreased below the limit.

1. Switch "SC" is in position Yes:

The softstarter turns off

2. Switch "SC" is in position No:

Full voltage is applied to the motor

Energy saving

If the function is selected (switch "PF") a power factor optimisation commences 60 sec after the start-ramps end, this is indicated with the LED "P".

If a slower reaction on decreased load is requested, the switch "TPF" shall be put at position "slow".

To comply with the EMC-directive 89 / 336 / EEC see instructions on page 3

High current switch off

If the current limit is overridden for more than 200 ms after "top of ramp", the softstarter turns off.

Reset via a stop signal.

The function is selectable with switch "SC", yes/no

Note: This is not complete short circuit protection, normal fuses for protecting the equipment from short circuit are always required.

Over temperature

If the heat sink becomes overheated a temperature sensor will turn off the softstarter.

Reset via a stop signal.

Thyristor fault

If a thyristor is damaged (short circuit or open circuit) the softstarter will indicate this.

If a thyristor is shorted a start can be accomplished if the energy saving function is not selected.

Phase loss

If one or more of the phases are missing when a start signal is applied, the softstarter will turn off and indicate a fault. Reset via a stop signal.

5.2 PS D75 ... 840 / PS DH30 ... 720 with built-in electronic overload protection

Power on

When the softstarter is supplied with power the green LED "On" is illuminated and the board executes a self check routine. If there are faults, the LED's "F1" and "F2" indicate these.

Start

When the start/stop input is supplied with 24V (switch is closed) the soft start routine is executed and an increasing linear time-voltage ramp is applied to the motor, Start voltage is selectable while the end voltage is always full voltage.

LED "R" and relay "Run" will indicate that a start has begun.

LED "T" and relay "TOR" will indicate that the start ramp has finished.

A 0,25 sec. pulse with voltage up to the current limit setting is applied to the motor at the beginning of the ramp if the switch 'kick' is in position "YES".

A soft start can be done with a shorted thyristor if the switch "PF" is in position "No" (LED's F1 and F2 will be illuminated, and relay "Fault" will be activated).

Stop

When the start signal is removed from the start/stop input the soft stop routine is executed and a decreasing linear time-voltage ramp is applied to the motor. Start and stop voltages are selectable (end voltage = initial voltage for start ramp).

LED "T" and relay "TOR" are switched off when the stop begins.

LED "R" and relay "RUN" are switched off when the stop ramp is finished

Current limit

(Start sequence) If the motor current reaches the level of the current limit, no higher voltage is applied to the motor unless the current decreases below the limit.

During a start sequence the softstarter can't limit the current for more than 240 sec.

When the start routine is finished (ramp time + max. 240 sec) the following will occur if the current hasn't decreased below the limit.

1. Switch "SC" is in position Yes: The softstarter turns off
2. Switch "SC" is in position No: Full voltage is applied to the motor

Energy saving

If the function is selected (switch "PF") a power factor optimisation commences 60 sec after the start-ramps end, this is indicated with the LED "P".

If a slower reaction on decreased load is requested, the switch "TPF" shall be put at position "slow".

To comply with the EMC-directive 89 / 336 / EEC see instructions on page 3

High current switch off

If the current limit is overridden for more than 200 ms after "top of ramp", the softstarter turns off.

Reset via a stop signal. The function is selectable with switch "SC", yes/no

Note: This is not complete short circuit protection, normal fuses for protecting the equipment from short circuit are always required.

Over temperature

If the heat sink becomes overheated a temperature sensor will turn off the softstarter.

Reset via a stop signal.

Thyristor fault

If a thyristor is damaged (short circuit or open circuit) the softstarter will indicate this.

If a thyristor is shorted a start can be accomplished if the energy saving function is not selected.

Phase loss

If one or more of the phases are missing when a start signal is applied, the softstarter will turn off and indicate a fault. Reset via a stop signal.

Overload protection

The built in electronic overload function protects the motor and the softstarter from damage due to overload. When an overload situation occurs the softstarter stops immediately and indicates this with the LED OVL and relay K3. After a certain delay (cooling time) the softstarter can be reset and a new start can be tried. Reset is done with the push-button on the softstarter or by a short-circuit between terminals no. 24 and no. 25. The start signal must always be opened before a reset can be accomplished (security).

High over current detection

1. $\geq 8 \times I_e$. If the RMS value calculated during 50ms is higher than this value the softstarter turns off immediately.

2. Level of current limit. If the switch SC is Y (On) and the RMS value calculated during 200ms is higher than this value (after top of ramp) the softstarter turns off immediately.

Note: This is not complete short circuit protection, it only protects the thyristors from some critical situations, normal fuses for protecting the equipment from short circuit are always required.

6. Trouble shooting

6.1 PS D without electronic overload protection

6.1.1 Different status on LED's and signal relays

- LED on ■ Signal relay energised
 ○ LED off □ Signal relay not activated

See next page	LED's		Signal relays			
			Run	TOR	Fault	
I	F1 ○ On ○ T ○	F2 ○ R ○ P ○	□	□	□	No control voltage on terminal 1 and 2
II	F1 ○ On ● T ○	F2 ○ R ○ P ○	□	□	□	Control voltage supplied Ready for start
III	F1 ○ On ● T ○	F2 ○ R ● P ○	■	□	□	a) Control voltage supplied and start signal is given. b) Control voltage supplied and making ramp down during stop
IV	F1 ○ On ● T ●	F2 ○ R ● P ○	■	■	□	Normal continuous run. 100% voltage to the motor By-pass signal relay energised
V	F1 ○ On ● T ●	F2 ○ R ● P ●	■	■	□	Normal continuous run. 100% voltage to the motor By-pass signal relay energised Power factor optimising (energy saving) activated (Switch PF in position-Y,(On))
VI	F1 ● On ● T ○	F2 ○ R ○ P ○	□	□	■	Control voltage supplied and start signal is given. Fault F1 (See also fault code tables and flow diagram) a) Phase loss b) Switched off by the function "High current switch off" The switch SC has to be in Y-position (On) Reset Via stop signal
VII	F1 ○ On ● T ○	F2 ● R ○ P ○	□	□	■	Control voltage supplied. Fault F2 (See also fault code tables and flow diagram) a) Over temperature on heat sink b) Internal fault PCB Reset Via stop signal
VIII	F1 ● On ● T ○	F2 ● R ○ P ○	□	□	■	Control voltage supplied. Fault F1+F2 (See also fault code tables and flow diagram) a) Shorted thyristor b) Semiconductor not conducting
IX	F1 ● On ● T ●	F2 ● R ● P ○	■	■	■	Continuous run with shorted thyristor (Switch PF must be in N-position, Off)

The motor does not start

Check the status on LED's and signal relays and read the explanation below.

