



WEG Soft Starters Training

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Soft Starters

What is a Reduced Voltage Soft Starter?

- A Reduced Voltage Soft Starter (RVSS) is a piece of electrical equipment used to control or limit the terminal voltage of an AC motor
- We will discuss several configurations for RVSS's in this presentation
- The selection of reduced voltage starting method depends on the type of load being started



Soft Starters

Why Use a Reduced Voltage Soft Starter?

- The torque of the AC motor is mostly uncontrolled when started using a full voltage connection and can shock the connected equipment
- A Reduced Voltage Soft Starter (RVSS) helps protect the motor and connected equipment from damage by controlling the terminal voltage
 - The soft starter reduces the motor terminal voltage producing a more regulated motor acceleration up to full speed
 - Soft starters are also capable of providing a gradual ramp to stop* where sudden stopping may create problems in the connected equipment

* Deceleration time is limited to coast-to-rest or longer



Soft Starters

Why Use a Reduced Voltage Soft Starter?

- A Reduced Voltage Soft Starter is also beneficial to electrical systems with limited current capacity
 - When accelerating an AC motor to full speed using a full voltage connection, a large inrush current may be required.
 - Additionally, there may be peak demand penalties from the power utility



Soft Starters

Why Use a Reduced Voltage Soft Starter?

- Provides a smooth / stepless ramping of the motor speed
- Reduce / limit motor starting torque
 - Reduction of shock and wear in mechanical components (belt wear, gear and bearing failures, pump impeller wear, water check valves and pipe repairs)
- Reduce / limit motor inrush current
 - Reduce electrical stress on transformers, power lines, etc.
 - Avoid penalties for high peak demand current
- Gradually stop a load (avoid water hammer in pipe lines)
- Productivity and uptime can be greatly increased by reducing the costs associated with maintenance, downtime and parts replacement



Soft Starters

Additional benefits of using an RVSS

- Motor parameter monitoring
 - Current, kW, kVA, Power Factor
- Enhanced motor protection
 - Electronic Overload, Phase Loss, Locked Rotor
- Connected load protection
 - Phase Sequence, Instantaneous Over Current, Underload
- Fieldbus interface with Process Automation / PLC / SCADA



Soft Starters

When and Where to use a Soft Starter

- Soft Starters can be used in virtually every application as long as these important factors are addressed:
 - Motor only needs to run at full speed
 - Soft Starter is properly sized
 - Mounted in proper enclosure
 - Electrically protected
 - Interface meets requirements



WEG Drives and Soft Starters White Paper



Choosing a Variable Frequency Drive or Soft Starter based on your application need

Overview

When accelerating an AC motor to full speed using a full voltage connection, a large inrush current may be required. Additionally, the torque of the AC motor is mostly uncontrolled and can shock the connected equipment, potentially causing damage. Variable Frequency Drives and Reduced Voltage Soft Starters can both be used to reduce inrush currents and limit torque; thereby protecting expensive equipment and extending the life of the motor and coupling devices. Choosing between a variable frequency drive and soft starter often depends on the type of application, the mechanical system requirements, and cost (both for initial installation and over the lifecycle of the system).

Soft starters

A reduced voltage soft starter helps protect the motor and connected equipment from damage by controlling the terminal voltage. This limits the initial inrush of current and reduces the mechanical shock associated with motor startup and provides a more gradual ramp up to full speed. Soft Starters are also beneficial to electrical systems with limited current capacity when using a soft starter for motor starting to limit the inrush current. By gradually increasing the motor terminal voltage the soft starter produces a more regulated motor acceleration up to full speed. Soft starters are also capable of providing a gradual ramp to stop where sudden stopping may create problems in the connected equipment.



Soft Starters

Motor Starting Methods

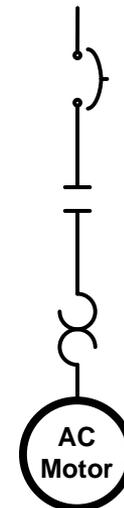
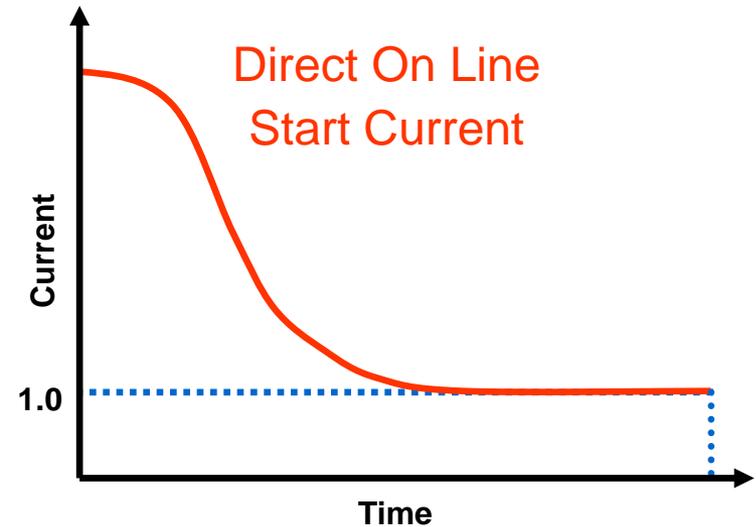
- Direct on-line starter (D.O.L.)
- Star-Delta starter (Also known as Wye-Delta)
- Auto-transformer starter
- Variable Frequency Drive (VFD)
- Solid State Soft Starter



Soft Starters

Direct Online Starter (D.O.L.)

