Medium Voltage Soft Starter
HRVS - DN

HRVS-DN

Catalog • 2008/2009

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Medium Voltage Soft Starter HRVS-DN
Catalog 2008

1. Overview

Why Soft Starters?

Three-phase AC induction motors are commonly used in a wide variety of industrial applications. Due to their starting characteristics, in many cases these motors cannot be connected directly to the power supply system. When starting direct on line (DOL) the motor can see a very high surge current reaching up to 6 times the rated motor current. This excessive current puts stress on the supply system and the switchgear. Also, when starting direct on line, a very high peak torque can occur stressing the driven motor, the mechanical system including auxiliary power transmission parts (V-belt, gears, etc.).

There are several methods for reducing the damaging effects of this excessive starting current. Conventional methods include reactors and autotransformers. But these methods only allow the voltage to be reduced in steps whereas a soft starter provides step-free acceleration of the drive system by continuously increasing the voltage over a selected period of time. This approach to starting minimizes the effect of high inrush current on the supply system, the motor and the driven load.

Soft starters provide the following benefits:

- Reduced starting current eliminates voltage drops and dips of the supply network
- Smoother acceleration of loads eliminates process or product damage
- Extended lifetime of all mechanical components, e.g. eliminating gearbox damage and resulting in less maintenance and downtime
- Extended motor life
- Reduced maintenance and operating costs

HRVS-DN Enclosure Type IP31 (NEMA1 equivalent) closed view

HRVS-DN - Setting a New Standard

The HRVS-DN is an innovative product that provides a flexible, low cost alternative to fixed speed (DOL) starting.

Designed for use with standard medium voltage three-phase squirrel cage induction motors, this high-performance digital soft starter ensures smooth acceleration and deceleration.

HRVS-DN is available in all standard internationally recognized medium voltage ratings: 2.3 kV, 3.3 kV, 4.16 kV, 6 kV and 6.6 kV, 10kV, 11kV, 13.8kV and 15kV.

The standard current output range capability is from 60 - 2700A (200 kW to 50 MW).

HRVS-DN is designed and built to meet international standards including:

- IEC
- EN
- DIN VDE
- NEMA
- UL/CUL
- IEEE

The HRVS-DN soft starters are manufactured to the highest quality level. The entire design, production and delivery process has been certified DIN ISO 9001.2000.

The enclosed versions of the HRVS-DN are provided as ready-to-connect cabinet enclosed type units (shown in Figures 1 and 2) or - for OEMs only - chassis type OEM kits are available for building the unit into custom enclosures or other relevant equipment (please note: the complete interface is then the responsibility of the OEM or end user).

HRVS-DN Enclosure Type IP31 (NEMA1 equivalent) open view

1. Overview

HRVS-DN - Application Experience

The applications for the HRVS-DN medium voltage soft starter are many. From starting motors with limited supply power (including diesel-generators), avoiding inrush current on loaded transformers, preventing over pressure & water hammer in pumping, soft starting and soft stopping general industrial equipment (conveyors, shredders, ball mills, etc)…the list of possible uses is nearly endless.

For more details on Solcon's application experience around the world see the applications technical notes on our web site at www.solconusa.com.

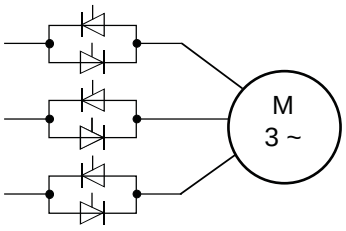
Examples of applications

- **Pumps (fresh water, sewage, hollow shaft, oil, etc.)**
- **Fans and blowers**
- **Extruders**
- **Centrifuges**
- **Mixers**
- **Compressors (screw type, piston, centrifugal, turbo)**
- **Refrigeration compressors**
- **HVAC systems**
- **Crushers**
- **Ball Mills**
- **Conveyors**
- **Marine**
- **Main propulsion**
- **Thrusters**
- **Anchor winches**
- **Bilge pumps**

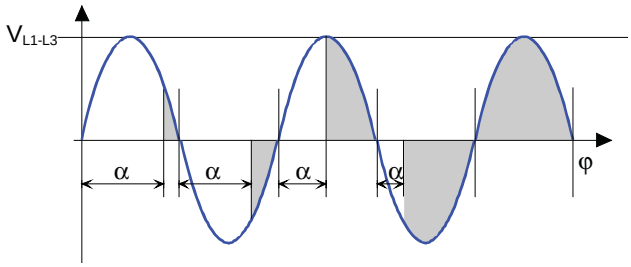
1. Overview

How Soft Starters Work

By using thyristors (SCRs) in a phase angle control mode, reduced voltage control can be achieved. Phase control makes it possible to gradually increase the motor terminal voltage from an initial set point up to the system supply voltage level. The related starting current and the starting torque can be optimally adjusted to the motor/load conditions.



Basic diagram of HRVS-DN medium voltage soft starter



Phase control of the line voltage using semiconductor (SCR) devices

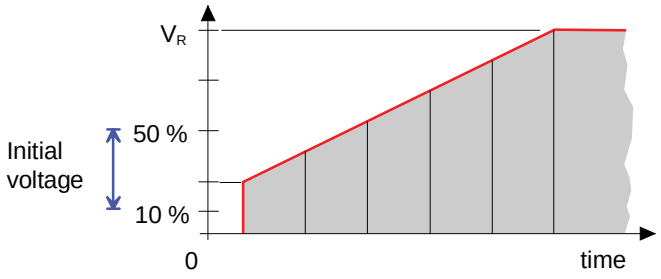
In addition, the Solcon HRVS-DN soft starters provide the “soft stopping” function as a standard feature. Similar to the reduced voltage start, upon a stop command the motor voltage is gradually decreased over time until the motor load stops. Abrupt stopping is avoided, a particular advantage in pumping applications to prevent the damaging effects of water hammer and on conveyor belts where the load may be damaged by an abrupt stop.

Starting and Stopping Characteristics

Initial voltage

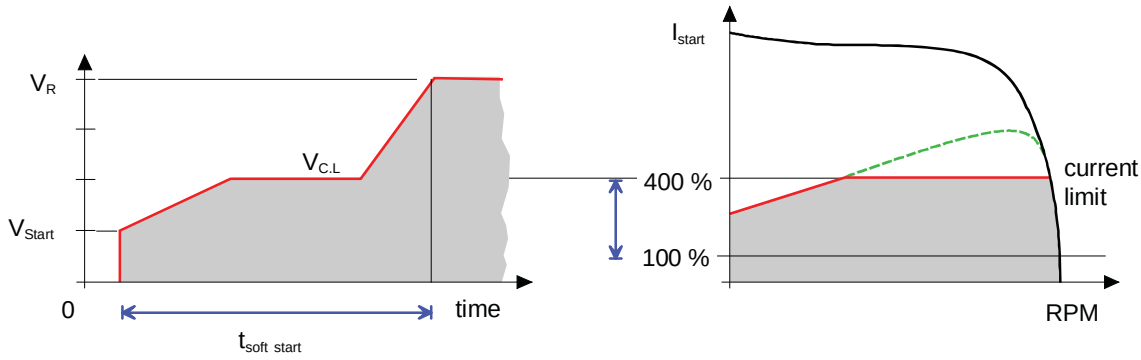
Determines motor’s initial starting torque (the torque is directly proportional to the square of the voltage). Adjustable from 10 – 50% of nominal motor voltage V_R (with option to extend to 80 % V_R).

