V2 >

ELECTRONIC SOFTSTARTER

Electronic Softstarter
User's Manual

POWER ELECTRONICS ®

V2 ➤

ELECTRONICS SOFT-STARTER

User's Manual V2MT01JI Rev. J

POWER ELECTRONICS®

IMPORTANT NOTES

❑ **RECEPTION**

- V2 soft-starters are carefully tested and perfectly packed before leaving the factory.

- In case of transport damage, notify it to transport agency and to **POWER ELECTRONICS** (+34 96 136 65 57), not later than 24hrs from delivery date.

❑ **UNPACKING**

- Make sure model and serial number of the soft starter are the same in the box, delivery note and unit.

- Position 1: V2 soft starter.

- Position 2: V2 Technical Manual.

❑ **SAFETY**

- It is electrician's responsibility to ensure the configuration and installation of the V2 meets the requirements of any site specific, local and national electrical regulations.

- The V2 operates from HIGH VOLTAGE, HIGH ENERGY ELECTRICAL SUPPLIES. Always isolate before servicing.

- Service only by qualified personnel. For any question or enquiry please contact **POWER ELECTRONICS** Technical Department or with your local distributor.

- The V2 contains static sensitive printed circuit boards. Use static safe procedures when handling these boards.

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Date	Revision	Description
May 2009	J	Drawings for IP54 with internal bypass.
September 2006	I	Installation regulations.
June 2005	H	General update.
		New power and control wiring.
March 2004	G	Add new dimensions for 60 and 75A (IP54)
		Change DT0048D (Page 11).
March 2003	F	IP54 new range release.
October 2002	D	Jumper 7: Default value Freewheel Stop.
July 2002	B	PCB Change. 00016B.
		Modify the jumper 9.

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1. MOUNTING AND WIRING.

1.1 ENVIRONMENTAL CONDITIONS

1.1.1 IP00 MODEL
The maximum V2 ambient/working temperature is 40ºC. It is possible to be operated up to higher temperature of 50ºC, by over sizing the soft starter 2% per extra degree.

Example: Motor 15kW, 380V, 30A
Working temperature 50ºC.

Soft-Starter required: At 40ºC the soft starter required should be a V2030 (30Amps), but at 50ºC the soft starter should be oversized a 2% per extra ºC. Thus,

Temperature: 10°C; 2% x 10ºC means a 20% oversize:
I motor x 20% = 30 x 1.2 = 36 Amp

Then the soft starter required is a V2045 (@50ºC).

1.1.2 IP54 MODEL
The maximum V2 ambient/working temperature is 50ºC.

1.2 IEC PROTECTION

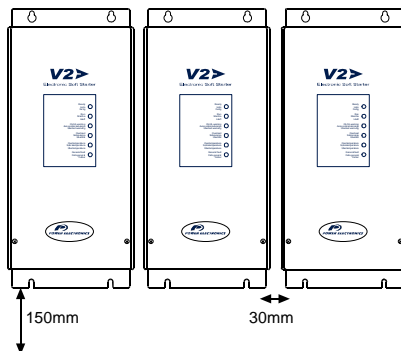The V2 soft-starter ingress protection is IP00 and IP54.

1.3 MOUNTING

To improve heat dissipation, it is recommended to mount the soft starter over a metal plate.
Minimum safe 30mm side distance and 150mm top and button distance is to be kept between soft starters.
Do not install V2 above any heat source, unless heat airflow is driven out of the cabinet.

DT0055

Fig. 1: Vertical mounting.

1.3.1 IP00 MODEL
The V2 IP00 soft starter is designed to be mounted vertically inside an electrical cabinet with forced air-cooling.

1.3.2 IP54 MODEL
IP54 Model can be mounted within a sealed cabinet if its internal temperature does not exceed 50ºC and limiting the number of starts according to its technical specifications.

1.4 POWER LOSS DISSIPATION

1.4.1 IP00 MODEL
The V2 has a power loss of 3 watt per amp, this means that a V2045 has a power loss of 135 Watts at full load.

1) Without forced cooling:
Practical example:
Ambient temperature is 30ºC.
Maximum working temperature of the V2 is 40ºC.
Power losses of the soft starter are 3 watts per amp at full load and 6 watts per amp during the start (only with more than 6 starts per hour).
If the V2017 is going to be drawing constantly 15A, our power loss must be:

$$P = Im \times Loss = 15 \times 3 = 45 \text{ watts}$$

This is the worst case assuming a duty cycle of 100% at full load (45W). You have also to take the losses of switches, contactors, relays into account (20Watts).

$$P_{loss} = 45 + 20 = 65 \text{ watts}$$

The heat transfer coefficient of metals and polyester must be known:

$$\text{Polyester:} \quad 3.5 \text{ W / m²K°}$$
$$\text{Metal:} \quad 5.5 \text{ W / m²K°}$$

The total surface required without forced cooling should be:

$$\text{Area} = P_{loss} / k \ (Tr-Ta)$$
$$\text{Area} = 65 / 5.5 \times (40 - 30) = 1.181 \text{m²}$$

Chosen an 800 x 600 x 400 cabinet, the total area of dissipation is:

$$\text{Area} = \text{Door} + 2 \text{ (side)} + \text{Top Covers}$$
$$\text{Area} = (0.8 \times 0.6) + 2(0.8 \times 0.4) + (0.6 \times 0.4) = 1.36 \text{m2}$$

The area of the cabinet is high enough to dissipate the total power loss.
NOTE: When you place cabinets in parallel, just take one side (for the total area) into account for thermal calculations.