See 6.1.1 for PS D without electronic overload protection and

See 6.2.1 for PS D(H) with electronic overload protection.

Status signals

I

No control voltage

- Check voltage on terminals 1 and 2.
 - Correct voltage level according to the rating plate?
 - Are the cooling fans running? (not PS DH30)
 - If everything is OK - Internal fault on the PCB
-

II

No starting signal present

- Check the circuit for start signal.
 - a Connection between 7 and 10 present.
Start signal present, closed circuit between terminal 8 and 9
 - b PLC-connection
Connected +24 DC to terminal 9 and
-(OV) connected to terminal 10
-

VI (See also the fault codes and flow chart)

Alt. a)

Phase loss

- The main circuit contactor is not closing or closes to late. It must be closed within 100ms after start signal
- One or more phases missing due to tripped fuse

Alt. b)

High current switch off (The switch SC must have been in position Yes, otherwise no tripping due to overcurrent)

- The main circuit contactor is not closing or closes to late. It must be closed within 100ms after start signal
 - One or more phases missing due to tripped fuse
-

VII (See also the fault codes and flow chart)

Over temperature

- Check to make sure the cooling fans are working.
 - Clean the heat sink if it is dirty
 - Check the temperature monitor under the front cover.
Short circuit between terminals X3 1, 2.
If LED F2 is off, then change the temperature monitor.
-

VIII (See also the fault codes and flow chart)

Alt. a)

Shorted thyristor

- The motor can start with shorted thyristor when switch PF is in N (Off) position.
Then the status will be IX.
Change the faulty thyristor at the next maintenance shutdown.

Alt. b)

One of the thyristors is not working / Open circuit between motor and starter

Too small motor in the circuit (too low current for the thyristors).

- Check the gate wiring under the front cover
 - Change thyristor.
-

X (See also the fault codes and flow chart)

Tripped electronic overload (only for PS D and PS DH with electronic over load)

- There is an overload (too high load) on the motor shaft.
- It can also be too long starting time.

Check if the current limit is set to a low value.

If the value is set too low there is not enough torque for the start.

PS: It's not possible to reset the over load if the start signal is present.