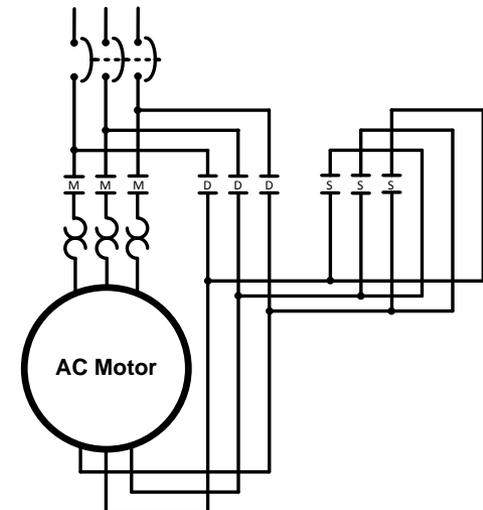
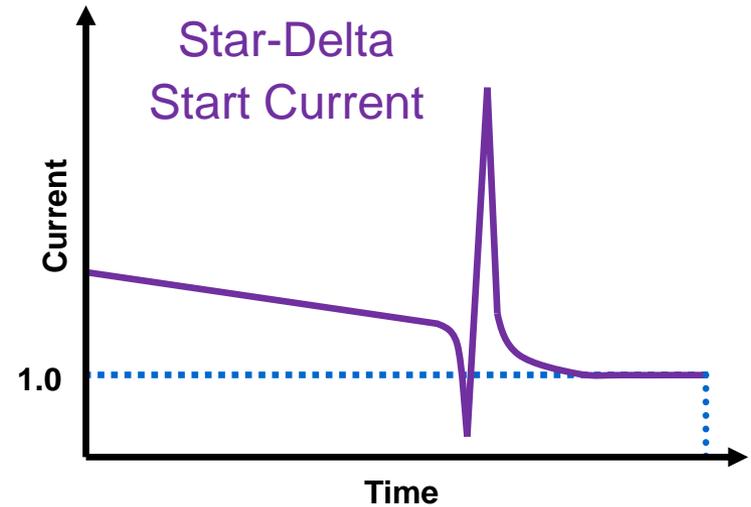
- Most commonly used starting method
- Main Contactor with Overload Relay
- Lower cost
- Compact size -> Reduced space
- High starting current (6 to 7 times motor FLA)
- High stresses on couplings and driven equipment
- Oversized components (cable, contactor)
- Limited starts per hour due to motor heating



Soft Starters

Star-Delta Starter

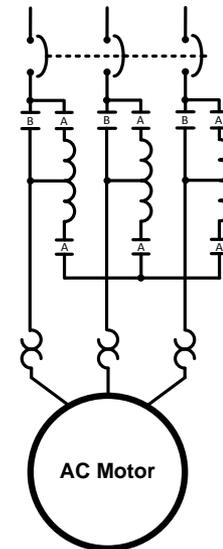
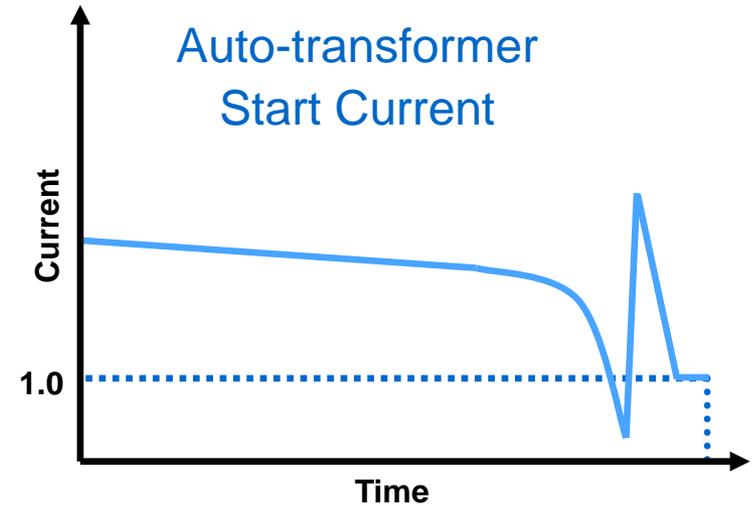
- Reduces starting current and starting torque
- Uses 3 Contactors + O.L. + Timer
- Special wound motor required
- Moderate cost
- Compact size → Reduced space
- $\frac{1}{3}$ of D.O.L. torque at starting
- Motor speed must reach 80-90% at starting in wye connection
- Motor can stall in transition
- Current spikes still occur when switching over to delta position