2) With forced cooling:
The power loss dissipated is the same as without forced cooling, but now you have to calculate the air flow required to get the desired differential temperature between the inside and the outside of the cabinet.

We have a V2017 working at 30ºC ambient temperature. We want the air inside the cabinet less than 40ºC.

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P$_{Loss}$ = Total power loss dissipated.
T$_r$ = Maximum temperature inside the cabinet.
T$_a$ = Ambient temperature.
Ø = Airflow required in m^3/min.

$$Ø = P_{Loss} / 20 \ x \ (T_r-T_a)$$
$$Ø = 65 / 20 \ x \ (40-30) \ 0.325 \ m^3/min$$

NOTE: Using filters at the air intake/exhaust of the cabinet should protect the V2 from dust.

1.4.2 IP54 MODEL
IP54 range V2 do not need forced cooling as no heat is produced during nominal operation, only start and stop heat is dissipated, thus number of starts is limited to 6 per hour and provided 50ºC as maximum working temperature.

1.5 POWER WIRING

Most electrical wiring regulations require a mains isolator on solid-state equipment. The V2 soft-starter falls to this category. This is to ensure there is an air break in the circuit, as semiconductors cannot be relied upon to be safe isolation. There are many choices, the most common are using a magnethermic protection with a trip coil, and the other is placing a contactor.

Magnetic protection is required to protect the V2 soft-starter from damage due to a short circuit within the V2 or on the output cabling or motor. When a faster protection was needed, it is recommended ultra fast fuses. The fuses should be mounted as close to the V2 soft-starter as possible. Power factor correction capacitors must not be connected after the fuses or on the output of the V2.

The V2 protects the motor with electronic overload sensing, so an external overload relay is not necessary. If multiple motors are connected separate, overloads are required for each motor.

An isolator can be fitted after the V2 but is recommended for off load use only. A motor isolator is not necessary for the operation of the V2 soft-starter but site standards or electrical wiring regulations may require an isolator near the motor.

If a contactor is to be fitted, an output relay of the soft starter can energize it on receiving the start signal.

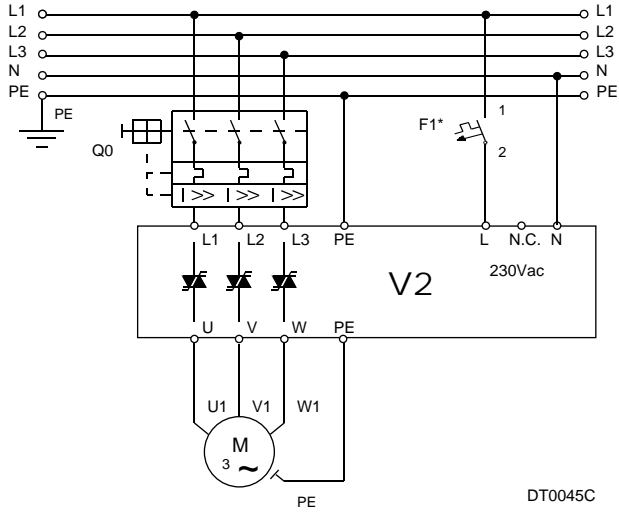**POWER WIRING FOR IP00 MODELS**

Fig. 2: V2 Power wiring configuration.

Note: *Minimum recommended protection 1A for F1.*
It is absolutely necessary that the installer guaranties the correct observance of the law and the regulations that are in force in those countries or areas where this device is going to be installed.

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POWER WIRING FOR IP54 MODELS – BYPASS BUILT-IN
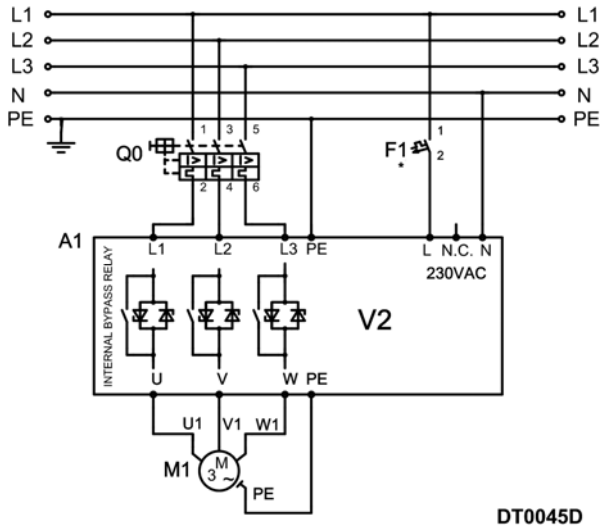

Fig. 2b: V2 Power wiring configuration for IP54 with internal bypass.