6.1.2 Fault codes

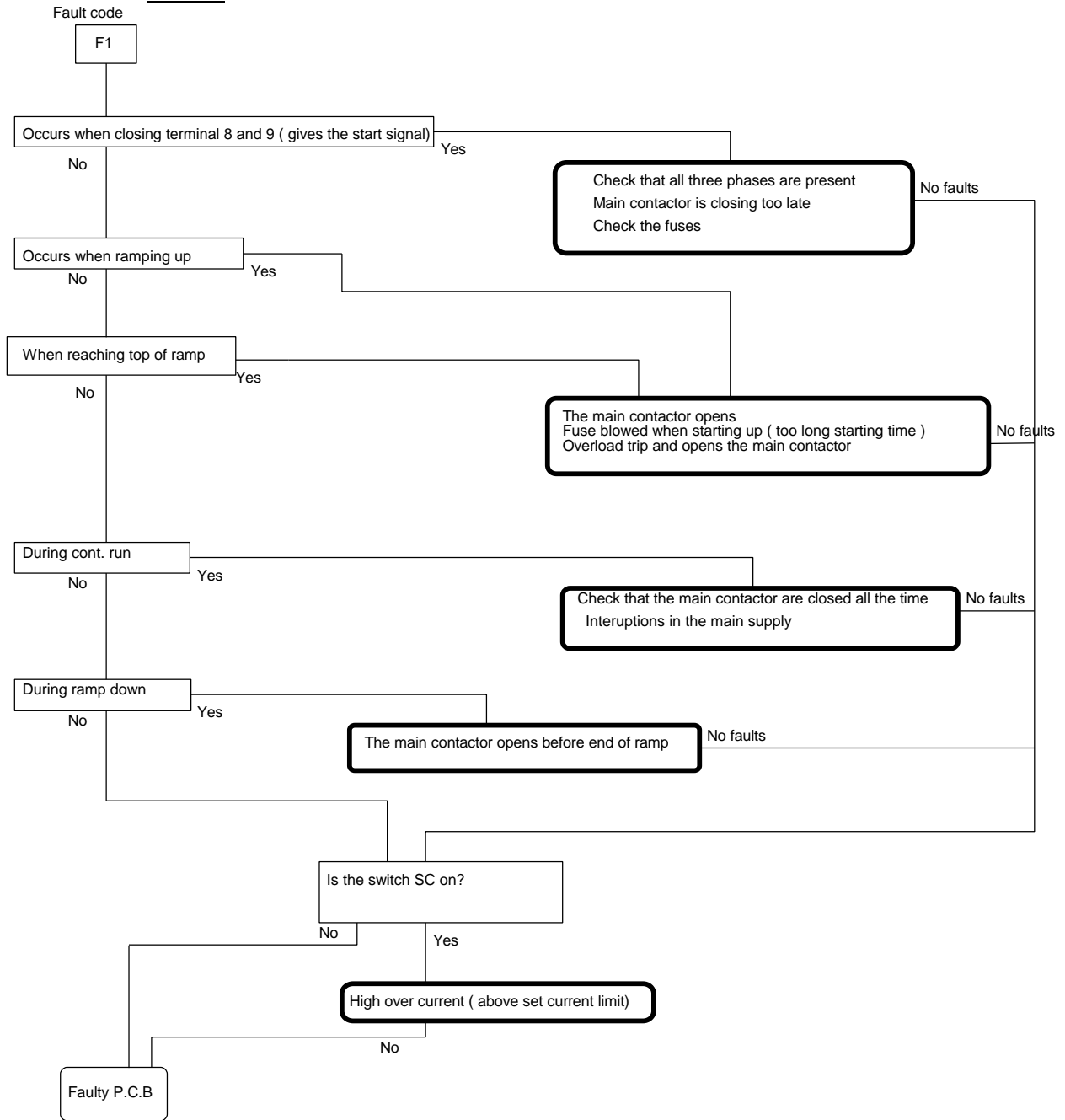
Softstarter without O.L card mounted

Softstarter mode			Shorted thyr.	High current (SC)	High curr. (50ms)	Signal fault OL	Nom conducting thyristor	Over temp	Open circuit 2) 1 phase missing	Open circuit 2) >=2 phase missing	Over load
Without energy saving PF=No	Stand by	-	-	-	-	-	-	X	-	-	-
	After start signal a)	X	1)	-	-	-	X	X	X	3)	-
	Ramp up	X	-	-	-	-	X	X	X	-	-
	Normal run	X	-	X	-	-	X	X	X	-	-
	Stopping	X	-	X	-	-	X	X	X	-	-
With energy saving PF=Yes	Stand by	-	-	-	-	-	-	X	-	-	-
	After start signal a)	X	X	-	-	-	X	X	X	X	-
	Ramp up	X	X	-	-	-	X	X	X	X	-
	Dwell	X	X ⁴⁾	X	-	-	X ⁴⁾	X	X ⁴⁾	X ⁴⁾	-
	Optimise	X	X ⁴⁾	X	-	-	X ⁴⁾	X	X ⁴⁾	X ⁴⁾	-
	Stopping	X	X	X	-	-	X	X	X	X	-
Signal code		F1	F1+F2	F1 when selected	-	-	F1+F2	F2	F1+F2	F1+F2	-

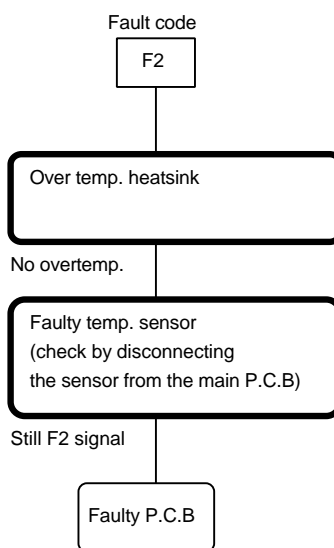
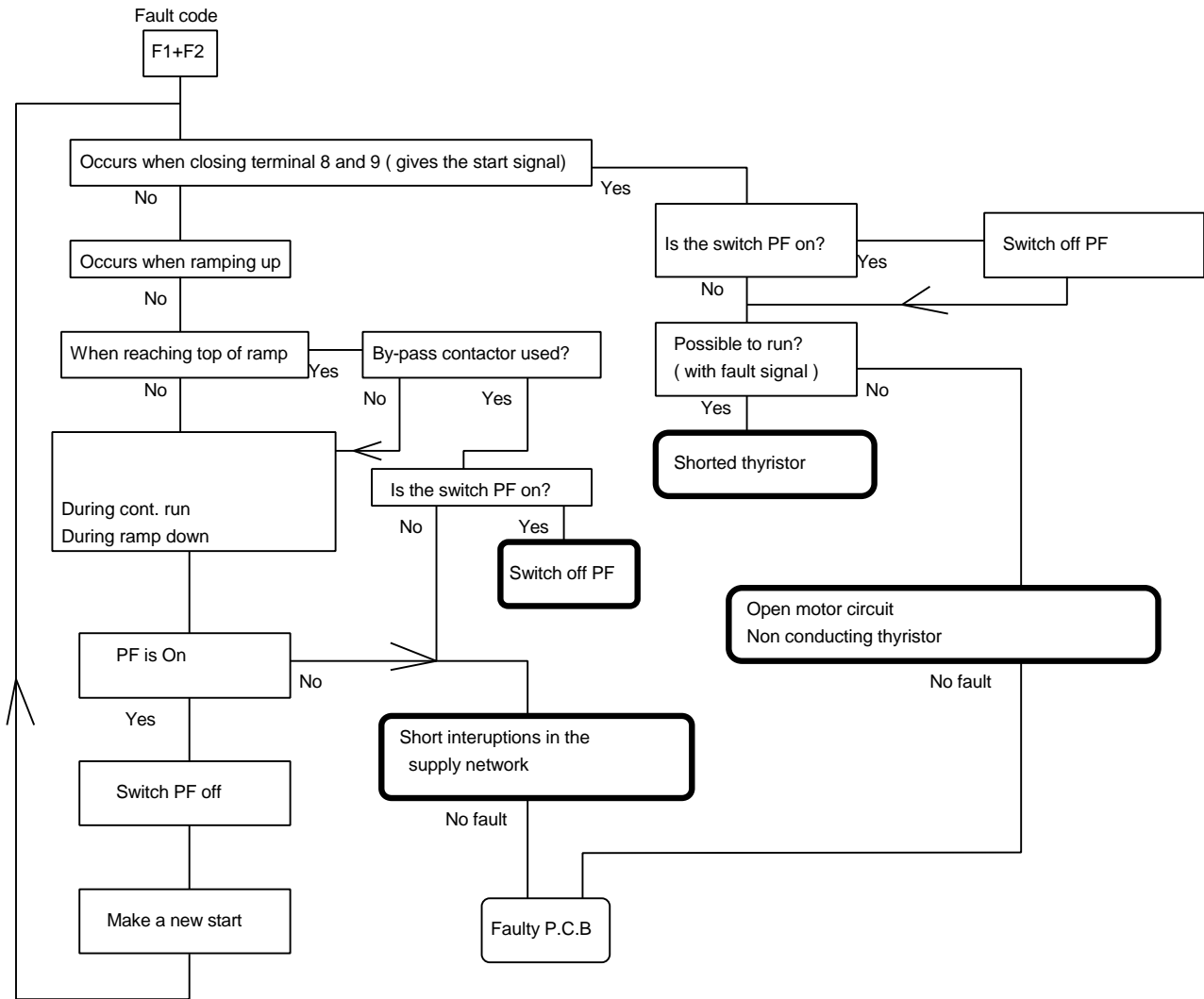
- 1) Detecting the fault and gives a fault signal but the softstarter is able to run.
- 2) Open circuit means open circuit between softstarter and motor
- 3) Associated with an open circuit on the motor side with 2 or more phases missing. Although the fault is detected if the fault was present when the start signal was activated the system will not trip, i. e it is just an indication.
- 4) The F1+F2 fault signals are delayed when running with the function PF in position YES under 60 sec. from TOR is activated to PF have been activated. The fault have to be present longer then 5 sec. before tripping. During this 5 sec the LED F1 flashes. Then the LED F2 flashes for another 5 sec. If the fault remains or occur during these last five sec. it will trip with a F1+F2 signal. If no fault, it will go back to normal run.
- a) When the fault is present before the start signal is given (closing between 8 and 9).