Soft Starters

Auto-transformer Starter

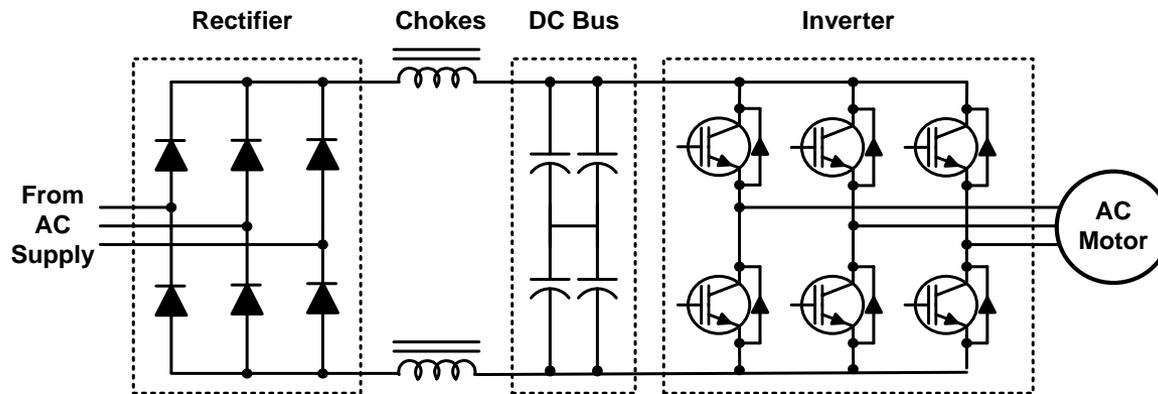
- Works with standard AC motor
- It has multiple voltage taps that allow for step ramp voltage starting of the motor
- Delivers high starting torque
- Reduces commutation current spikes (better than Star-Delta)
- Large Size
- High Cost



Soft Starters

Variable Frequency Drive

- Controls the two main variables of AC motors: frequency & voltage
- By controlling the frequency and voltage, rated torque is available at virtually all speeds
- Motor overload current is limited to 150% FLA unless oversized
- Able to provide soft stopping *
- Requires a relatively large up-front investment



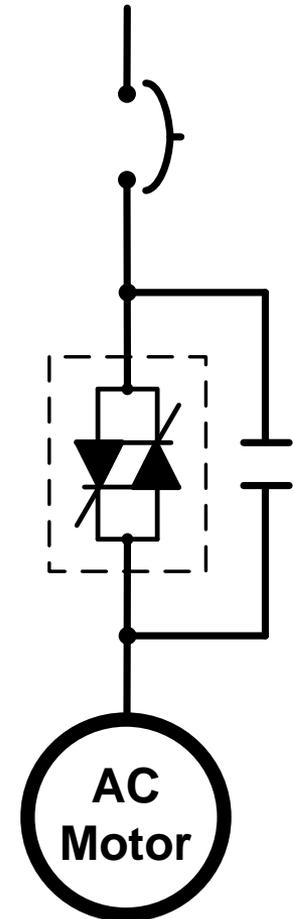
* Stopping deceleration time is limited unless dynamic braking is used

Soft Starters

Solid State Soft-Starter

- Solid State Soft-Starters are static (electronic) starters that accelerate, decelerate and protect three-phase AC induction motors
- The Solid State Soft-Starter accelerates and decelerates** the AC motor smoothly
- It also helps reduce mechanical shock to the driven load and high inrush current in the supply network
- A Soft-Starter can only vary the speed during the ramping function (accel / decel) for a limited time

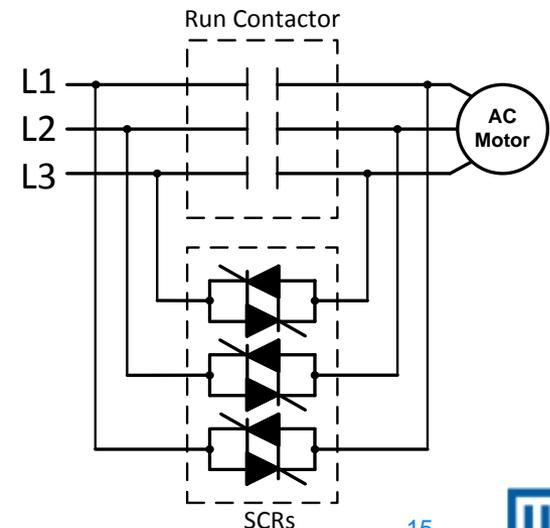
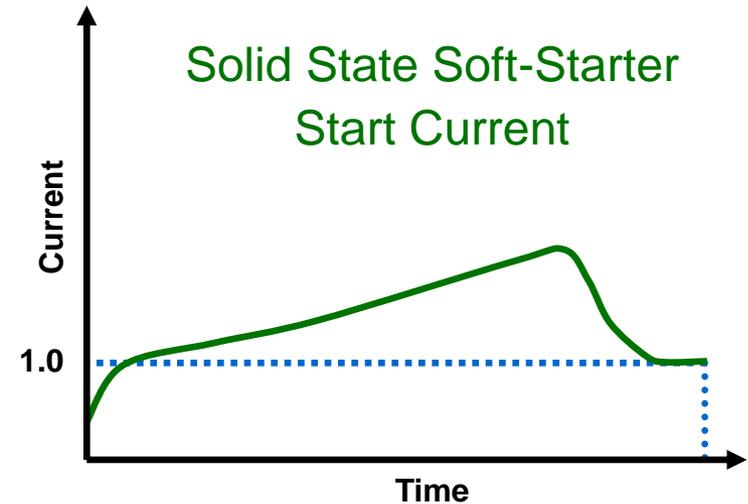
** Deceleration time is limited to coast-to-rest or longer