Note: *Minimum recommended protection 1A for F1.*
It is absolutely necessary that the installer guaranties the correct observance of the law and the regulations that are in force in those countries or areas where this device is going to be installed.
Internal Bypass Relays for IP54 models built-in.
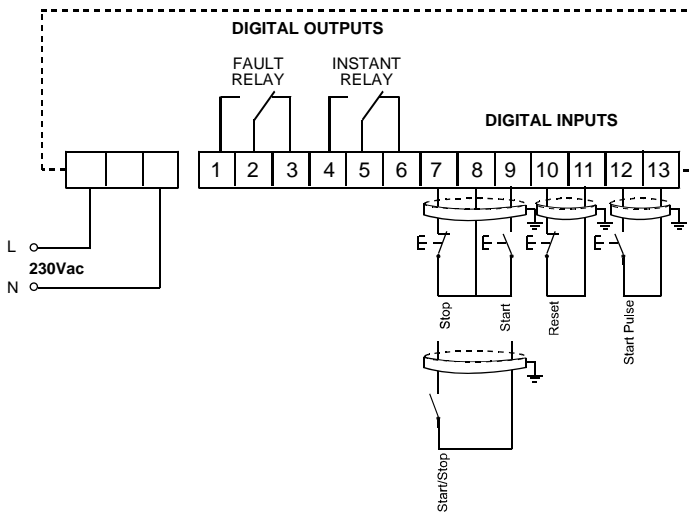
1. 6 CONTROL WIRING

NOTE: **Wiring distance.**
Control wiring shouldn't run in parallel with power input or output cables to the motor. Space at least 300mm away, and cross at right angles.

Control terminals:
The control terminals do need to be screened when running in parallel with power cables. (Terminals 7 to 13)

Start/Stop wiring:
Wiring options with push buttons or selector (switch) according to Selection 4.2.

DT0038E

Fig. 3: V2 Control Wiring.

1. 7 CHECKS BEFORE COMMISSIONING

1. Check for foreign objects in the V2 cabinet that may be left from installation.

2. Check the control board main supply (T1-T2, 230Vca +/-10%) is connected.

3. Check the mains connection is connected to terminals L1, L2, L3 and the motor is connected to terminals U, V, W. Confirm the mains supply is within V2 specifications and motor nameplate matches to V2 rated nameplate.

4. Check control wiring and ensure the installation is electrically safe and it is safe to run the motor.

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2. ELECTRICAL SPECIFICATIONS.

INPUT
Input voltage:	230-400V(~3 phases), ±10%
Supply frequency:	47-62 Hz
Control Voltage:	230V +/-10%, others under demand

OUTPUT
Output voltage:	0 -100% Supply Voltage
Output frequency:	47-60 Hz
Efficiency (at full load):	> 99%

ENVIRONMENTAL CONDITIONS
Ambient temperature:	Operating: 0 to +40ºC
	Storage: -10ºC to +70ºC
Altitude losses:	>1000m 1% each 100m, maximum 3000m
Humidity:	95%@ 40ºC non-condensation
Protection degree:	IP00
Cooling:	Natural

PROTECTIONS	Input phase loss
	Starting current limit
	Rotor locked
	Motor overload (thermal model)
	Underload
	Phase unbalance

V2 PROTECTIONS	General fault
	V2 over temperature

SETTINGS	Initial torque
	Acceleration ramp
	Deceleration ramp
	Overload: 0.8 to 1.2 In
	Overload curve
	Underload: 0.2 to 0.6 In
	Underload curve
	Current limit: 1 to 5 In

NOTE: V2 IP54 number of starts per hour is limited to 5

OUTPUT SIGNALS	2 changeover relays (5A 230Vac non inductive)
	· **Fault:** It opens in case of any fault condition
	· **Instantaneous:** Its position changes when starting and stopping

LED'S INDICATIONS	LED 1 Run
	LED 2 Ready
	LED 3 Overload warning / Underload fault
	LED 4 Overload Fault
	LED 5 Over temperature
	LED 6 General fault

3. DIMENSIONS AND STANDARD RATINGS.
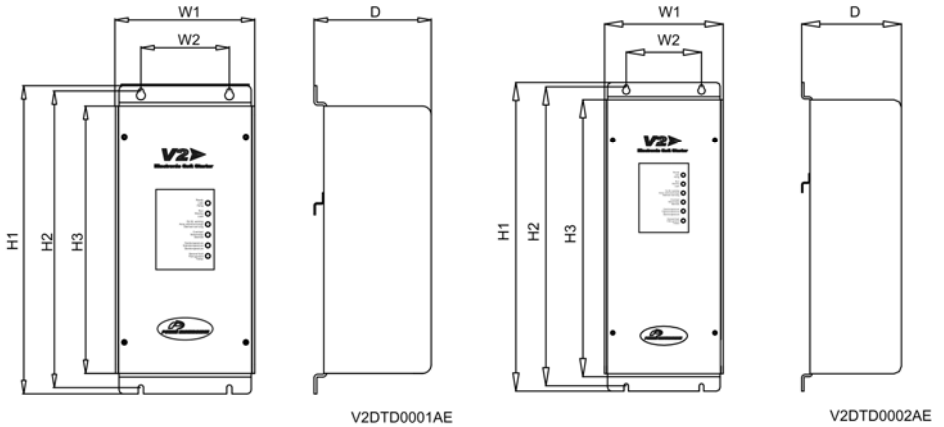
IP00 – IP54

V2009 – V2075

IP54

V2060B – V2075B

V2DTD0001AE

V2DTD0002AE

Fig. 4: V2 Dimensions.