6.1.3 Flow chart

Version PS D without a built in electronic overload



Version PS D without a built in electronic overload



6.2 PS D(H) with electronic overload protection

6.2.1 Different status on LED's and signal relays

- LED on ■ Signal relay energised
 ○ LED off □ Signal relay not activated

See next page	LED's		Signal relays				
			Run	TOR	Fault	Over load	
I	OVL ○						No control voltage on terminal 1 and 2
	F1 ○	F2 ○					
	On ○	R ○	□	□	□	□	
	T ○	P ○					
II	OVL ○						Control voltage supplied Ready for start
	F1 ○	F2 ○					
	On ●	R ○	□	□	□	□	
	T ○	P ○					
III	OVL ○						a) Control voltage supplied and start signal is given. b) Control voltage supplied and making ramp down during stop
	F1 ○	F2 ○					
	On ●	R ●	■	□	□	□	
	T ○	P ○					
IV	OVL ○						Normal continuous run. 100% voltage to the motor By-pass signal relay energised
	F1 ○	F2 ○					
	On ●	R ●	■	■	□	□	
	T ●	P ○					
V	OVL ○						Normal continuous run. 100% voltage to the motor By-pass signal relay energised Power factor optimising (energy saving) activated (Switch PF in Y, On-position)
	F1 ○	F2 ○					
	On ●	R ●	■	■	□	□	
	T ●	P ●					
VI	OVL ○						Control voltage supplied and start signal is given. Fault F1 See fault codes and flow chart Phase loss Reset Via stop signal
	F1 ●	F2 ○					
	On ●	R ○	□	□	■	□	
	T ○	P ○					
VII	OVL ○						Control voltage supplied. Fault F2 See fault codes and flow chart a) Over temperature on heat sink b) High current switch off With the switch in position Y (On) c) Internal fault P.C.B Reset Via stop signal
	F1 ○	F2 ●					
	On ●	R ○	□	□	■	□	
	T ○	P ○					
VIII	OVL ○						Control voltage supplied. Fault F1+F2 See fault codes and flow chart a) Shorted thyristor b) Semiconductor not conducting
	F1 ●	F2 ●					
	On ●	R ○	□	□	■	□	
	T ○	P ○					
IX	OVL ○						Continuous run with shorted thyristor (Switch PF must be in N-position, Off)
	F1 ●	F2 ●					
	On ●	R ●	■	■	■	□	
	T ●	P ○					
X	OVL ●						Tripped electronic over load Reset: With the reset button or by closing between terminals X2: 24...25 The start signal has to be removed and the LED OVL has to flash.
	F1 ○	F2 ○					
	On ●	R ○	□	□	□	■	
	T ○	P ○					

The motor does not start

Check the status on LED's and signal relays and read the explanation below.

See 6.1.1 for PS D without electronic overload protection and

See 6.2.1 for PS D(H) with electronic overload protection.

Status signals

I

No control voltage

- Check voltage on terminals 1 and 2.
 - Correct voltage level according to the rating plate?
 - Are the cooling fans running? (not PS DH30)
 - If everything is OK - Internal fault on the PCB
-

II

No starting signal present

- Check the circuit for start signal.
 - a Connection between 7 and 10 present.
Start signal present, closed circuit between terminal 8 and 9
 - b PLC-connection
Connected +24 DC to terminal 9 and
-(OV) connected to terminal 10
-

VI (See also the fault codes and flow chart)

Alt. a)

Phase loss

- The main circuit contactor is not closing or closes to late. It must be closed within 100ms after start signal
- One or more phases missing due to tripped fuse

Alt. b)

High current switch off (The switch SC must have been in position Yes, otherwise no tripping due to overcurrent)

- The main circuit contactor is not closing or closes to late. It must be closed within 100ms after start signal
 - One or more phases missing due to tripped fuse
-

VII (See also the fault codes and flow chart)

Over temperature

- Check to make sure the cooling fans are working.
 - Clean the heat sink if it is dirty
 - Check the temperature monitor under the front cover.
Short circuit between terminals X3 1, 2.
If LED F2 is off, then change the temperature monitor.
-

VIII (See also the fault codes and flow chart)

Alt. a)

Shorted thyristor

- The motor can to start with shorted thyristor when switch PF is in N (Off) position.
Then the status will be IX.
Change the faulty thyristor at the next maintenance shutdown.

Alt. b)

One of the thyristors is not working / Open circuit between motor and starter

Too small motor in the circuit (too low current for the thyristors).

- Check the gate wiring under the front cover
 - Change thyristor.
-

X (See also the fault codes and flow chart)

Tripped electronic overload (only for PS D and PS DH with electronic over load)

- There is an overload (too high load) on the motor shaft.
- It can also be too long starting time.

Check if the current limit is set to a low value.

If the value is set too low there is not enough torque for the start.

PS: It's not possible to reset the over load if the start signal is present.