Soft Starters

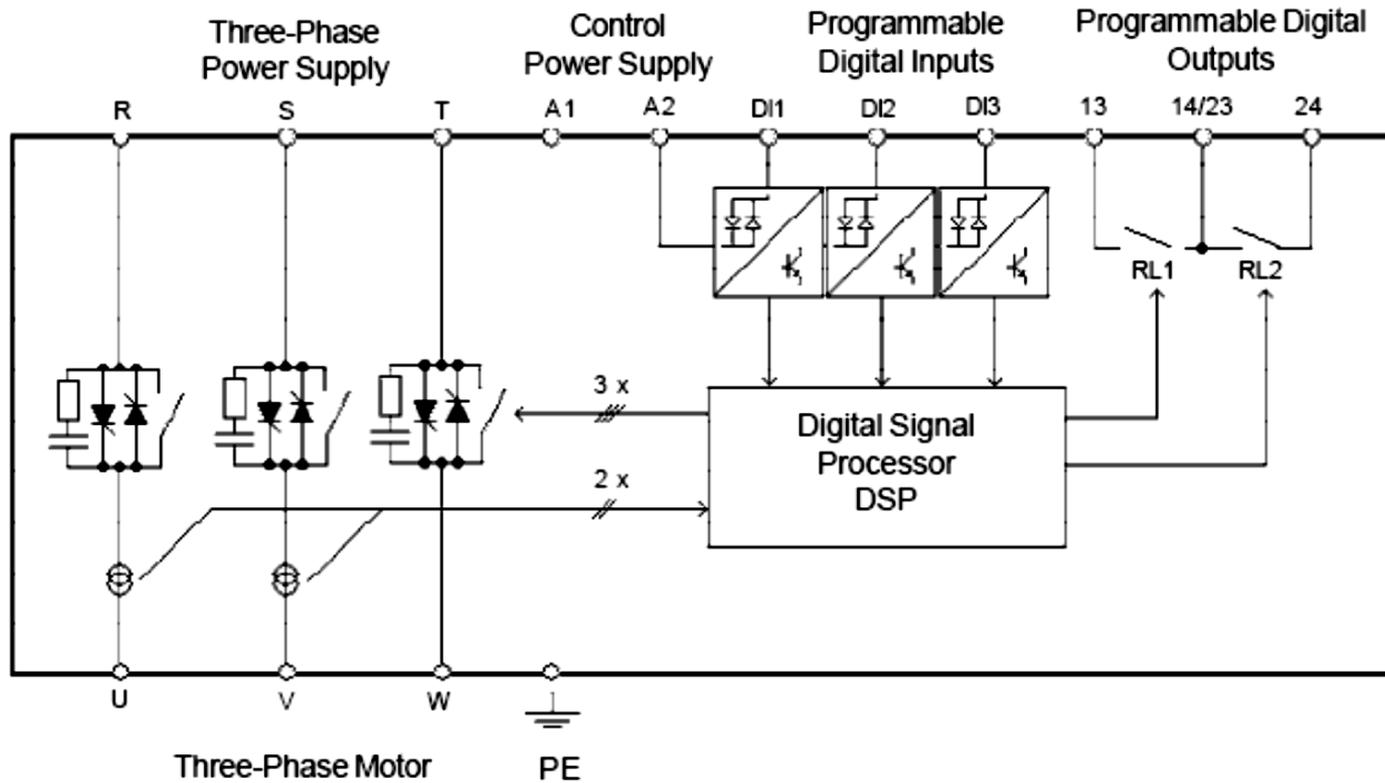
Solid State Soft-Starter

- The main power components of a Solid State Reduced Voltage Soft-Starter are the Thyristor or Silicon Controlled Rectifier (SCR)
- The Soft-Starter uses the thyristors to control the level of voltage during the starting and stopping ramps
- The thyristors are connected in anti-parallel configuration and placed in two or three phases of the main circuit
- At full speed, a 'Run Contactor' or 'By-Pass' is used to remove the thyristors from the circuit.
- When motor voltage is reduced during start, the starting current and starting torque are also reduced