REFERENCE	A	220V KW	380V KW	DIMENSIONS (mm)	IP PROTECTION
V2009	9	2.2	4	350x157x132	IP00
V2017	17	4	7,5	350x157x132	IP00
V2030	30	9	15	350x157x132	IP00
V2045	45	15	22	350x157x132	IP00
V2060*	60	18.5	30	350x157x132	IP00
V2075*	75	22	37	350x157x132	IP00
V2009B*	9	2.2	4	350x157x132	IP54
V2017B*	17	4	7,5	350x157x132	IP54
V2030B*	30	9	15	350x157x132	IP54
V2045B*	45	15	22	350x157x132	IP54
V2060B*	60	18.5	30	410x157x132	IP54
V2075B*	75	22	37	410x157x132	IP54

* All types signed with "*" do have an integrated BYPASS function. The Motor protection is operating all the time.

Table 1: V2 standard ratings.

4. CONTROL INPUTS.

The next figure provides the electrical specification of all V2 control inputs. Each input is individually described below.
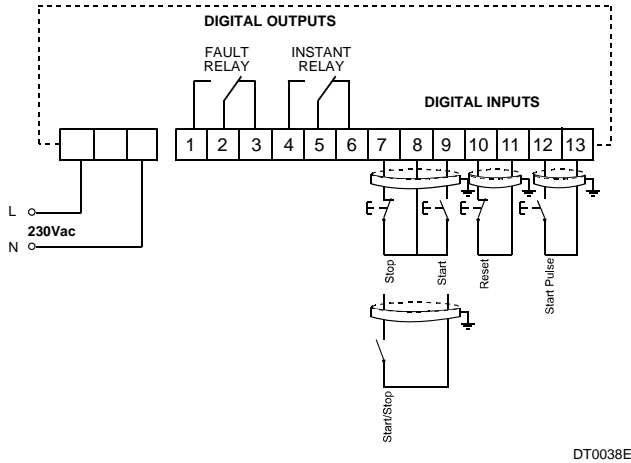
4.1 CONTROL TERMINALS

Fig. 5: V2 Control Terminals.

4.2 TERMINAL DESCRIPTIONS

Control voltage terminals.
Input terminal for control board voltage supply (230V +/-10%). Other voltage rates are also available on demand.
Between 1 and 2 there is an empty terminal with no use to secure electrical isolation.

Terminals 1-6 Output relays
Fault: It switches in case of any fault condition.
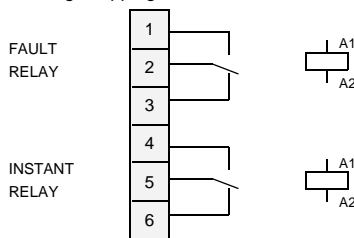**Instantaneous:** It switches when starting/ stopping.
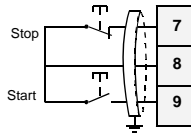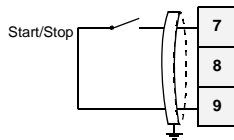

Fig. 6: Output relay.

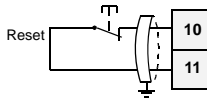**NOTE:** Maximum current per contact 5A at 230V.

Terminals 7-9: Inputs
Start/stop pushbutton configuration:

DT0049C

Fig. 7: 3-wire configuration.

NOTE: Terminals 10 - 11 only reset.

Start/stop switch configuration:

DT0050C

Fig. 8: Start/stop contact configuration.

NOTE: Terminals 10 - 11 stop/reset.

Terminals 10-11: Inputs
Remote reset configuration

DT0051C

Fig. 9: Reset configuration.

NOTE: If reset is not using terminals 10 and 11 must be linked.

Terminals 12-13: Inputs
Start pulse pushbutton configuration.
For variable load applications (different material mixing, etc.), where sometimes a higher torque is required, a torque pulse pushbutton inputs are provided.
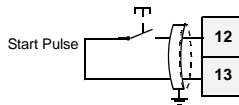
DT0052C

Fig. 10: Start pulse configuration.

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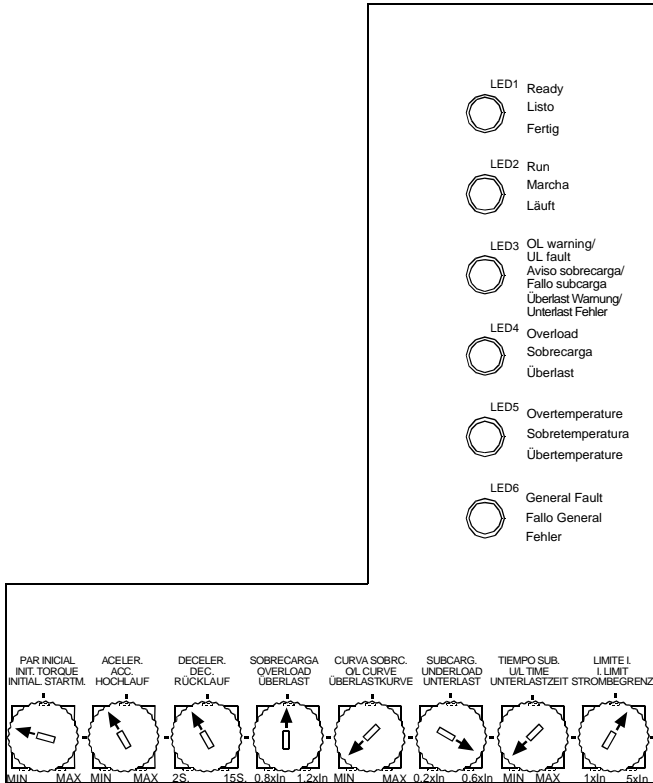## 5. LEDS INDICATIONS.