This adjustment also determines the inrush current and mechanical shock. A setting which is too high may cause excessive initial mechanical shock and high inrush current (even if current limit is set low, as the initial voltage setting overrides current limit setting). A setting which is too low may result in prolonged start time before the motor shaft will begin to turn. Ideally, the motor shaft should slowly begin to turn immediately after a start signal is initiated.



Current limit

Determines highest allowable current during starting. Adjustable from 100 – 400% of nominal motor current I_R (with option to extend to 500 % I_R).



Too high a current limit setting will cause excessive current draw from the mains and faster acceleration. A setting which is too low may prevent the motor from completing the acceleration process and reaching full speed. In general this setting should be set to a value that is high enough to prevent the motor from stalling.

Note: Current limit is not operational during run mode or during soft stop.

1. Overview

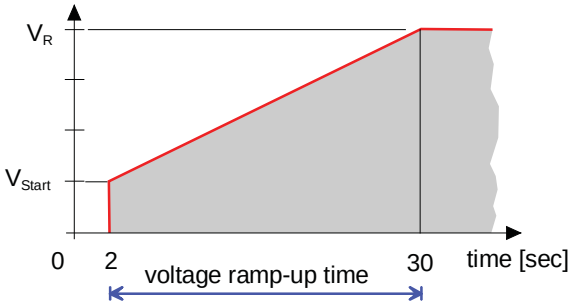
Acceleration (ramp-up time)

Determines the motor's voltage ramp-up time, from initial votage setting to full voltage. Adjustable from 1 - 30 seconds (with option to extend to 90 sec).

It is recommended that the acceleration ramp time be set to the minimum acceptable value (approx. 5 sec).

Notes:

- Since current limit overrides acceleration time, when current limit is set low starting time will be longer than the preset acceleration time.
- When the motor reaches full speed before nominal voltage is reached, acceleration time setting is overridden and voltage ramps up quickly to full voltage.



Deceleration - soft stop (ramp-down time)

Used for controlled deceleration of high friction loads.

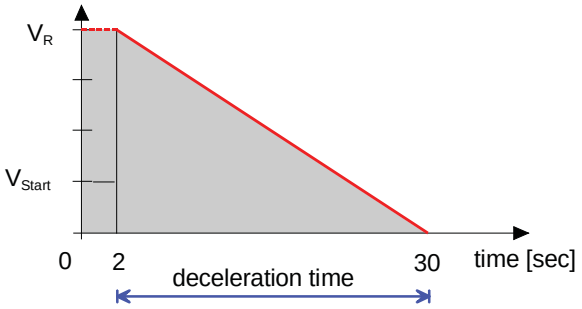
Determines motor's voltage ramp-down time. Adjustable from 1 - 30 seconds (with option to extend to 90 sec.)

Notes:

When soft starter is supplied with a by-pass contactor (standard):

- soft stop initiation opens the "end of acceleration" contact,
- tripping opens the by-pass contactor.

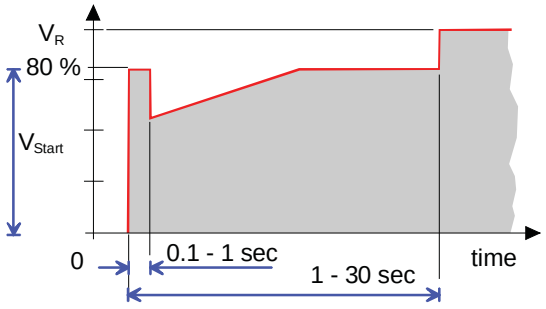
Load will then be transferred to the HRVS-DN and voltage begins ramping down.



Pulse start (kick start)

Intended to start high friction loads requiring high starting torque for a short period of time. A pulse of 80% V_R (without current limit) is initiated to break the load free. Pulse time is adjustable from 0.1 - 1 seconds.

After this pulse, the voltage ramps down to the initial voltage setting before ramping up again to full voltage based on the starting parameters settings.

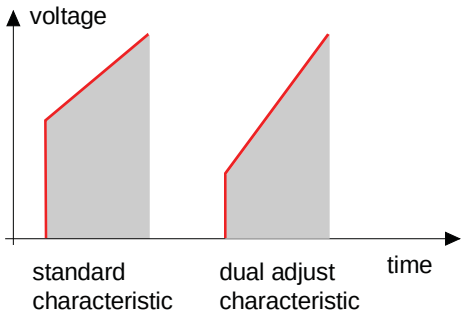


Dual adjustment

The HRVS-DN allows two start/stop characteristics for varying load applications (example: starting and stopping different motors or loads that vary due to changing ambient conditions).

Dual adjustment parameters are:

Special starting mode:	Diesel generator supply*
Initial voltage:	10 - 50 % (80 %) VR
Current limit:	100 - 400 % of motor FLA setting
Motor FLA:	50 - 100 % starter Full Load Current (FLC) setting
Acceleration time:	1 - 30 sec (with option to extend to 90 sec)
Deceleration time:	1 - 30 sec (with option to extend to 90 sec)



***Diesel generator starting**

When starting from older Diesel generator sets (especially those equipped with low cost voltage regulators) both voltage and frequency are unstable causing irregular firing of the SCRs. The HRVS-DN is equipped with a special program which overcomes this voltage and frequency instability.

1. Overview

Pump control - Start curves

Induction motors produce peak torque of up to 3 times the rated torque during the starting process. In some pump applications, this peak may cause high pressure in the pipes.

Standard soft starters drastically reduce the starting torque however peak torque still remains high, causing high acceleration torque and rapid acceleration toward the end of starting process. Peak torque and acceleration torque must be reduced in order to extend the acceleration time.

The HRVS-DN provides 6 different starting curves for voltage ramp-up to reduce peak torque and extend acceleration time:

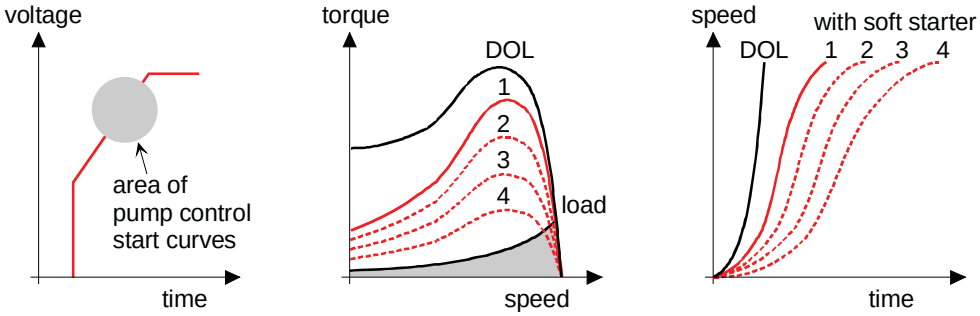
Curve 0: Basic curve for commissioning.

Curve 1: Standard curve (default). The most stable and suitable curve for the motor; prevents prolonged starting time and motor overheating.

Curves 2, 3, 4: During acceleration (before reaching peak torque) the pump control program automatically controls the voltage ramp-up, reducing peak torque.

Curve 5: Torque curve

By default, the process should always be started using curve 1. If toward end of acceleration the peak torque is considered to be too high (pressure is too high) starting curves 2, 3 or 4 can be selected instead.