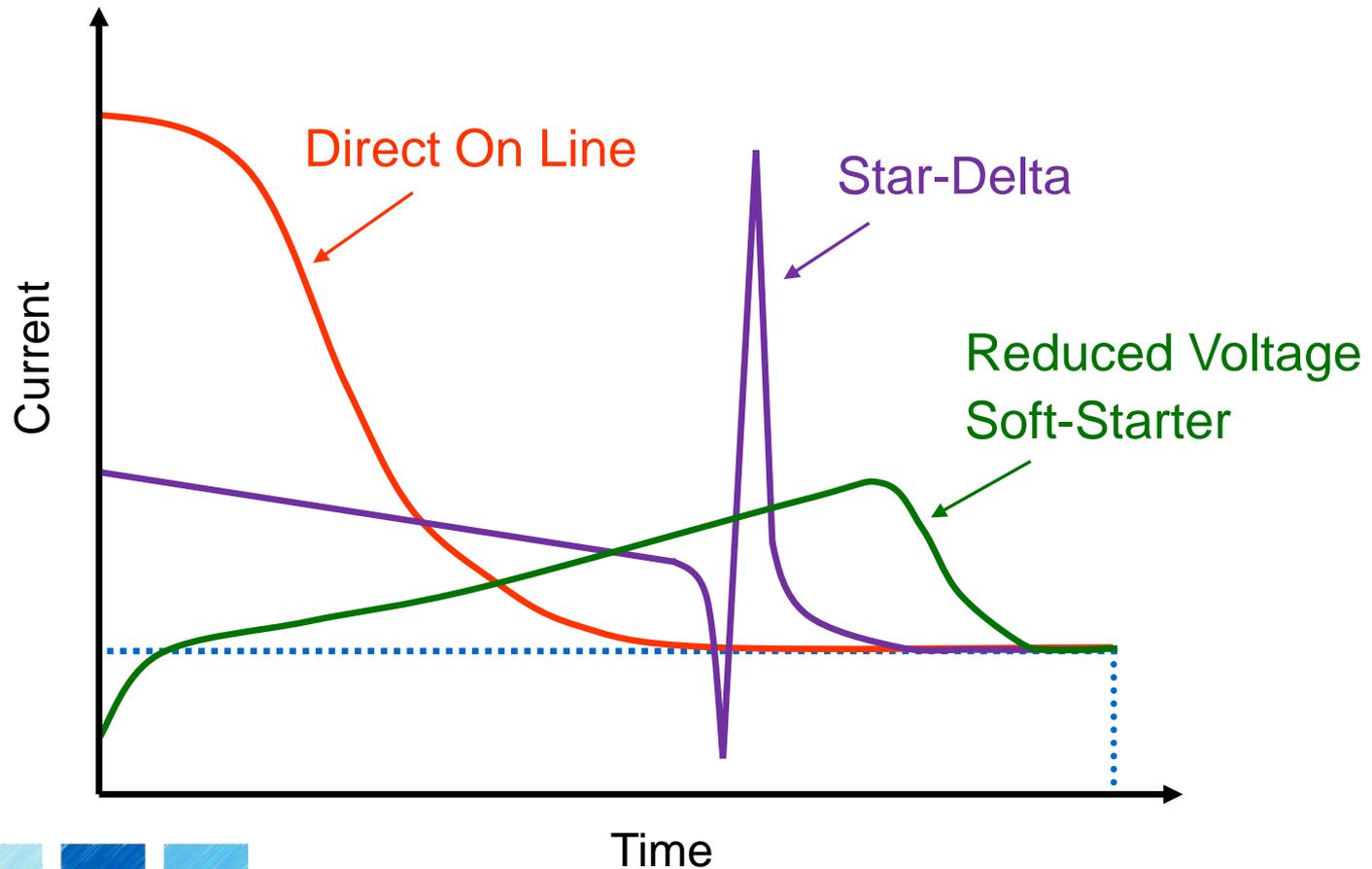
Soft Starters

WEG Solid State Soft Starter Circuit Diagram



Soft Starters

Starting Methods Comparison



Soft Starters

Selecting a Soft Starter

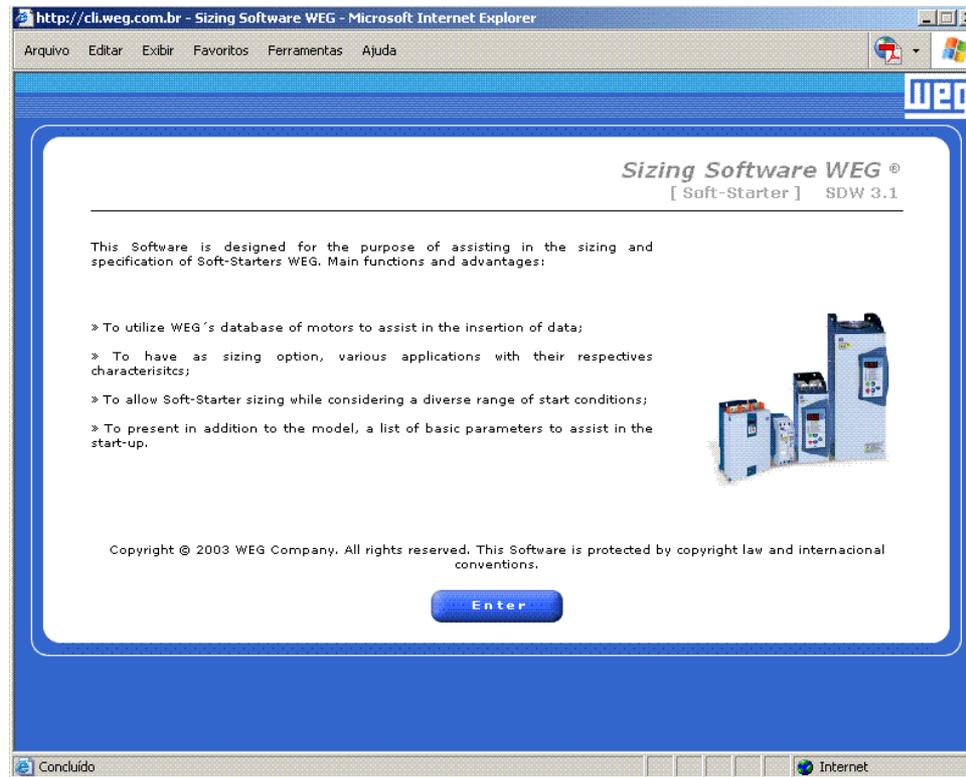
To properly select a soft starter you must determine:

- The Type of Application (Constant vs. Variable Torque)
- The Motor Nameplate Full Load Current (FLA)
- Rated Motor Horsepower
- AC Supply Voltage
 - Control Power Supply Voltage
- Number of Starts/Hour
- Ambient Conditions