DT0039E

Fig. 11: Led and potentiometer PCB

| LED 1 | **READY STATUS** |
| | It shows 230V is applied to control board. |

LED 2	**RUN STATUS**
	It blinks during acceleration and deceleration ramp.
	It is steadily on after acceleration ramp when running at nominal current.

LED 3	**OVERLOAD WARNING & UNDERLOAD FAULT**
	Blinking light: **UNDERLOAD FAULT**
Description	Motor Underload.
Possible Cause	Motor working with no load.

	Wrong setting of Underload conditions.
Action	In case of pump application, check there is no air inside the pipe network and that the pump suction is not obstructed.
	Increase Underload potentiometer.

Steady light: **OVERLOAD WARNING**

Description   Motor overload warning before the soft-starter will trip on overload fault.

LED 4   **OVERLOAD FAULT**
Description   Adjusted motor overload has reached an unacceptable level.

Trip is produced during start:
Possible Cause   Motor overload due to mechanical or load problems and wrong settings.
Action   Check mechanical conditions.
Check there is not a power input supply voltage drop lower than a 10%.
Increase acceleration ramp (high inertia applications).
Increase Overload curve potentiometer.
Increase current limit.

Trip is produced at nominal speed:
Possible Cause   Wrong Overload potentiometer setting or load conditions change.
Action   Check working conditions of motor.
Check load.
Increases overload potentiometer.

LED 5   **V2 OVER TEMPERATURE**
Description   Heat sink too hot (>85ºC).
Sense level   (> 85°C).
Possible Cause   Insufficient cooling.
Fan failure.
Ambient temperature too high, >40ºC for IP00 model and >50ºC for IP54 model.
The actual current is higher than the nominal.
Action   Check the ambient temperature during normal operation doesn't exceed 40ºC for IP00 model and 50ºC for IP54.
Check that actual motor current is the same or smaller than the V2 nominal current.

LED 6   **GENERAL FAULT**
Description   Phase or PCB fault.
Possible Cause   Phase loss.
Phase unbalance.
Thyristor fault.
Action   Check supply, all cables, motor.
If the problem persists, call to **POWER ELECTRONICS** or an authorized distributor.

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6. POWER PCB JUMPER CONFIGURATION.

The Soft-starter could be damaged by setting the jumpers during operation. For safety reasons, the jumpers are located underneath the potentiometer and LED PCB. This PCB must be removed only when control and power supply is off.
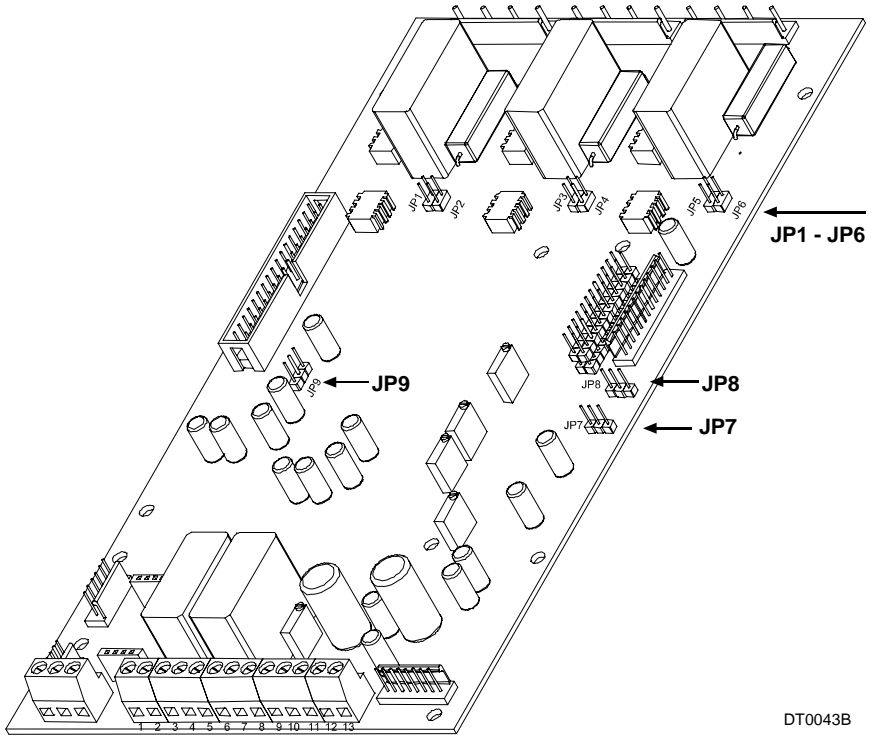

Fig. 12: Power PCB Jumper drawing.

JUMPER'S FUNCTION

JP1-JP6	**MOTOR SUPPLY VOLTAGE**
Description	Rated (Nameplate) Motor Voltage
Default Value	400V (No jumper required)
Function	Adjust nominal motor voltage.
Adjust	Position 1: 400V
	Position 2: 230V (to introduce 6 jumpers according to drawing).
	Add or remove 6 jumpers (2 per phase) according to input voltage at the soft starter input. Make sure this value is related to rated (Nameplate) motor voltage.
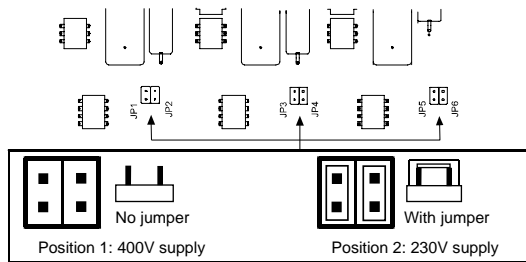
DT0047D