6.2.2 Fault codes

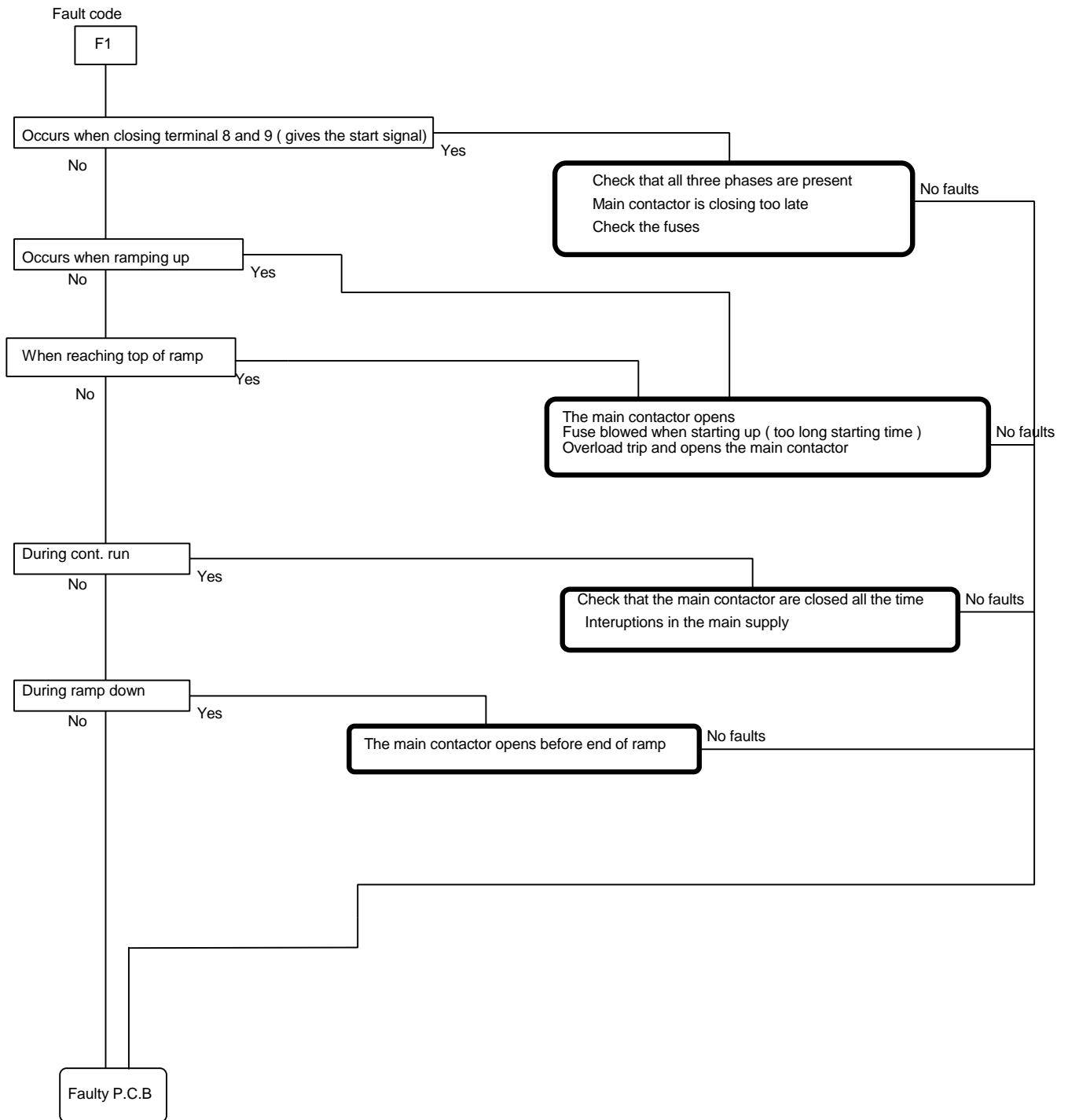
Softstarter with built-in O.L card mounted

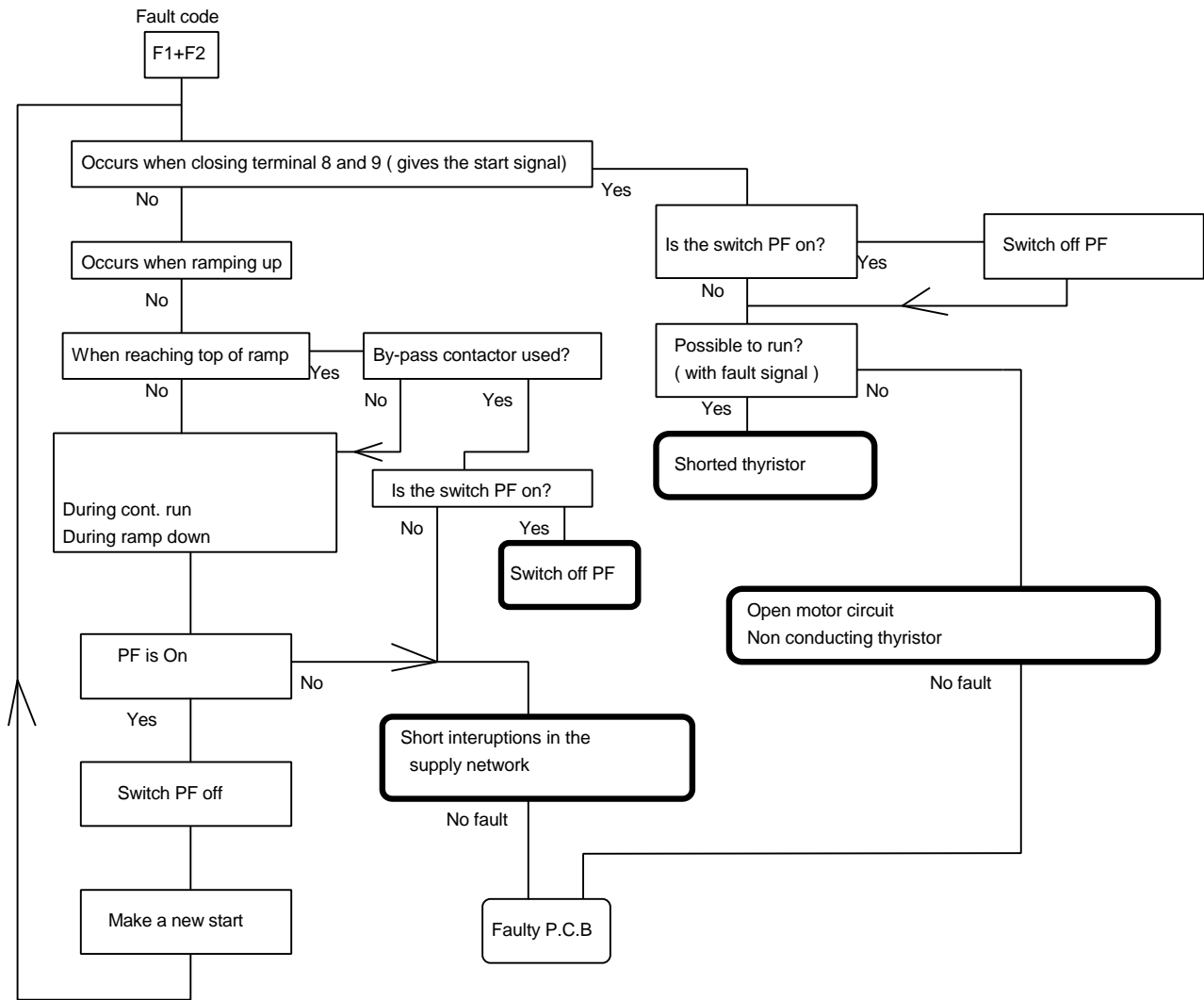
Softstarter mode		Phase loss	Shorted thyr.	High current (SC)	High curr. (50ms)	Signal fault O.L	Signal loss	Over temp	Open circuit 2) 1 phase missing	Open circuit 2) >=2 phase missing	Over load
Without energy saving PF=No	Stand by	-	-	-	X	X	-	X	-	-	X
	After start signal a)	X	1)	-	X	X	X	X	X	3)	X
	Ramp up	X	-	-	X	X	X	X	X	-	X
	Normal run	X	-	X	X	X	X	X	X	-	X
	Stopping	X	-	-	X	X	X	X	X	-	X
With energy saving PF=Yes	Stand by	-	-	-	X	X	-	X	-	-	X
	After start signal a)	X	X	-	X	X	X	X	X	X	X
	Ramp up	X	X	-	X	X	X	X	X	X	X
	Dwell	X	X ⁴⁾	X	X	X	X ⁴⁾	X	X ⁴⁾	X ⁴⁾	X
	Optimise	X	X ⁴⁾	X	X	X	X ⁴⁾	X	X ⁴⁾	X ⁴⁾	X
	Stopping	X	X	-	X	X	X	X	X	X	X
Signal code		F1	F1+F2	F2 when selected	F2	F2	F1+F2	F2	F1+F2	F1+F2	OVL