Soft Starters

SDW – WEG Soft Starter Sizing Software



<http://www.weg.net/files/products/WEG-sdw-soft-starter-software-sizing-4.0-software-english.zip>



WEG Soft Starters Power Range



SSW05: 3 to 75HP
3 to 85 Amps
208 - 480 Vac



SSW06: 30 to 2,650HP
85 to 1,400 Amps
220 – 575 Vac



SSW07: 6 to 200 HP
17 to 412 Amps
220 – 575 Vac



Soft Starters

SSW05 Soft Starter Features

- Input power supply: 208 - 480 Vac, 50/60Hz
- Duty cycle: 300% rated current for 10 seconds, 4 starts per hour (every 15 min.)
- Built-in run rated (AC1) bypass contactor
- RS-232 serial interface
- Adjustable acceleration and deceleration ramps (1- 20 seconds)
- Adjustable pedestal voltage (30 - 80% of line voltage)
- Protective features include:
 - Motor overload, overcurrent, locked rotor, SCR overload, phase loss and phase rotation
- DIN rail or direct mounting features
- Ambient: 32°F (0°C) to 131°F (55°C)
- Altitude: 3300ft. (1000m) altitude
- 90% humidity non-condensing



Soft Starters

SSW05 Soft Starter Interfaces

Standard I/O

- One digital input for Start/Stop (90 - 250 Vac)
- One digital input for Fault Reset (90 - 250 Vac)
- One relay output for Run indication (1 Amp - 250 Vac)
- One relay output for Full Voltage indication (1 Amp - 250 Vac)

Optional Features

- Remote Keypad
- Free PC Programming Software



Soft Starters

SSW06 Soft Starter Features

- 200 - 600VAC, 50/60Hz input power supply
- Built-in run rated (AC1) bypass contactor *
- 300 % for 30 seconds, 10 starts per hour
- 450 % for 30 seconds with 33% current derating
- Conformal coated circuit boards
- Voltage ramp or current limit start modes
- Detachable keypad with dual display (LCD and LED) includes copy function
- 90 - 250VAC auxiliary control voltage
- Single 32 bit RISC processor based control board
- Adjustable acceleration and deceleration ramps (1 - 299 seconds)
- Adjustable pedestal voltage (25 - 90% of line voltage)



* Up to 820 Amp rating (Frame 6)



Soft Starters

SSW06 Soft Starter Features (cont'd)

- Diagnostic features:
 - Motor overload, over current and phase loss
 - Motor instantaneous over and under current
 - SCR over temperature and fault
 - Line phase loss and phase rotation
 - Line over and under voltage
- Display readings: Motor current, voltage, kW and power factor, line voltage and frequency, last four fault trips, run and power-up timers
- Ambient: 32°F (0°C) to 131°F (55°C)
- Altitude: 3300 ft. (1000m) altitude
- 90% non-condensing humidity



Soft Starters

SSW06 Soft Starter Features (cont'd)

Standard I/O

- Six isolated 24VDC programmable digital inputs
- Three programmable relay outputs (2 Amp - 250VAC)
- One 0 - 10VDC programmable analog output
- One 4 - 20mA programmable analog output
- Motor PTC thermistor input
- RS-232 serial interface

Optional Features

- Remote Keypad
- Free PC Programming Software



Soft Starters

SSW07 Soft Starters



Soft Starters

SSW07 Current Ranges

- Frame 1: 17A, 24A and 30A
- Frame 2: 45A, 61A and 85A
- Frame 3: 130A, 171A and 200A
- Frame 4: 255A, 312A, 365A and 412A



Soft Starters

SSW07 Soft Starter Features

- 200 - 575VAC, 50/60Hz input power supply
- 110 - 240VAC auxiliary control voltage
- Built-in run rated (AC1) bypass contactor
- 300% for 30 seconds, 10 starts per hour
- Voltage ramp or current limit start modes
- Simple setpoint programming through trim pots
- Integral, electronic motor protection
- Built-in electronic thermal relay
- Conformal coated circuit boards
- Ambient: 32°F (0°C) to 131°F (55°C)
- Altitude: 3300 ft. (1000m) altitude
- 90% non-condensing humidity
- Adjustable acceleration and deceleration ramps (1 - 299 seconds)
- Adjustable pedestal voltage (25 - 90% of line voltage)



Soft Starters

SSW07 Soft Starter Features

Standard I/O

- Three isolated 120VAC programmable digital inputs
- Two programmable relay outputs (1 Amp - 240VAC)