Fig. 13: JP1-JP6: Motor supply voltage jumper selection.
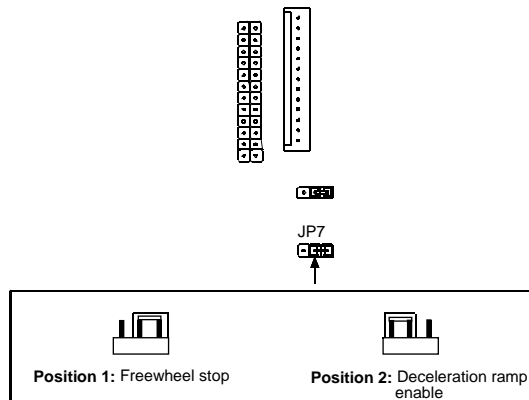
JP7	FREEWHEEL STOP
Description	Enable/disable deceleration ramp.
Default value	Position 1: Freewheel stop
Function	Set the type of stop required. The stop could be controlled through a ramp down voltage or uncontrolled where the stop depends on the load torque (freewheel stop).
Adjust	Position 1(default): Freewheel stop. Deceleration ramp disabled.
	Position 2: Deceleration ramp is enabled.

DT0044F

Fig. 14: JP7: Freewheel stop selection jumper.

JP8	SUPPLY FREQUENCY
Description	Supply frequency
Default value	Position 1: 50Hz
Function	Set the mains frequency.
Adjust	Where the mains frequency is known as 50Hz, leave as default. Where the mains frequency is 60Hz set jumper to Position 2.

![V2 logo]
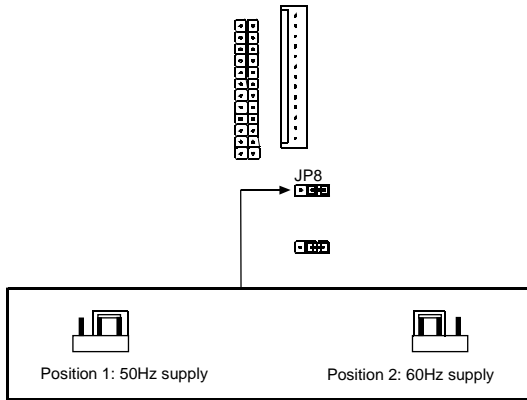
DT0046D

Fig. 15: JP8: Supply frequency selection jumper.

JP9   **UNDERLOAD PROTECTION**
Description   Underload current.
Default Value   Position 1: Underload protection disabled.
Function   Set underload protection.
Adjust   Position 1 (default): Underload protection is disabled.
                           Position 2:   Underload protection is enabled.
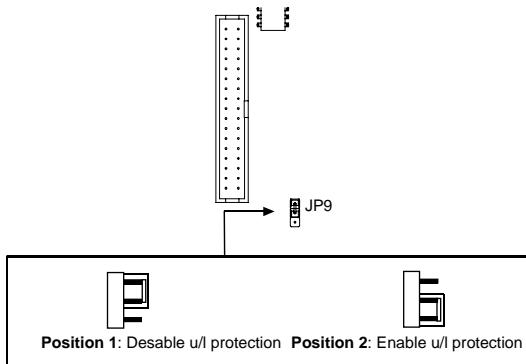
DT0057D

Fig. 16: JP9: Underload current selection jumper.

7. POTENTIOMETER COMMISSIONING

The commissioning process described bellow is only an orientating guide. Each application has its own load characteristics and regulation may change from one to another. It is recommended to carry out several settings until optimum result is achieved.
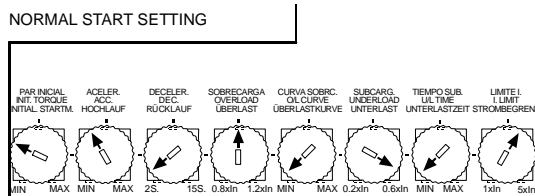
NOTE: Potentiometers spinning angle is ¾ of turn approximately. To spin further this range can damage the potentiometer.

NORMAL START SETTING

DT0040E

Fig. 17: Normal start potentiometer configuration.

POT 1	INITIAL TORQUE
Description	Initial Torque
Range	30 to 99%
Unit	% of rated Motor torque
Function	Establish the initial torque to be applied to the motor at the beginning of the ramp up.
Adjust	It is recommended to begin with a low initial torque value, normally default. Observe motor rotation immediately after start command. If the motor doesn't spin, machine torque requirement may be bigger, and it should be necessary to increase it until the motor spins normally. If very high current is noticed at the very beginning of starting process, it could be due to a too high initial torque, it must be decreased until a proper value is achieved.
Applications	For submerged pumps, generally it's needed a torque between 40% and 45%. For hard applications like mills or crushers, the required torque is normally between 40% and 50%.
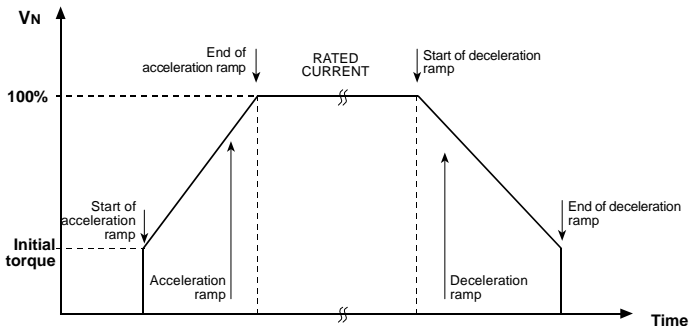
DT0042B

Fig.18: Initial torque.

