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DRIVESTART

OVERVIEW

Solcon Group overview

200	Employees 3 subsidiaries (Europe, USA and Asia)
40	years in business
Over 100	International Partners
Over 250,000	Installations WW
	Full scope of both MV & LV SST and Motor Protection

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GROUP OVERVIEW - GLOBAL OPERATIONS

Standardization & Certification

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UL cUL GL Germanischer Lloyd LR Lloyd's Register Marine BUREAU VERITAS DNV RINA 1861 CCS

Ex CE KR KOREAN REGISTER ABS EAC ClassNK

LOW VOLTAGE PRODUCTS - DIGITAL

iStart

- ✓ Full Range – up to 1100A
- ✓ Internal Bypass
- ✓ Modular Design
- ✓ 3 & 2 Phase control
- ✓ Multi-language Support

RVSDN

- ✓ Heavy Duty - Up to 3000A
- ✓ External Bypass
- ✓ Marine Type Tested

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MEDIUM VOLTAGE SOFT STARTERS

DriveStart

- Groundbreaking, IGBT based MV Soft Starter
- Ratings: up to 6.6KV
- Optimized for applications that require low starting current and/or a high starting torque

HRVSDN *PowerStart*

- MV Soft Starter in Fully Type Tested Switchgear
- Ratings: 2300-15000V, up to 48MW
- Reliable, heavy duty soft starter
- Integrated data Logger

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POWER CONTROL PRODUCTS

TPS

Low voltage
Power Control System

MV TPS

Medium Voltage
Power Control System

WHO AM I?

2010 – today - Solcon Industries Ltd. - Vice President Engineering and Projects - Management of all global engineering activities in the company, in Europe as well as in the USA including, managing engineering groups in Europe and USA.

2005-2010 - Solcon Industries Ltd. - Technical support manager - working with clients abroad.
Pre-sale, after-sale & commissioning of low and Medium voltage soft starters and motor protection relays.

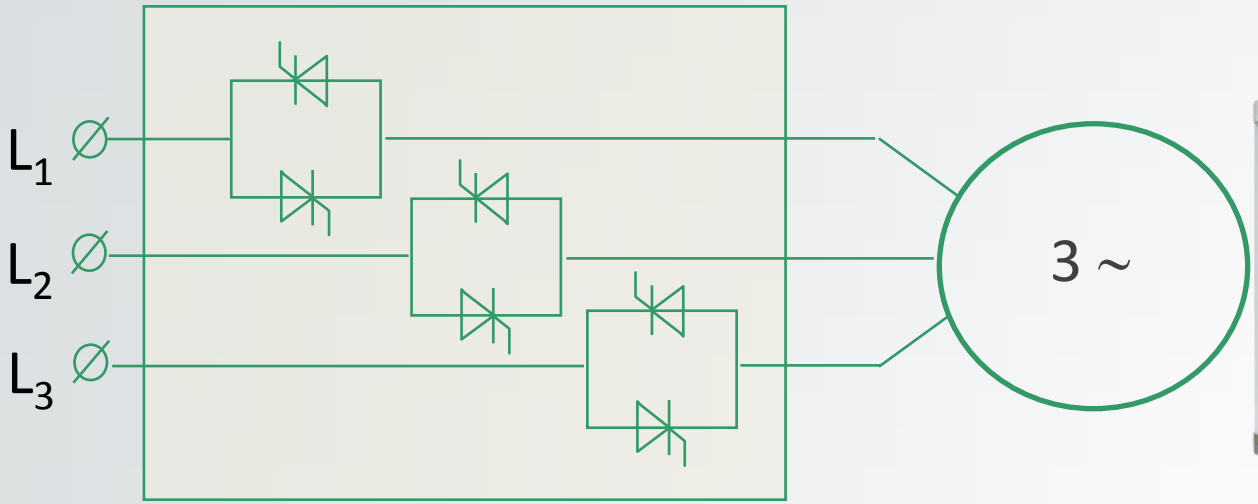
1993-2005 - Consulting Engineers "R. Cohen & Assoc.". - Design electrical installations of all types, high voltage installations, low voltage, low voltage, power distribution, special projects.

1983-1988 - Electrician in a Navy vessel.