- 1) Detecting the fault and gives a fault signal but the softstarter is able to run.
- 2) Open circuit means open circuit between softstarter and motor
- 3) Associated with an open circuit on the motor side with 2 or more phases missing. Although the fault is detected if the fault was present when the start signal was activated the system will not trip, i. e it is just an indication.
- 4) The F1+F2 fault signals are delayed when running with the function PF in position YES under 60 sec. from TOR is activated to PF have been activated. The fault have to be present longer then 5 sec. before tripping. During this 5 sec the LED F1 flashes. Then the LED F2 flashes for another 5 sec. If the fault remains or occur during these last five sec. it will trip with a F1+F2 signal. If no fault, it will go back to normal run.
- a) The fault have to be present before the start signal is given (closing between 8 and 9).

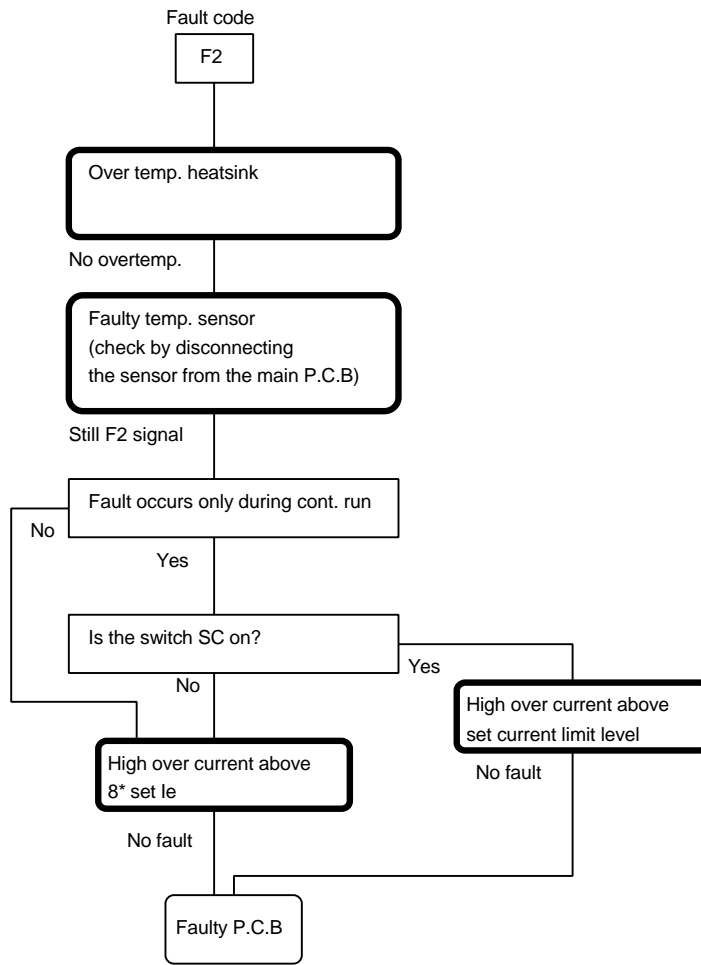
6.2.3 Flow chart

Version PS D and PS DH with built in electronic over load





Version PS D and PS DH with built in electronic over load



7. Technical data

General data

		PS D Normal starts	PS DH Heavy duty starts
Rated insulation voltage, U_i	V	660	660
Rated operational voltage, U_e	V	220-500	220-500
Motor output, P_e			
220-230V	kW	22-250	7,5-200
380-415V	kW	37-450	15-400
500V	kW	45-560	18,5-500
UL:			
208V	HP	10-250	5-200
230V	HP	10-300	5-250
480V	HP	25-600	10-500
Max. rated current I_e	A	74-840	30-720
	UL: A	28-720	14-602
Ambient temperature During operation	°C	0-50	0-50
<i>Above 40 °C reduce the rated current with 0,8 % per °C</i>			
During storage	°C	-40 - +70	-40 - +70
Degree of protection		IP 00	IP 00
Harmonic contents During start	%	5	5
During operation	%	2	2
Shortest interval between starts	ms	500	500
Settings			
Initial voltage during start	%	10-60	10-60
Ramp time during start	s	0,5-60	0,5-60
Ramp time during stop	s	0,5-240	0,5-240
Current limit at start		2-5 x I_e	2-5 x I_e
Rated motor current I_r	%	70-100	70-100
Step down voltage	%	100-30	100-30
Signal relay			
Rated operational voltage U_e	V	250	250
Rated thermal current I_{th}	A	5	5
Rated operational current I_e at AC 11 ($U_e=250V$)	A	1,5	1,5

Cross section of connectable cables

	PS D size PS DH size	- 30	75 45...60	110...145 75...110	175...570 145...470	720 570	840 720
Main circuit							
Connection clamp							
Cu-cable	mm ²	6	35	-	-	-	-
Al-cable	mm ²	6	35	-	-	-	-
Connection bar							
Width x thickness	mm	-	-	15x4	25x6	40x6	50x6
Hole diameter	mm	-	-	6,8	11	11	11
Control circuit							
Connection clamp	mm ²	2,5	2,5	2,5	2,5	2,5	2,5
Signal relay							
Connection clamp	mm ²	2,5	2,5	2,5	2,5	2,5	2,5
UL info:							
Power connection	AWG	18-2	18-2	8-3/0	(2) 4-500kcmil	(2) 4-500kcmil	(3) 4-500kcmil
Control connection	AWG	22-12	22-12	22-12	22-12	22-12	22-12