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POT2   **ACCELERATION TIME**
Description   Acceleration Time
Range   0 to 15
Unit   Seconds
Function   Establish the time motor will go from 0 to nominal speed; if no current limit
                  occurs which will cause a longer acceleration time.
Adjust   Depending on the application, time will be different in order to make sure no
                  current limit will take place during acceleration, in such a case acceleration time
                  or acceleration current limit increase will be necessary.
Applications   In submerged pumps, the usual acceleration time is between 4 and 8 seconds.
                  NOTE: These values are generic adjustments. Each application requires an individualized
                  adjust to optimize the correct performance.

POT3   **DECELERATION TIME**
Description   Deceleration Time.
Range   0 to 45
Unit   Seconds
Function   Establish the time for the controlled stop.
Adjust   Begin with a short time (10 or 15 seconds) and increase it until desired stop is
                  achieved.

POT4   **OVERLOAD**
Description   Overload motor current
Range   0.8 to 1.2xInom, where Inom equal nominal current of the soft starter.
Unit   Amps
Function   This parameter sets the overload motor current protection at nominal conditions.
                  The time for this protection to trip depends on the actual current drawn by the
                  motor and overload curve Potentiometer.
Adjust   Look at the rated (nameplate) motor current and set this value. To do so, turn
                  overload potentiometer from right to left when motor is already working until
                  overload warning led turns on steadily. Then turn it clockwise until this led turns
                  off. In this position overload, protection will be exactly motor operating current.

POT5   **OVERLOAD CURVE**
Description   Overload curve.
Range   Min.-Max.
                  Min: Fastest curve.
                  Max: Slowest curve.
Function   The overload curve determines the response time under overloads conditions.
                  There is a nonlinear relation between the overload potentiometer and this
                  potentiometer in order to set the time required for tripping on OVERLOAD. If Min.
                  setting is made then the response time since an overload condition has occurred
                  is almost immediate, but if it is Max. then takes more time until the soft starter
                  trips on OVERLOAD.
Adjust   If you need a fast response under overload conditions, please select Min. If you
                  need a slow response, then select Max. For normal operation, leave this value
                  as medium setting.

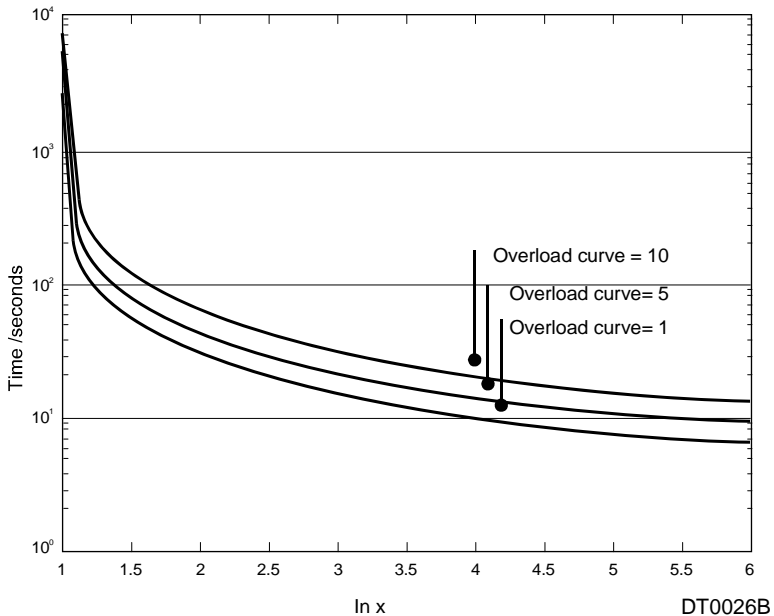This drawing shows response time under different overload conditions:

Fig. 19: Overload curve.

POT6	**UNDERLOAD**
Description	Underload current.
Range	0,2 to 0.6 x In, where In is the nominal current of the soft starter.
Unit	Amps
Function	Underload current determines the current bellow a motor must not work.
Adjust	Usually leave as 60% of the nominal current of the motor. Minimum Underload setting is 0.2x nominal current, medium is 0.4x nominal current, and maximum position is 0.6x nominal current.
Applications	This protection helps to detect mechanical problems as broken shafts, belts, ... when this occurs, the motor is running on no load conditions. Working with pumps this protection help us to detect no load pump operation, due to a lack of water or pump input pipe water leakage.

| POT7	**UNDERLOAD CURVE**
Description	Underload curve.
Range	Min.-Max.
	Min: Fastest curve.
	Max: Slowest curve.
Function	This parameter sets the maximum operation time under underload conditions before tripping. See overload POT5.
Adjust	Depends on the application, but should be set to trip as soon as a condition occurs.
Applications	Pumps, fans.