Pump control - Stop curves

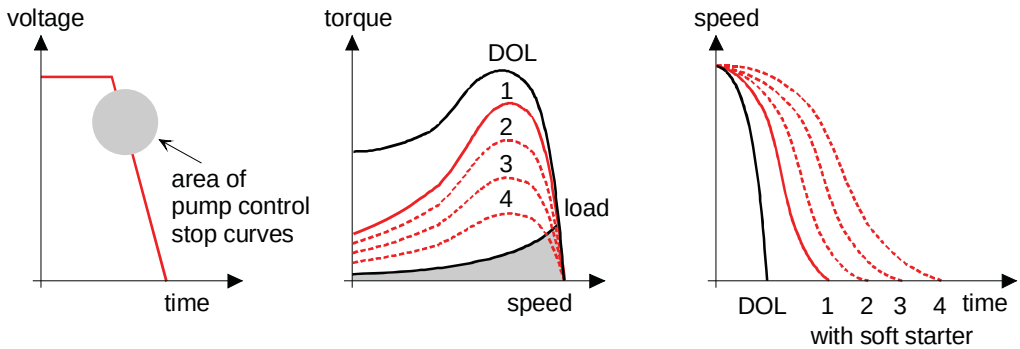
When stopping a pump motor using a starter that does not have the soft stop feature, motor torque will immediately fall below the load torque. This causes abrupt stalling creating the water hammer phenomenon which can be very damaging to the pump, the pipes, valves, etc. A soft starter with the “Soft stop” feature will smoothly decreases the motor speed to zero, eliminating this phenomenon.

The HRVS-DN incorporates 4 different stopping curves for special voltage ramp-down (decel control) preventing the motor from stalling and eliminating water hammer. The pump control stop curves can also be set so the final torque stops the motor when the valve closes.

Curve 1: Standard default curve. The voltage is linearly reduced from nominal to zero.

Curves 2, 3, 4: According to the actual pump characteristic the soft stop behavior can be selected out of four preset curves.

By default, always try using curve 1 first. If the motor stalls quickly instead of slowly decreasing its speed, try stop curve 2. If this still is not satisfactory, try curves 3 or 4.



2. Product Design

Standard HRVS-DN Soft Starter Design

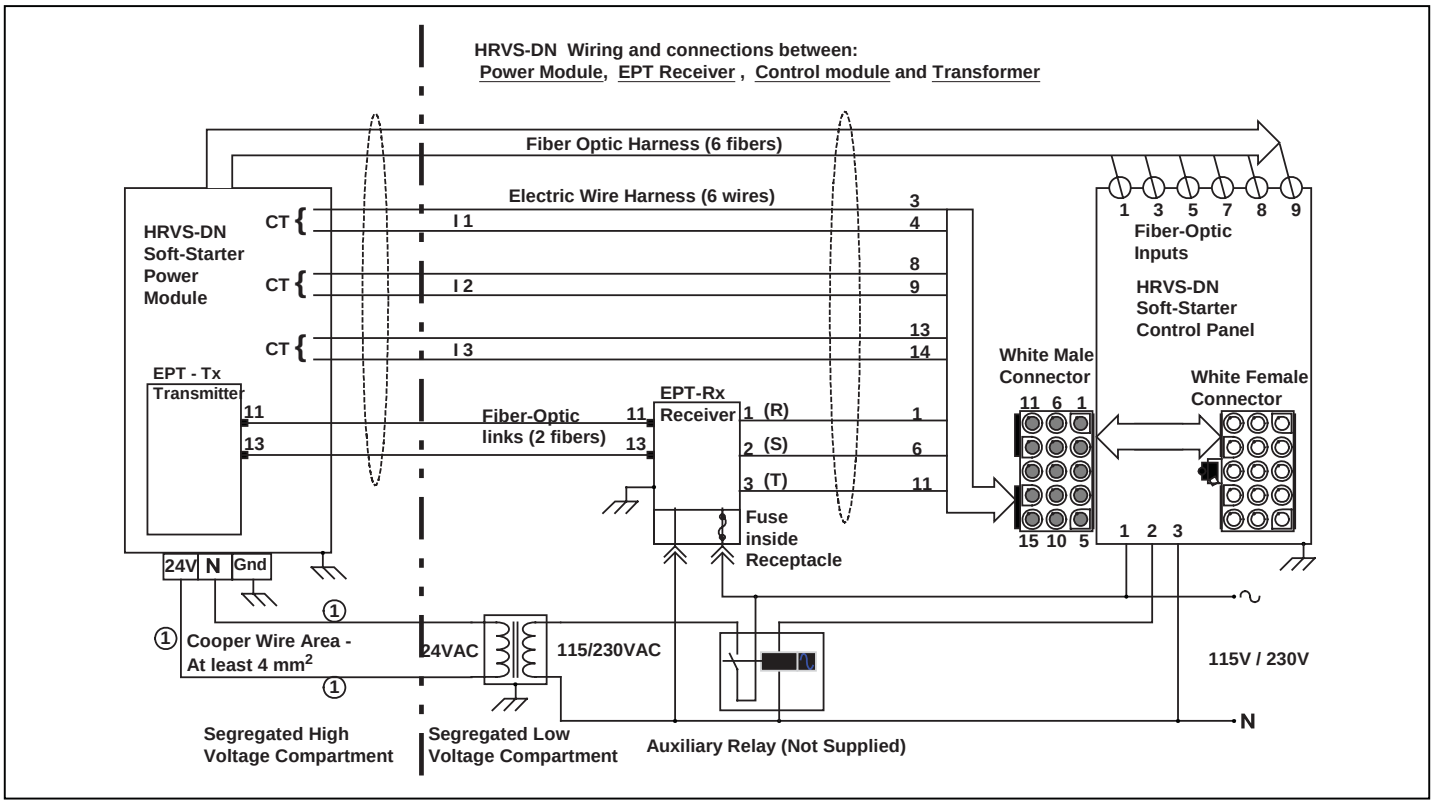
The HRVS-DN soft starter is supplied in a standard IP31 (NEMA1 equivalent) enclosure ready to be installed and operated. Optional IP54 (NEMA3R/12) enclosure is available for harsh environmental conditions.

The design includes:

- Digital soft starter, high-voltage and low-voltage compartment
- Switchgear, line and bypass vacuum contactors.
- Low voltage controls

Optional RS485 communication is available (Modbus, Profibus or others), allowing for:

- remote control (start, stop, etc.)
- remote supervision



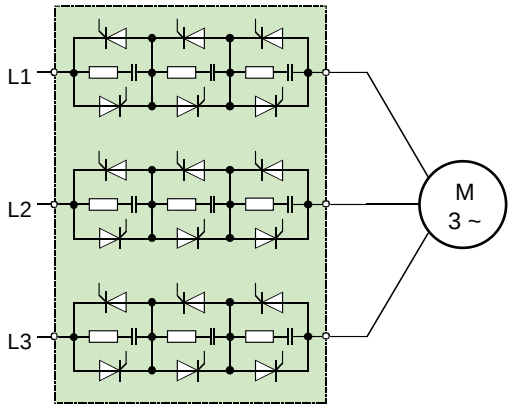
Basic diagram of HRVS-DN enclosed unit

High voltage compartment

The advanced digital firing system connects the low voltage control to the high voltage section via fiber optics.

A service-friendly design allows the individual phase modules to be changed (if required) in a minimal amount of time.