Optional Features

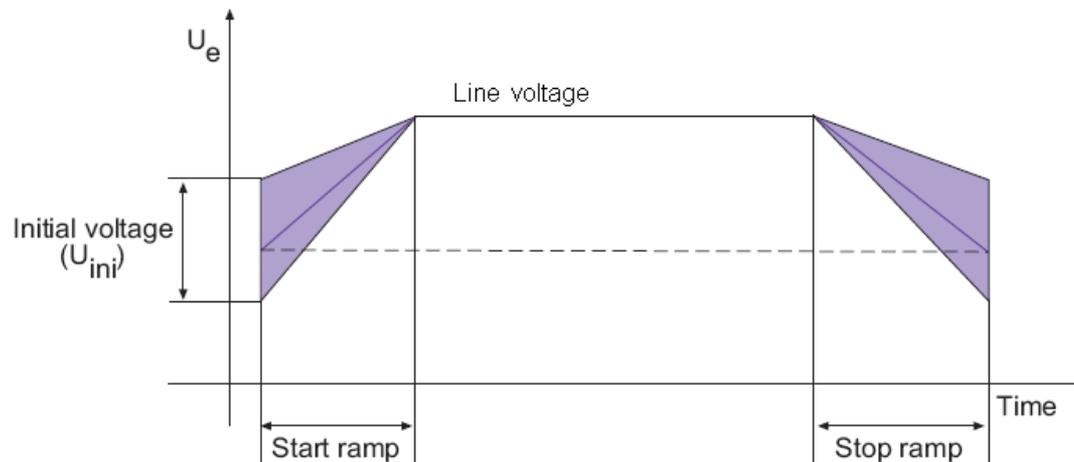
- Local / Remote Keypad kits
- RS-232 interface kit
- RS-485 interface kit
- Motor PTC thermistor input kit
- SSW07 fan kits



Soft Starters

Common Settings on Soft Starters

- Voltage Ramp Starting
 - Voltage increases based on a preset ramp time
 - Starting current is a function of ramp time and type of load
 - Ideal application for variable torque loads and when a gradual start is desired



Soft Starters

Common Settings on Soft Starters

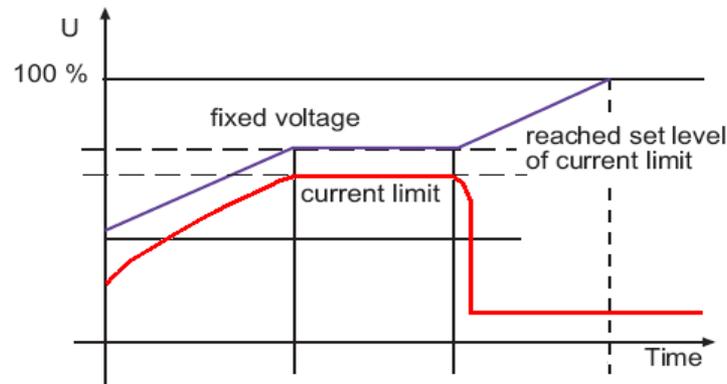
- Voltage Ramp Starting and Stopping
 - Initial Voltage: The voltage level from which the soft starter starts or ends its ramps. 'Initial Voltage' should be adjusted to a level that is just high enough to cause the motor begin turning immediately in order to limit unnecessary heating
 - Start Ramp: The time selected in the soft starter to ramp up from the 'Initial Voltage' level up to full voltage (line voltage)
 - Stop Ramp: The time selected in the soft starter to ramp down from full voltage to the 'Initial Voltage' level
 - Used when a soft stop is desired



Soft Starters

Common Settings on Soft Starters

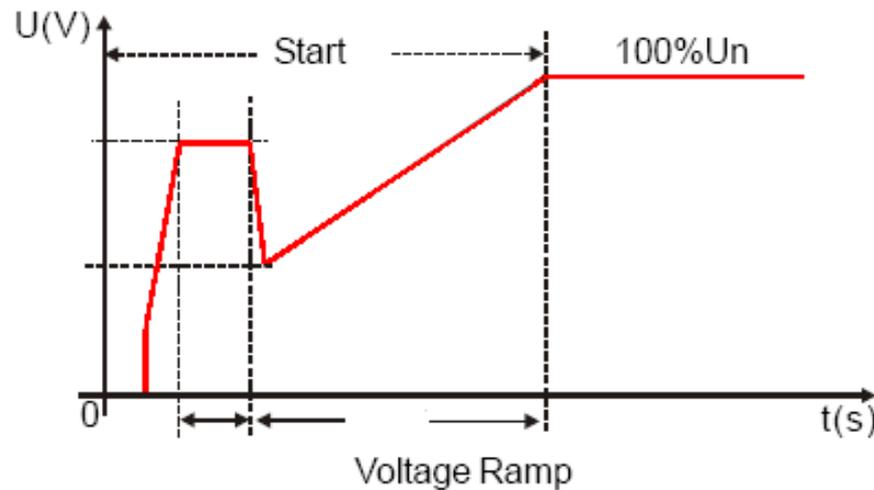
- Current Limit Starting
 - When 'Current Limit' level is reached, the soft starter will temporarily prevent the voltage from increasing further until the motor current level returns to less than the set limit
 - This limiting feature is active until full voltage is achieved
 - Adequate for constant torque loads and where there are power supply limitations where limited starting current is desired



Soft Starters

Common Settings on Soft Starters

- Kick Start
 - Helpful with high breakaway torque loads
 - Torque pulse during the starting process



GPH2 Combination Soft Starters

Standard Features

- SSW07 Soft Starter with ratings of 17 to 412 Amps
- 65kA SCCR UL rated without fuses
- 300 % for 30 seconds, 10 starts per hour
 - 5 – 175HP at 230V
 - 10 – 350HP at 460V
- NEMA 4 and NEMA 12 enclosure ratings
- Wall mount enclosures available up to Frame 4 (312 Amp rating)
- Floor mount kit included for Frame 5 (365 and 412 Amp ratings)
- Circuit breaker with lockable door mounted operator
- Automatic run rated (AC1) integrated bypass contactor
- Fused Control Power Transformer (CPT)
- Terminals for 2 or 3 wire remote Start/Stop
- Start / Stop Pushbuttons, Run / Fault Pilot Lights