POT8   **CURRENT LIMIT**
Description   Current limit at acceleration/deceleration
Range   0 a 5x nominal current of the soft starter.
Unit   Amps
Function   Maximum current a motor can draw during the acceleration/deceleration.
Adjust   Set the maximum current a motor can draw during the acceleration/deceleration
                     of the motor. Typically set to 2.5~3x nominal current of the motor.
                     Avoid using values below 2 times the motor's rated current as resulting motor
                     torque is generally insufficient to successfully start the load below this level; as
                     well as the soft starter would trip on Overload.
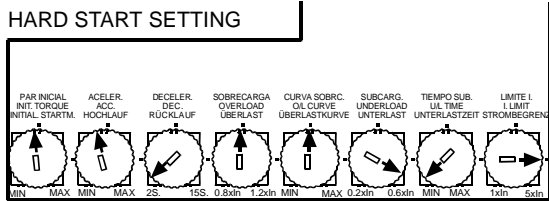
DT0041D

Fig. 20: Hard start potentiometer configuration.

8. APPLICATIONS.
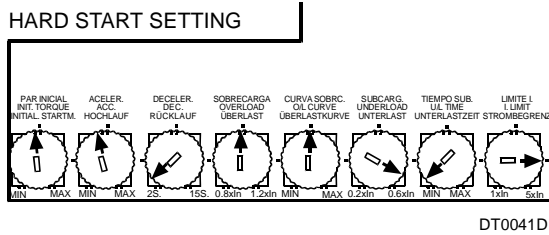
HARD START POTENTIOMETER CONFIGURATION.

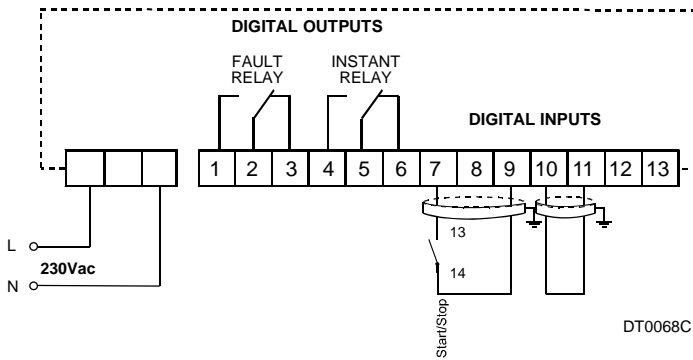*Fig. 21: Hard start potentiometer configuration.*

CONTROL TERMINALS

Fig. 22: V2 Control Terminals.
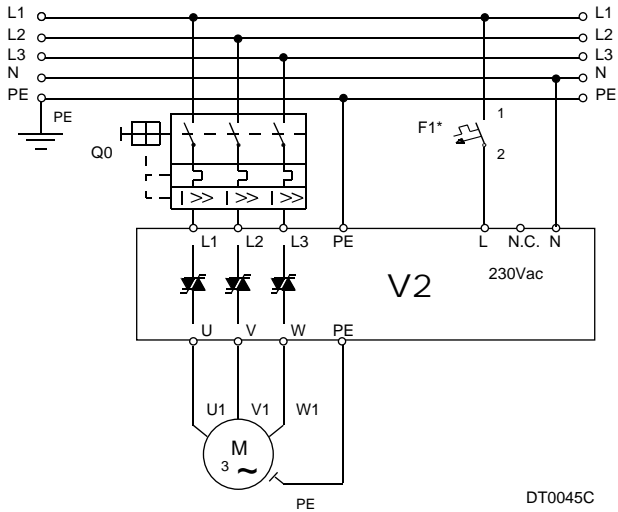
![V2 logo]
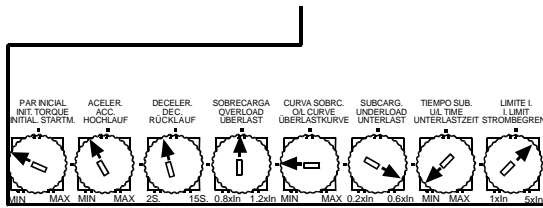
POWER WIRING

Fig. 23: V2 Power wiring configuration.

Note: Minimum recommended protection 1A for F1.

FANS AND PUMPS POTENTIOMETER CONFIGURATION.

DT0077A

Fig. 24: Fans and Pumps potentiometer configuration.

NOTE: For pumping systems please check fig. 14 and 16 to configure Jumpers 7 and 9 as deceleration ramp and underload activation.

DECLARATION OF CONFORMITY CE

The Company:

Name: **POWER ELECTRONICS ESPAÑA, S.L.**
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Declares under its own responsibility, that the product:

Electronic Softstarters for A.C. motors

Brand: Power Electronics
Model name: V2 Series

Is in conformity with the following European Directives:

References	Title
2006/95/CE	Electrical Material intended to be used with certain limits of voltage
2004/108/CE	Electromagnetic Compatibility

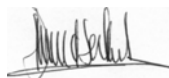**References of the harmonized technical norms applied under the Low Voltage Directive:**

References	Title
EN 60947-4-1:2001 A1:2002/A2:2005	Low-voltage switchgear and controlgear -- Part 4-1: Contactors and motor-starters - Electromechanical contactors and motor-starters.
EN 60947-4-2:2000 A1:2002/A2:2006	Low-voltage switchgear and controlgear -- Part 4-2: Contactors and motor-starters -- A.C. semiconductor motor controllers and starters.

References of the harmonized technical norms applied under the Electromagnetic Compatibility Directive:

References	Title
EN 60947-4-2:2000 A1:2002/A2:2006	Low-voltage switchgear and controlgear -- Part 4-2: Contactors and motor-starters -- A.C. semiconductor motor controllers and starters.

Paterna, January 17th 2008

David Salvo
Executive Director

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