The high-voltage compartment is fully segregated from the low-voltage compartment for safe operation.



Block diagram of digital medium voltage soft starter HRVS-DN (power section with 18 SCRs).

2. Product Design

Low-voltage compartment

The HRVS-DN has a separate, front accessible low voltage compartment mounted in the front door of the enclosure which includes the following components:

- Soft starter digital control module
- 2 miniature circuit breakers (6A)
- 1 selector switch soft starter off / bypass (DOL)
- 1 selector switch local / remote operation
- 8 interposing relays
- 2 pushbuttons start / stop
- 1 mushroom type emergency stop button
- 5 pilot lights: line contactor open (green),
  line contactor closed (white),
  by-pass contactor closed (white),
  fault (red)
  remote (white)
- Motor protection relay (optional)

All control components in the LV-compartment are wired to a customer terminal strip. The low voltage compartment door can be opened without switching off the starter.

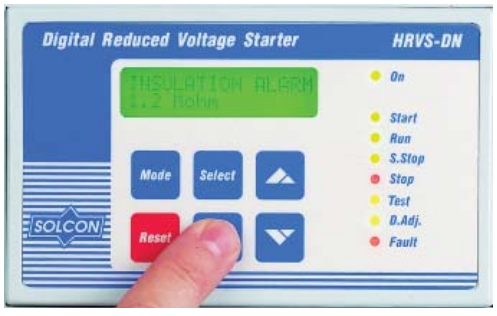
Operator panel

The HRVS-DN digital operator panel is easy to read, easy to navigate and easy to program. Critical parameters are factory preset but parameters can easily be changed via the user-friendly operator panel.

HRVS-DN Digital Operator Panel Located in isolated low voltage compartment

Operator panel with

- LCD-display:
  - Two lines, 16 characters each, back light
  - Selectable languages:
    English, German, French, Spanish (Chinese and Russian optional)
- 8 LEDs for quick status display
- 6 keys, menu driven software, default parameters



HRVS-DN LCD display/keypad operator

2. Product Design

MV Chassis Kit

Chassis type “OEM kits” are also available to qualified integrators for use in customized enclosures and switchgear.

Content of the chassis kit:

1. Control Module
2. Power Section & Fiber Optic Wire Harness
3. 24VAC Control Transformer

Power Section

Control Module

Transformer to 24VAC

Electronic P/T Receiver

HRVS-DN “Custom Line Up” using OEM kit

2. Product Design

Custom Lineups and Special Designs

Solcon is well known for their ability to provide unique technical solutions to the most challenging application requirements. These include custom linueps, synchronous motor starters and multi-motor starting... just to name a few. And, Solcon is the only company in the world who can offer a medium voltage soft starter for use in explosive environments.

With ratings from 2.3 kV to 15kV and up to 2500A, Solcon can provide the medium voltage soft starter designed to meet your specific application needs.

Explosion proof HRVS-DN medium voltage soft starter with EEx-D[ia]I

Synchronous HRVS-DN medium voltage soft starter with excitation controller

10 - 15kV HRVS-DN medium voltage soft starters rated up to 2700A

Multi-start system HRVS-DN with built in PLC control for sequential soft starting and stopping up to five MV motors

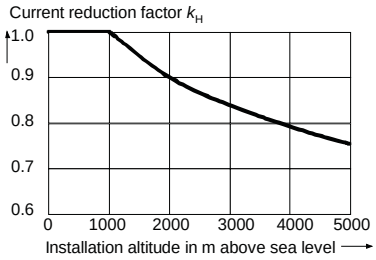
3. Specifications

General Specifications

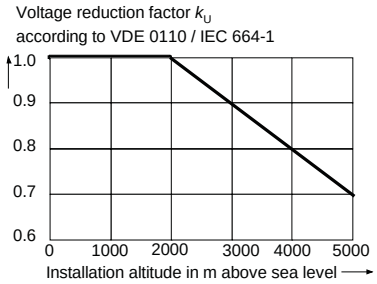
Power components	Uniquely ordered and specially matched sets of thyristors (SCRs)
Converter circuit arrangement	Three-phase AC voltage controller according to IEC 146
Controller	Fully digital with 32 Bit-Processor
System voltages	2.3 kV, 3.3 kV, 4.16 kV, 6.0 kV, 6.6 kV, 10KV, 11KV, 13.2KV, 13.8KV and 15KV
Current ratings	60 - 2700A
System frequency	50 / 60 Hz, ± 3%
System voltage tolerance	+10 %, -15 %
Auxiliary power supply (control voltage)	1-ph. 110 - 230 V AC, 50/60 Hz (std) 1-ph. 220 - 240 V AC, 50/60 Hz 110 V DC 35 VA running, 350 VA starting
Electrical isolation between power section and Control and feedback signals	Fiber optics
Degree of protection	IP00 (Chassis/OEM Kit) IP31 (NEMA1) standard IP54 (NEMA3R/12) optional
Cooling method	Air Cooling / Forced Air Cooling
Complied standards	IEC, EN, NEMA, UL/CUL, CSA, IEEE
Paint finish	RAL 7032, others upon request

The HRVS-DN is designed to operate under the following conditions:

Max. starting current		400 % of the motor's Full Load Ampere (FLA)
Max. starting time		30 sec, at 400 % FLA
Max. number of starts		4 starts at max. conditions (400 % I_R for 30 sec at 40 °C) (higher number of starts per hour based on the application)
Ambient temperature:	operating transportion storage	0 to + 40 °C, max. 60 °C, de-rating by 10 % for each 5 °C above 40 °C -10 to + 50 °C -25 to + 70 °C
Installation altitude		Max. 1000m above sea level, for higher altitudes de-rating required (see figures below)
Maximum relative humidity		95 %, non-condensing