Size related data

Size	Starting capacity	Recommended overload relay		Max. power loss at max. I_e W	Max. fusing rating main circuit ⁴⁾		Power requirements of control circuits VA
		Type	Current range A		Bussmann fuses	Ferraz fuses	
PS D							
75	4,5xI _e for 14s	T75 DU	22-80	³⁾	250A 170M1371 ⁵⁾	315A 6,6 URD 30 D08 A 0315	40
110	4,5xI _e for 14s	T135 DU	65-135	³⁾	315A 170M2619 ⁵⁾	400A 6,6 URD 30 D08 A 0400	40
145	4,5xI _e for 14s	T200 DU	100-150	³⁾	400A 170M2621 ⁵⁾	500A 6,6 URD 30 D08 A 0500	40
175	4,5xI _e for 14s	T200 DU	100-200	²⁾	450A 170M3020 ⁶⁾	500A 6,6 URD 30 D08 A 0500	65
210	5xI _e for 7s	T450 DU	130-235	²⁾	500A 170M3021 ⁶⁾	530A 6,6 URD 30 D08 A 0550	65
250	5xI _e for 7s	T450 DU	130-310	²⁾	630A 170M4016 ⁶⁾	550A 6,6 URD 31 D08 A 0550	65
300	5xI _e for 7s	T450 DU	165-310	²⁾	700A 170M4017 ⁶⁾	630A 6,6 URD 31 D08 A 0630	65
370	5xI _e for 7s	T900 DU	265-500	²⁾	900A 170M5015 ⁶⁾	900A 6,6 URD 32 D11 A 0900	90
470	5xI _e for 7s	T900 DU	265-500	²⁾	1250A 170M5018 ⁶⁾	1250A 6,6 URD 33 D11 A 1250	90
570	5xI _e for 7s	T900 DU	265-650	²⁾	1500A 170M6018 ⁶⁾	1250A 6,6 URD 33 D11 A 1250	90
720	5xI _e for 7s	T900 DU	355-850	²⁾	1800A 170M6020 ⁶⁾	2000A 6,6 URD 33 TTF 2000	90
840	5xI _e for 7s	T900 DU	465-850	²⁾	1800A 170M6020 ⁶⁾	2000A 6,6 URD 33 TTF 2000	90

PS DH

30	5xI _e for 25s	¹⁾	³⁾	125A 170M1368 ⁵⁾	160A 6,6 URD 30 D08 A 0160	40
45	5xI _e for 25s	¹⁾	³⁾	200A 170M2617 ⁵⁾	200A 6,6 URD 30 D08 A 0200	40
60	5xI _e for 25s	¹⁾	³⁾	250A 170M1371 ⁵⁾	250A 6,6 URD 30 D08 A 0250	40
75	5xI _e for 25s	¹⁾	³⁾	315A 170M2619 ⁵⁾	315A 6,6 URD 30 D08 A 0315	40
110	5xI _e for 25s	¹⁾	³⁾	400A 170M2621 ⁵⁾	450A 6,6 URD 30 D08 A 0450	40
145	5xI _e for 25s	¹⁾	³⁾	450A 170M3020 ⁶⁾	500A 6,6 URD 30 D08 A 0500	65
175	5xI _e for 25s	¹⁾	³⁾	500A 170M3021 ⁶⁾	550A 6,6 URD 30 D08 A 0550	65
210	5xI _e for 25s	¹⁾	²⁾	630A 170M4016 ⁶⁾	630A 6,6 URD 31 D08 A 0630	90
250	5xI _e for 25s	¹⁾	²⁾	700A 170M4017 ⁶⁾	700A 6,6 URD 32 D08 A 0700	90
300	5xI _e for 25s	¹⁾	²⁾	900A 170M5015 ⁶⁾	900A 6,6 URD 32 D08 A 0900	90
370	5xI _e for 25s	¹⁾	²⁾	1000A 170M5016 ⁶⁾	1000A 6,6 URD 33 D08 A 1000	90
470	5xI _e for 25s	¹⁾	²⁾	1250A 170M5018 ⁶⁾	1250A 6,6 URD 33 D08 A 1250	90
570	5xI _e for 25s	¹⁾	²⁾	1500A 170M6018 ⁶⁾	250A 6,6 URD 33 TTF A 1600	90
720	5xI _e for 25s	¹⁾	²⁾	1800A 170M6020 ⁶⁾	250A 6,6 URD 233 PLAF 2000	90

1) Electronic overload relay built in

2) Total power loss: $P_{Ltot} = (3 \times I_e \times 1,0) + 100$ (W)

3) Total power loss: $P_{Ltot} = (3 \times I_e \times 1,0) + 50$ (W)

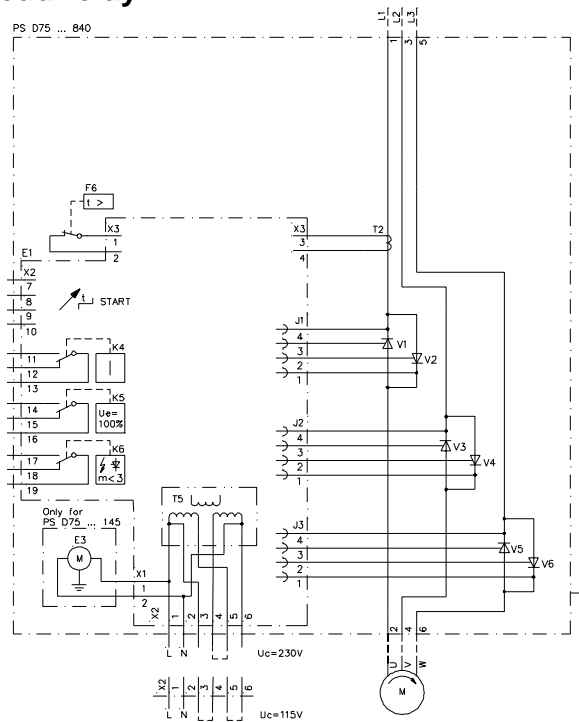
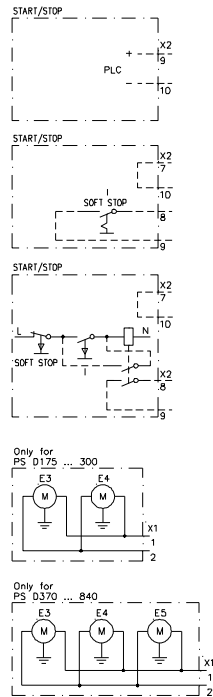
4) For the control circuit: 6 A delayed