CLASSIC **LV** SOFT STARTER

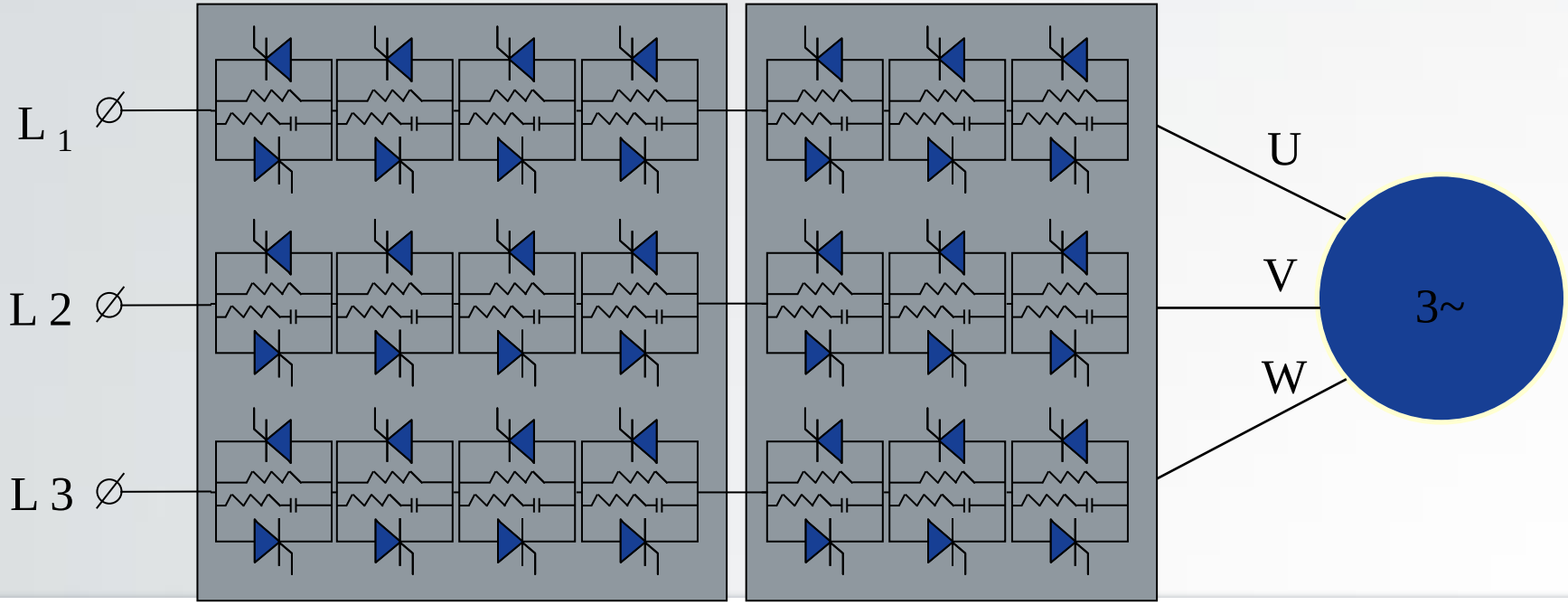
A soft starter controls motor currents by controlling motor's voltage

Low voltage soft starter



CLASSIC **MV** SOFT STARTER

Medium Voltage soft starter



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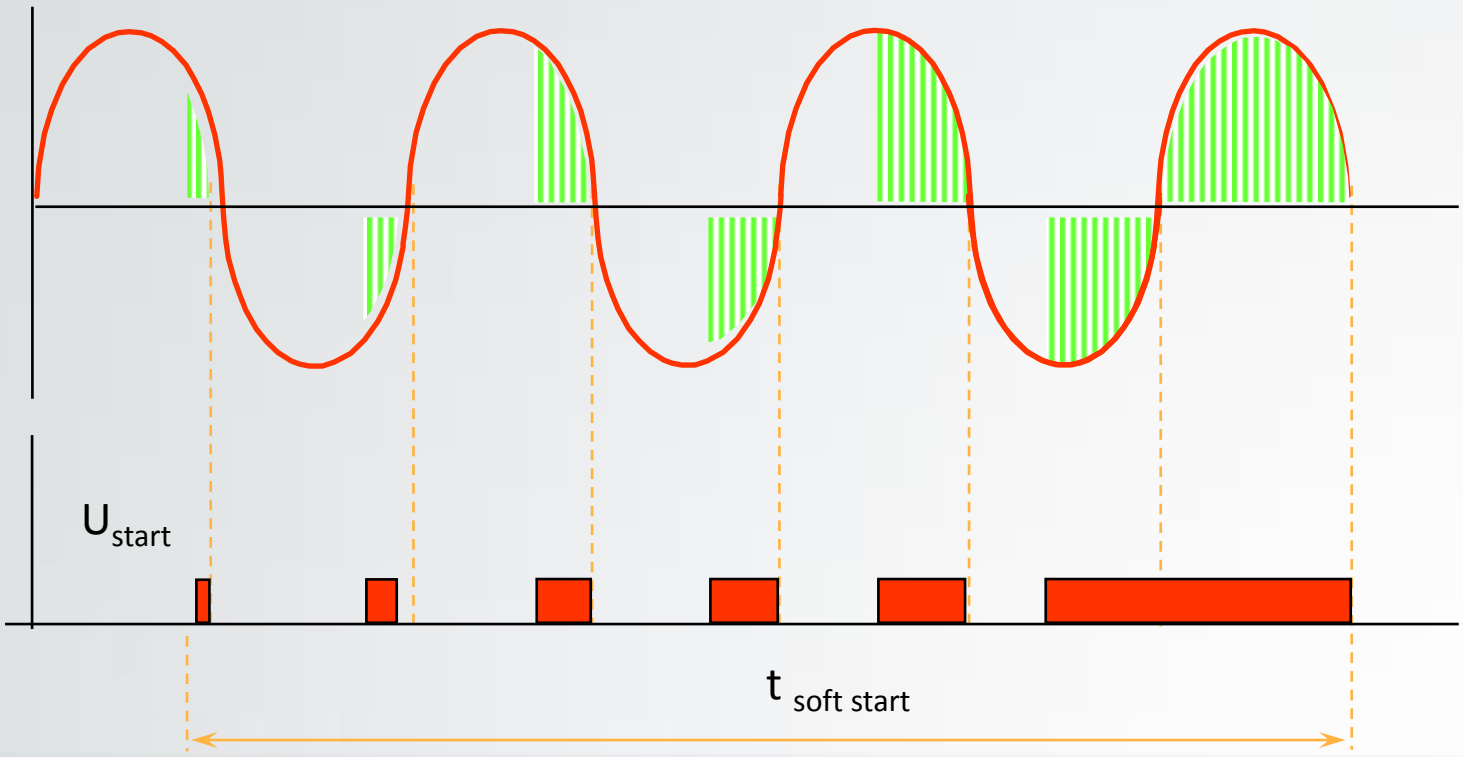
CLASSIC SOFT STARTER