Current reduction factor k_H as a function of the installation altitude



Voltage reduction factor k_U as a function of the installation altitude

3. Specifications

Motor and Starter Protection

Name / Description	Adjustments	Active protection at:			
		Start	Run	Soft Stop	Stop
Too many starts Prevents excessive starts during a set time period	- permitted number of starts: 1 - 4 - start period: 1 - 60 min - start inhibit time: 1 - 60 min (after too many starts)	+	-	-	-
Long start time Prevents stall condition, trips the starter if current does not drop to a fixed level within selected time.	- adjustable time: 1 - 30 sec	+	-	-	-
Over current shear-pin Trips the starter in less than 1 cycle when current exceeds 850 % I_{FLC}. Shear-pin ("immediate relay" set to "Shear-pin") - Stops (n/o trip) the motor when current exceeds the set level after preset time delay	- trip current: 200 - 850 % Motor FLC (during starting 850 %) - shear-pin delay: 0.5 - 5 sec (no delay at 850 %)	+	+	+	+
Motor overload Inverse time electronic overload becomes operational when RUN LED is lit. The O/L circuitry incorporates a thermal memory register calculating heating minus dissipation of the motor. The starter trips when the register fills up. The thermal register resets itself 15 minutes after the motor stops.	- motor FLA between: 75 - 150 % and factory set at 115 % - tripping time at 500 % FLA is adjustable between 1 - 10 seconds allowing trip curve selection.		+	-	-
Under current Trips the starter when current falls below the U/C Trip level after preset time delay. Under current auto reset allows for restarting after a predefined period of time to re-check the under current status.	- trip current: Off, 20 - 90 % I_{FLA} - trip delay: 2 - 40 sec	-	+	-	-
Under / no voltage Trips the starter when voltage drops below the U/V trip level after the preset selectable time delay. With programmable auto-reset.	- trip level: 60 - 90 % U_N - trip delay: 1 - 10 sec The starter will trip immediately, overriding the time delay if voltage drops to zero	+	+	+	-
Over voltage Trips the starter when voltage increases above the O/V trip level after the preset time delay.	- trip level: 110 - 125 % - trip delay: 1 - 10 sec	+	+	+	-
Phase loss Trips the starter when one or two phases are missing for over 1 sec. (programmable auto reset)		+	+	+	-
Phase sequence Trips the starter immediately when phase sequence is wrong.		+	+	+	-
Wrong connection / shorted SCR Trips the starter if: - motor is not properly connected to starters' load terminals - internal disconnect in the motor winding is detected - one or more SCRs are shorted - fiber optic lead insertion is incorrect		+	-	+	-
Heat sink over temperature Thermal sensors are mounted on the heat sink and trip the starter when temperature rises above 85 °C		+	+	+	-
External fault 1 & 2 Inputs from two NO contacts. The starter trips 2 sec after either of the contactors close		+	+	+	+
Unbalance Current Operational after start signal, trips the starter when current unbalance exceeds the preset "UNBALANCE TRIP" setting for more than "UNBALANCE DLY" time setting Range: 10 - 100 %, delay: 1 - 60 sec.		+	+	+	-
Ground fault current Operational after start signal, trips the starter when ground current exceeds the preset "GND FAULT TRIP" for more than "GND FAULT DLY" time Range: 10 - 100 %, delay: 1 - 60 sec.		+	+	+	-
Power on & no start Operational upon mains voltage connection. Trips the motor when mains is connected to the HRVS-DN for more than 30 sec without a start signal.		+	-	-	+
Bypass Open Operational when the bypass contactor does not close after "end of acceleration" contact signaled the interposing (pilot) relay to close.		-	+	-	-

"+" is active
"-" is not applicable or inactive

4. Product Selection

Selection and Ordering Data

HRVS-DN Series

Order No.	Example: HRVS-DN	**HRVS-DN 200-4160-115-115-S IP00**

Type

0	Chassis-type:	Degree of protection IP00
1	Cabinet-type:	Degree of protection IP31 (NEMA 1 equivalent)
	Other types available:	IP54 (NEMA3R/12 equivalent) and others

Nominal current

2.3 kV / 3.3 kV / 4.16 kV	6.0 kV / 6.6 kV
60 A	70 A
110 A	140 A
200 A	250 A
320 A	300 A
400 A	400 A
600 A…	500 A…
up to 2700 A	up to 2700 A

Nominal voltage

2300 V	6000 V	11000 V
3300 V	6600 V	13800 V
4160 V	10000 V	15000 V

Control voltage supply

115 VAC Standard
230 VAC Optional
110 VDC Optional
125 VDC Optional
220 VDC Optional
240 VDC Optional

Options

The soft starter can be equipped with a variety of options and are indicated as a supplementary code (See page 13)

4. Product Selection

Standard Scope of Supply

Control input voltage	115VAC	Standard, 240VAC or 110-240VDC optional
Analog outputs	Optional	Analog output card option
Input / output cable entry	Top or bottom entry	Standard on all enclosed units
Door opening	Hinge on left side, right hand side opening	Alternative for left to right opening available, applied to enclosed units only
Main isolation switch	Class E2 starter version	Standard, option for VCB at higher ratings
Main fuses	Class E2 starter version	Standard
Line contactor	Fixed, vacuum	Standard, option for VCB at higher ratings
Bypass contactor	Fixed, vacuum	Standard, option for VCB at higher ratings
Motor protection relay	Optional	MPS3000 or other models available depending on application requirements
Digital panel meter	Optional	
Space heater	Optional	Standard in IP54 (NEMA3R/12 equivalent) enclosed units, thermostat controlled
Cooling fan	Optional	

Available Options

Here are just a few of the many options and accessories available from Solcon. Contact us for your specific application requirements.

Code	Name / Description	Comment
Electrical options		
3M	RS-485 communication with MODBUS	No bridge required
3P	RS-485 communication with PROFIBUS	No bridge required
Relay	Relay card for start/stop control via communications	
Fan	Fan on top, air entry at bottom with filter and circuit breaker	For excessive starts per hour requirements
5	Analog output module	
MPS3000	Motor protection relay with 10 PT100 inputs	
400	400 V test voltage	for LV-motor test *
460	460 V test voltage	for LV-motor test *
575	575 V test voltage	for LV-motor test *
690	690 V test voltage	for LV-motor test *

* Complete functional test of the soft starter can be carried out using a small LV motor (3 to 10 kW).

Mechanical options		
Thick paint	Special painting, extra thick	Specify mil thickness and paint color
TIN	Tin-plated copper bus bars	
IP32-67	Degree of protection, enclosure options	NEMA12 - NEMA4X available
M	Suitable for marine applications	
Multi-start	For multi-motor applications	Contact factory for details
Spare part packages		
Spares - 1 year	Spare parts package 1	Includes: 1 - Phase power section module 1 - Digital controller module 1 - Vacuum contactor 1 - Current transformer 1 - Electronic PT (Tx and Rx) 1 - Firing power supply board
Spares - 2 years	Spare part package 2	Includes: 2 - Phase power section modules 1 - Digital controller module 1 - Vacuum contactor 1 - Current transformer 2 - Electronic PT (Tx and Rx) 1 - Firing power supply board

4. Product Selection

Application Information

To select the right soft starter, generally only the motor nominal voltage and motor full load current (FLA) need to be known. However, when sizing HRVS-DN soft starters for special applications, environments or starting conditions, the following information should be provided before ordering:

1. General data required for standard soft starter applications:

1.1 Type of application (Pump, Compressor, Conveyor, etc.)
1.2 Motor Rated Power (KW or HP)
1.3 Motor Full Load Current (FLA)
1.4 Motor Nominal Voltage (V)
1.5 Motor Synchronous speed (RPM)
1.6 Motor current vs. speed curve or Ist/In (% or Per Unit)
1.7 Motor speed/torque curve
1.8 Tmax/Tn (% or Per Unit)
1.9 Rotor inertia J=GD2/4 (Kgm2)
1.10 Load speed/torque curve (% or per unit)
1.11 Load inertia J=GD2/4 (Kgm2) at motor speed
1.12 Number of starts per hour and time between starts
1.13 Cabinet degree of protection (1PXX or NEMA requirement)
1.14 Ambient temperature
1.15 Altitude (Meters or feet Above Sea Level)
1.16 Power cables entry (Top or Bottom)
1.17 Max. Shipping split dimensions (WXHXD)

2. Data to be requested for soft starters requiring synchronous motor exciters:

2.1 Type of exciter (Rotating or Static)
2.2 Full nameplate data of motor and exciter
2.3 Is it new or refurbished motor
2.4 Data for existing/old excitation system
2.5 For rotating exciter DC voltage, DC current of the exciter generator field
2.6 For static exciter DC voltage, DC current of motor field
2.7 For static exciter full data of field starting/discharge resistor
2.8 If retrofit application, will the existing static exciter field starting/discharge resistor be used? If not, will customer supply or is this in Solcon's scope of supply?
2.9 Availability of LV 3 phase supply KVA required: 250V X IDC X 3 phaseX 1.3. Advise voltage and frequency

Note:

- A soft starter operated motor cannot deliver more torque than that of the motor started direct on line.