5) Fuse holder 170H 1007

6) Fuse holder 170H 3004

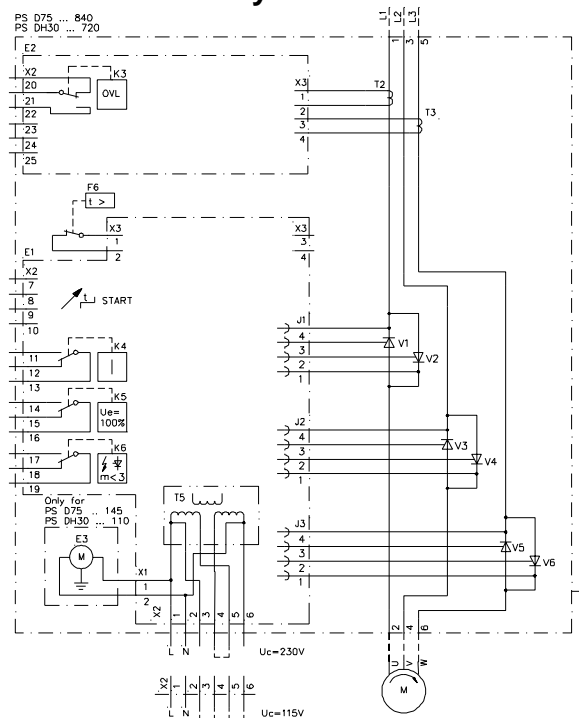
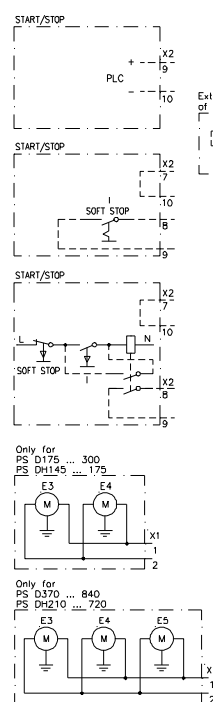
8. Circuit Diagrams

PS D without overload relay



- E1 Circuit board
- E3-E5 Fan
- F6 Temperature monitor
- J1-J3 Contact blocks
- K4 Relay, actuated in operational position
- K5 Relay, actuated at full voltage ($U_e = 100\%$)
- K6 Relay, fault signal
- T2 Current transformer
- T5 Control transformer
- V1-V6 Thyristor
- X1-X3 Terminal block

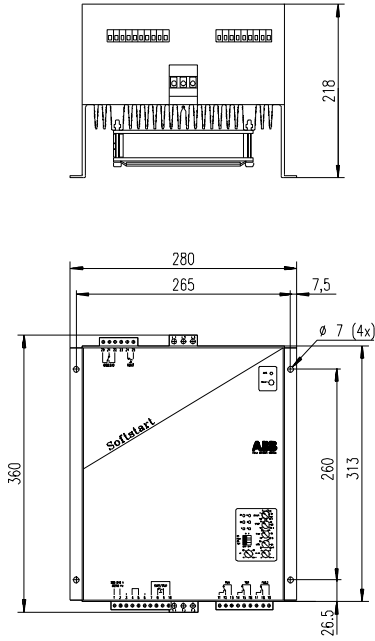
PS D and PS DH with overload relay



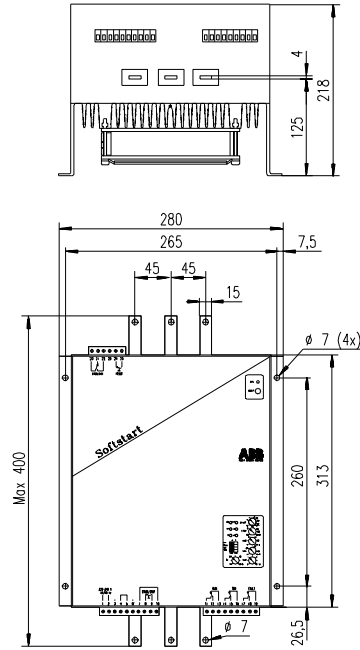
- E1 Circuit board
- E2 Circuit board OVL
- E3-E5 Fan
- F6 Temperature monitor
- J1-J3 Contact blocks
- K3 Relay, overload
- K4 Relay, actuated in operational position
- K5 Relay, actuated at full voltage ($U_e = 100\%$)
- K6 Relay, fault signal
- T2 Current transformer
- T3 Current transformer
- T5 Control transformer
- V1-V6 Thyristor
- X1-X3 Terminal block

9. Dimensions

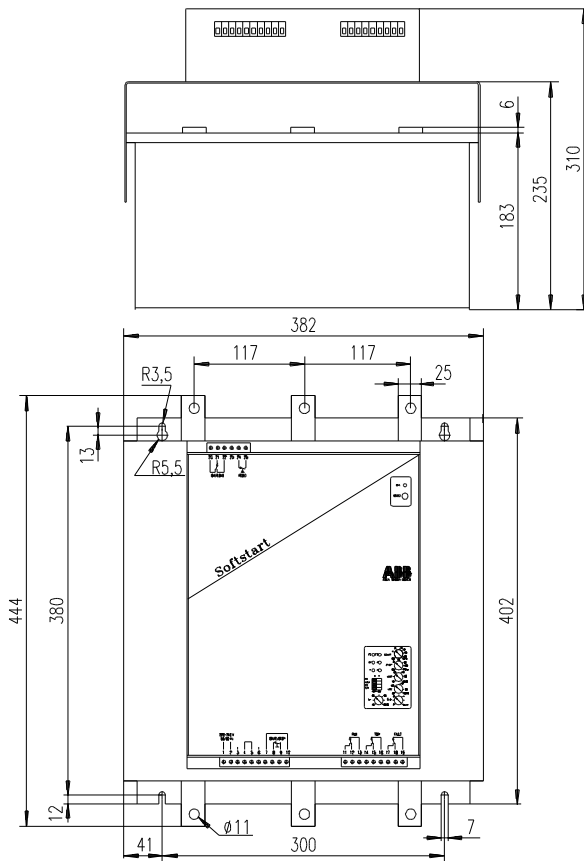
**PS D75
PS DH 30 ... 60**



**PS D110 ... 145
PS DH75 ... 110**



**PS D175 ... 300
PS DH145 ... 250**



**PS D370 ... 570
PS DH300 ... 470**