GPH2 Combination Soft Starters

GPH2 Availability

- Standard Combination Soft Starter Panels are in inventory for immediate shipment to customers
- Modified Stock Panels available in three days to two weeks
- Build to order panels have four to six week lead time
- Brand Labeling is available for volume customers

Benefits

- Significant reduction of mechanical stresses through the coupling and transmission devices (such as gearboxes, pulleys, gears, etc.)
- Increases motor and machine mechanical equipment lifetime due by elimination of mechanical shock
- Easy operation, setup, maintenance & installation
- Simple setpoint programming through trim pots
- Operates in environments up to 55°C without derating
- Integral, electronic motor protection
- Built-in electronic thermal relay



Low Voltage Drives and Soft Starters

It's HERE!

The new 2017 Automation Catalog:

- Focused on Low Voltage Drives, Soft Starters & Engineered Panels
- New layout, easier to follow
- Updated *Quick Selection Guides* with current products
- Updated pricing
- Available in hard copy, or download the PDF at: <http://www.weg.net/us>
- The online version will be maintained regularly
- *Just updated January 2017!*

2017

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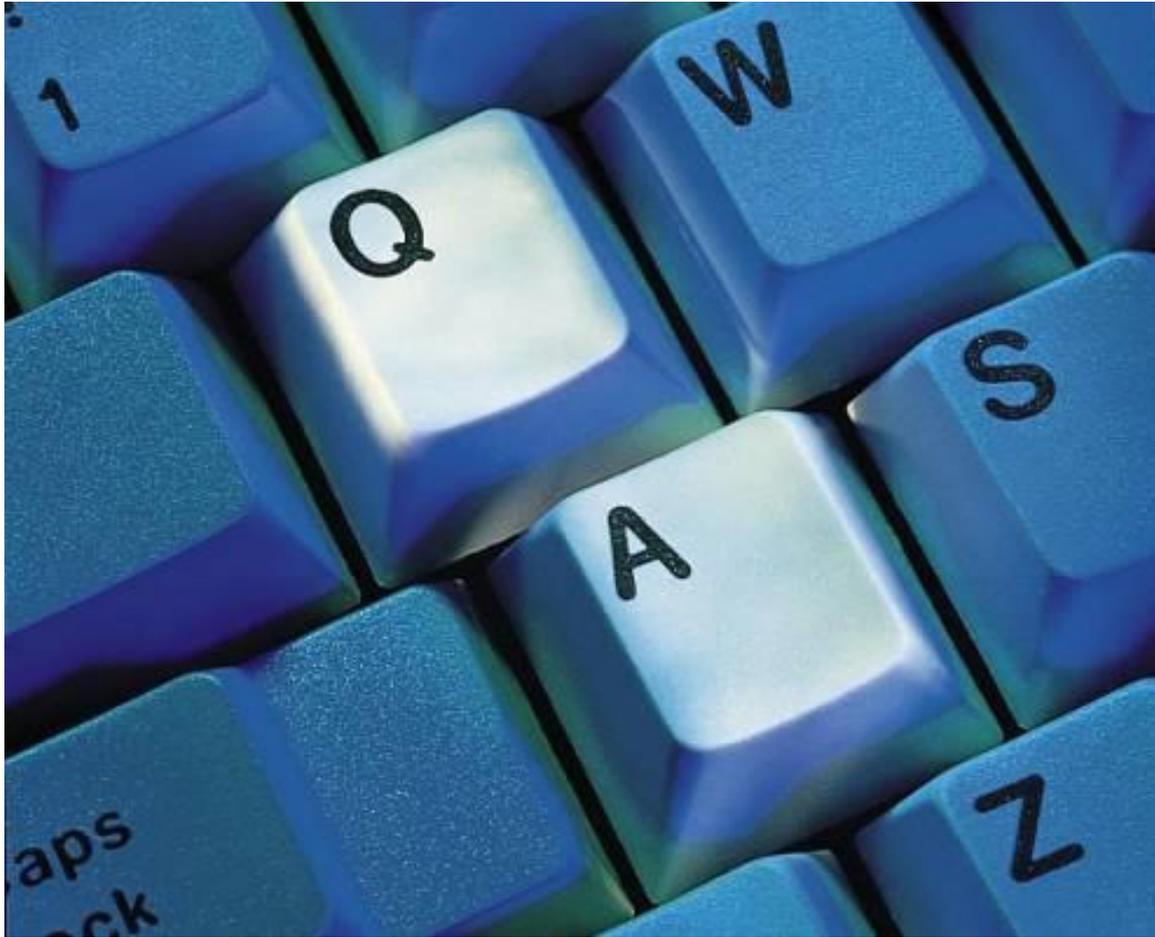
WEG Automation Catalog
LV Variable Frequency Drives
and Soft Starters

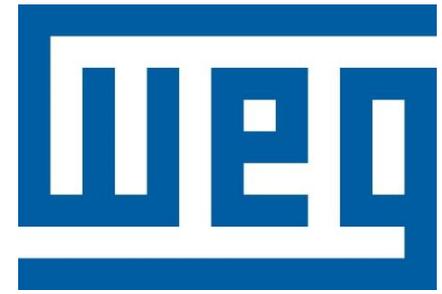
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Thank you!