4. Product Selection

Standard Ratings, Dimensions for IP00/Chassis and Enclosed Units

The starter must be selected based on the motor's Full Load Ampere (FLA) as indicated on its nameplate (even if the motor is not fully loaded). The kW and HP ratings given in the following selection table are related to standard motors and are for reference only.

Note: Weights do not include the disconnect and fuses. Contact Solcon USA for actual weight and dimensions of Class E2 starters.

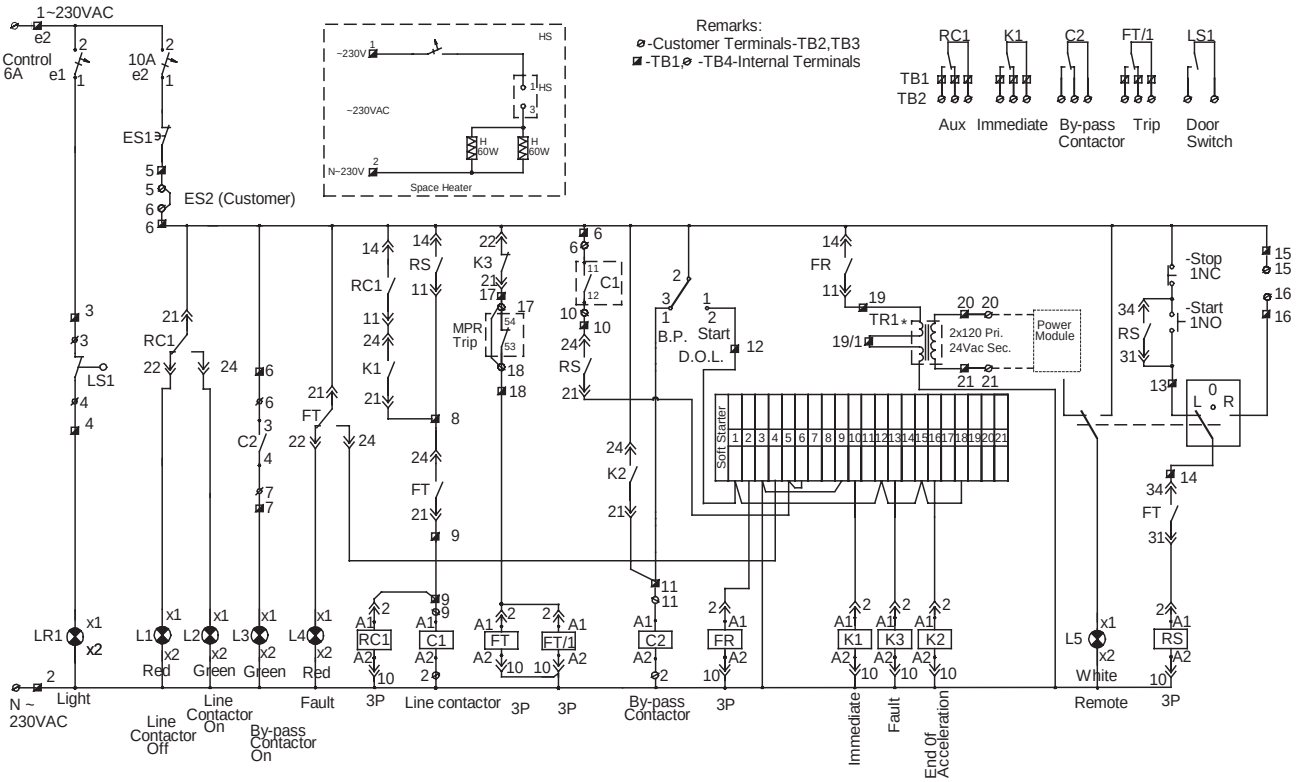
System Voltage	Starter Current	Motor KW	Motor HP	IP 00 (Chassis Version) Dimensions (mm) & Weight				IP 31 - 67 (NEMA 1- 3R,4X) Dimensions (mm) & Weight			IP 31 With L+BP contactors
				W	H	D	(Kg)	W	H	D	(Kg)
2300	60	200	260	660	550	470	90	900	2300	1000	500
	110	360	480	660	550	470	90	900	2300	1000	500
	200	660	880	660	550	470	90	900	2300	1000	500
	320	1,060	1,420	660	550	470	130	900	2300	1000	530
	400	1,330	1,770	660	800	490	160	900	2300	1000	570
	600	2,000	2,700	660	800	490	200	900	2300	1000	650
	800	2,660	3,600	900	1120	620	350	1100	2300	1100	1050
	1000	3,330	4,500	900	1120	620	450	1100	2300	1100	1100
3300	60	280	380	660	900	470	140	900	2300	1000	550
	110	520	700	660	900	470	140	900	2300	1000	550
	200	950	1,300	660	900	470	140	900	2300	1000	550
	320	1,530	2,050	660	900	470	140	900	2300	1000	550
	400	1,910	2,600	660	1000	470	200	900	2300	1000	650
	600	2,850	3,900	660	1000	470	250	900	2300	1000	650
	800	3,820	5,200	900	1120	620	400	1100	2300	1100	900
	1000	4,780	6,500	900	1120	620	400	1100	2300	1100	1100
4160	60	360	490	660	900	470	140	900	2300	1000	550
	110	660	880	660	900	470	140	900	2300	1000	550
	200	1,200	1,600	660	900	470	140	900	2300	1000	550
	320	1,930	2,570	660	900	470	150	900	2300	1000	560
	400	2,410	3,210	660	1000	470	180	900	2300	1000	620
	600	3,610	4,900	660	1000	470	195	900	2300	1000	650
	800	4,820	6,500	900	1120	620	450	1100	2300	1100	1050
	1000	6,030	8,200	900	1120	620	500	1100	2300	1100	1100
6600	70	670	900	900	1030	570	250	1100	2300	1100	850
	140	1,340	1,800	900	1030	570	250	1100	2300	1100	850
	250	2,390	3,200	900	1030	570	250	1100	2300	1100	850
	300	2,870	3,900	900	1120	580	300	1100	2300	1100	900
	400	3,820	5,200	900	1120	580	300	1100	2300	1100	900
	500	4,780	6,500	900	1120	620	300	1100	2300	1100	900
	700	6,740	9,100	1200	1200	713	450	1400	2300	1200	1150
	800	7,650	10,400	1200	1200	713	550	1400	2300	1200	1250
	1000	9,570	13,000	1200	1200	713	650	1400	2300	1200	1350
	1200	11,500	15,600	1200	1200	713	650	1400	2300	1400	1350
10,000	70	1,020	1,360	1136	1370	640	785	2600	2300	1200	2100
	140	2,040	2,720	1136	1370	640	785	2600	2300	1200	2100
	250	3,650	4,900	1136	1370	640	785	2600	2300	1200	2100
	300	4,300	5,900	1136	1370	640	810	2600	2300	1200	2100
	400	5,800	7,900	1136	1370	640	850	2600	2300	1200	2100
	700	10,150	13,800	1500	1700	750	1200	3500	2400	1400	2500
	800	11,600	15,800	1500	1700	750	1200	3500	2400	1400	2500
	1000	14,500	19,700	1500	1700	750	1500	3500	2400	1400	2800
	1200	17,400	23,700	1500	1700	750	1500	3500	2400	1400	2800
11,000	70	1,100	1,500	1136	1370	640	800	2600	2300	1200	2100
	140	2,200	3,000	1136	1370	640	800	2600	2300	1200	2100
	250	4,000	5,400	1136	1370	640	800	2600	2300	1200	2100
	300	4,800	6,500	1136	1370	640	830	2600	2300	1200	2100
	400	6,400	8,650	1136	1700	640	870	2600	2300	1200	2100
	700	11,200	15,200	1500	1700	750	900	3500	2400	1400	2700
	800	12,800	17,300	1500	1700	750	950	3500	2400	1400	2700
	1000	16,000	21,700	1500	1700	750	1000	3500	2400	1400	2800
	1200	19,200	26,000	1500	1700	750	1000	3500	2400	1400	2800
13,800	70	1,400	1,900	1136	1700	640	900	3000	2400	1200	2800
	140	2,800	3,800	1136	1700	640	900	3000	2400	1200	2800
	250	5,000	6,800	1136	1700	640	900	3000	2400	1200	2800
	300	6,000	8,150	1136	1700	640	950	3000	2400	1200	2800
	400	8,000	10,900	1136	1700	640	1000	3000	2400	1200	2800
	700	14,000	19,000	3000	1400	750	1150	4200	2400	1400	2900
	800	16,000	21,800	3000	1400	750	1150	4200	2400	1400	2900
	1000	20,000	27,200	3000	1400	750	1400	4200	2400	1400	3100
	1200	24,000	32,700	3000	1400	750	1500	4200	2400	1400	3100
15,000	70	1,500	2,000	1136	1900	640	950	3000	2500	1200	3150
	140	3,000	4,100	1136	1900	640	950	3000	2500	1200	3150
	250	5,400	7,400	1136	1900	640	950	3000	2500	1200	3150
	300	6,500	8,800	1136	1900	640	1000	3000	2500	1200	3200
	400	8,700	11,800	1136	1900	640	1050	3000	2500	1200	3250
	700	15,200	20,700	3000	1500	750	1300	4200	2500	1400	4100
	800	17,400	23,700	3000	1500	750	1300	4200	2500	1400	4100
	1000	21,800	29,600	3000	1500	750	1700	4200	2500	1400	4200
	1200	26,150	35,500	3000	1500	750	1700	4200	2500	1400	4200

5. FAQs

Question	Answer
Can an HRVS-DN soft starter be used to start a heavy-duty load or a load with a high moment of inertia if the motor will not start direct-on-line (DOL)?	**Yes** **But we need certain data to calculate the minimal starting conditions. Contact technical support for assistance.**
Can an HRVS-DN soft starter be connected to the medium-voltage bus without using a load breaker?	**Yes** The HRVS-DN can be provided without a load break switch (with inline and bypass contactors only). A fused load-break disconnect switch at the medium-voltage feeder is sufficient. The fuses are only used as cable protection and protection against catastrophic failure. The motor protection relay is usually included in the circuit breaker or the soft-starter can be equipped with a comprehensive motor protection relay (MPS3000 or equivalent) If an existing circuit-breaker is used, this can remain closed or switches in the no-current condition (exception: under fault conditions)
Can an HRVS-DN soft-starter also be used to start synchronous motors?	**Yes** A non-excited synchronous motor behaves essentially the same as a squirrel-cage induction motor. If the motor has reached the rated speed in a non-excited condition (rated slip in induction motor operation), the excitation system (which can be supplied by Solcon) is switched-in and the motor then pulls into synchronized mode
Is the HRVS-DN soft-starter available in an explosion-proof version?	**Yes with certification (EEx-D)[ia]I** Solcon is the only MV soft starter manufacturer in the world to offer this certification.
Can the HRVS-DN soft-starter be used to start several different motors or can one HRVS-DN soft starter be used to start more than one motor?	**Yes** Two parameter settings can be programmed using the "Dual Adjustment" function. This means that two different motor types can be started. However, there may be little difference in the actual motor output. Several identical motors can be started. However, due to the higher thermal load, a larger soft-starter (always equipped with a fan), must be used. One (or several) additional cabinets with vacuum contactors can be provided for sequential starting of multiple motors.
When is a tachometer (shaft encoder) required to be used with the HRVS-DN soft-starter?	A tachometer is generally not required for standard applications, only for special cases: • Soft stopping with shutdown (power-off) at a specific speed • Starting and/or stopping with an adjustable speed profile • If it has to be accurately determined when the motor has reached full speed
Can the HRVS-DN soft-starter be used for braking?	**YES**
Is the HRVS-DN soft-starter also available in an outdoor versions ?	**Yes** to NEMA 3R (IP67)
Is the HRVS-DN soft-starter designed to meet industry sector-specific and local standards	**YES** IEC, NEMA UL / CUL in process DNV and ABS or similar upon request
Is it possible to use HRVS-DN soft-starters on synchronous or slip ring motors?	**Yes** Unless the slip ring motor was originally specified due to especially high starting torque requirements. Under these circumstances, a soft-starter cannot be used !
Can you use the HRVS-DN soft starter with any manufacturer's motor?	**Yes** In especially critical cases, increased pulsating torques can be observed with some motor designs. The non-sinusoidal current and voltage waveform of the soft starter does not represent a risk.
Can HRVS-DN soft starters operate at high altitudes (i.e. locations 4000m above sea level)?	**Yes** But the nominal voltage and current have to be reduced based on the derating table (please refer to page 10) and the starting frequency (number of starts per unit time) may need to be reduced
Can the HRVS-DN soft-starter be operated with supply voltages which are not listed in the table (intermediate values)?	**Yes** In this case, the next higher voltage class should be selected, and the actual supply voltage specified when ordering.
Can an HRVS-DN soft starter be operated into a step-up transformer?	**Yes** But why should a step-up transformer be used when Solcon offers the HRVS-DN in ratings up to 15kV?
Does an HRVS-DN soft-starter generate harmonics which are fed back into the supply?	**Yes** But only for a very brief period of time until the bypass contactor closes (low level harmonies only)

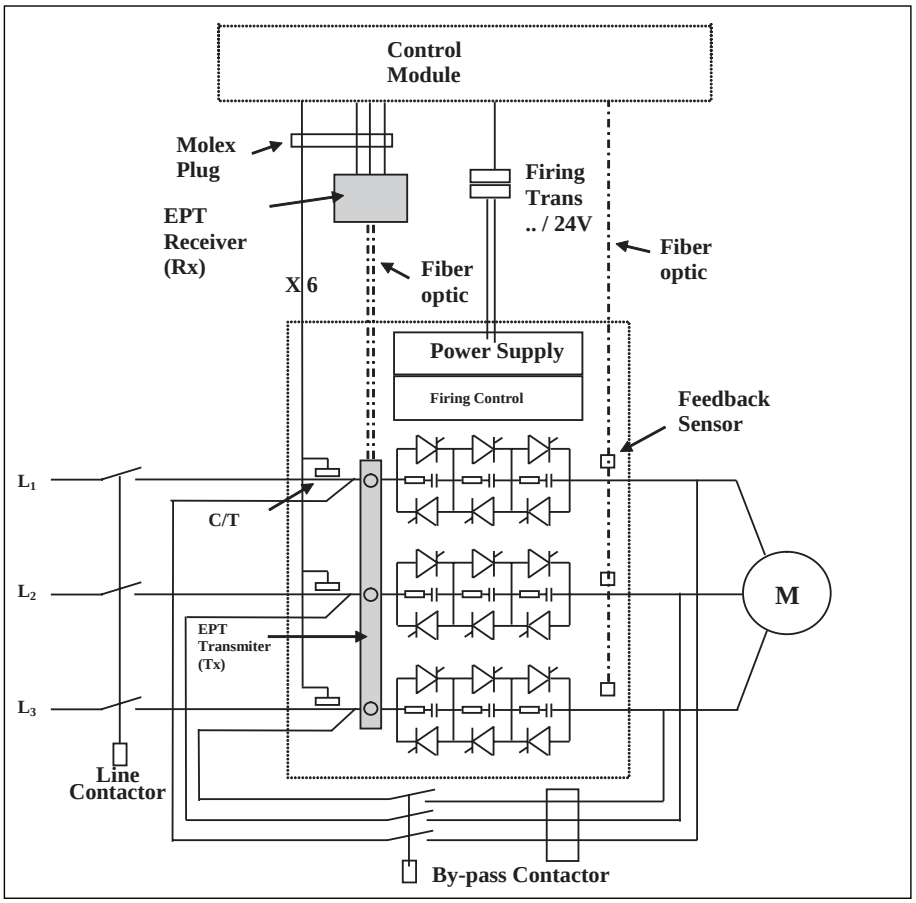
6. Wiring diagrams and dimensional drawings

Wiring diagram



Note: Current is continuously monitored even when the bypass contactor is closed.

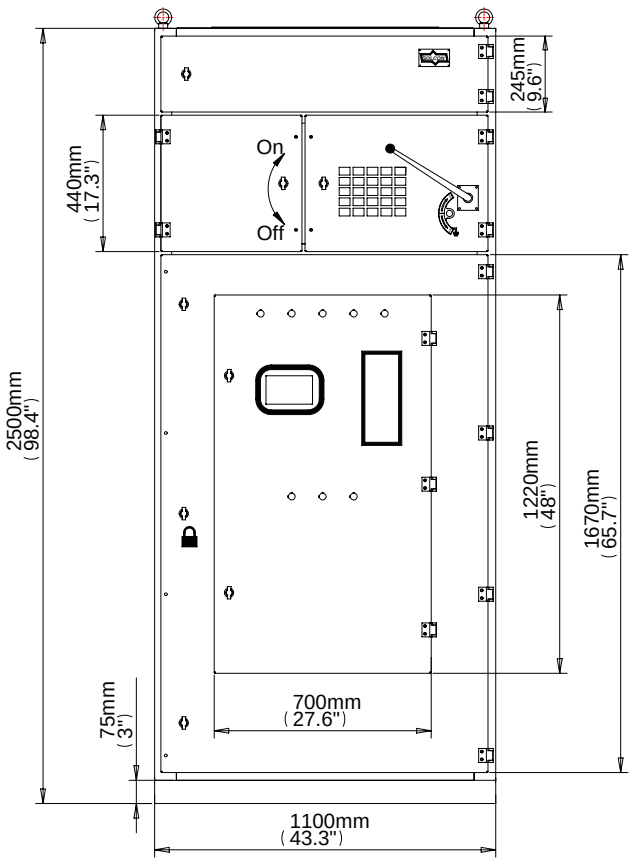
Block diagram



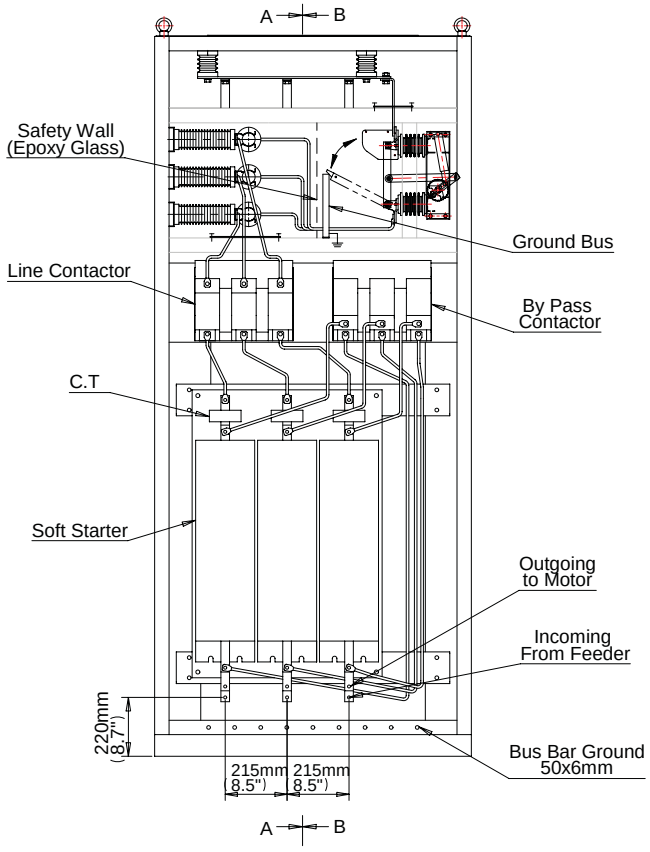
6. Wiring Diagrams and Dimensional Drawings

Dimensional drawings

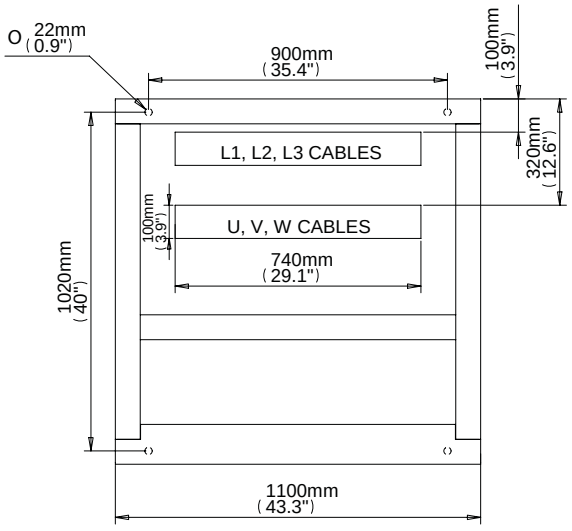
Typical Enclosed unit IP31/54
2.3 / 3.3 / 4.16 kV up to 400 A (ALL IN ONE DESIGN)



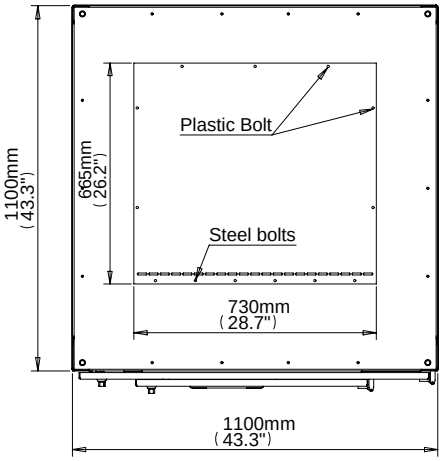
BASE



TOP



Front



Front

Notes:

1. Dimensions are shown in mm and inches.
2. Dimensions are for reference only and are subject to change. Contact Solcon USA for exact dimensions.

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