The firing point of thyristors determines output voltage level

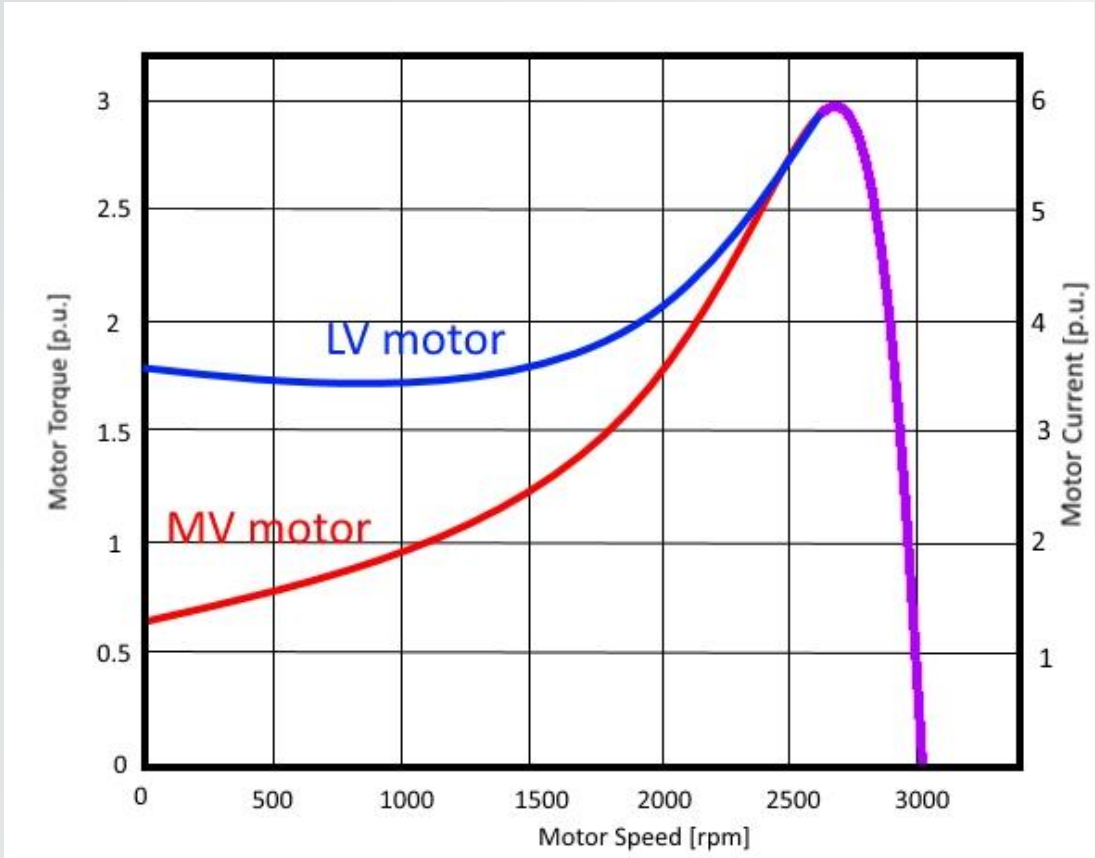


CLASSIC SCR TECHNOLOGY SOFT STARTERS

- Reduced voltage starting where the operating frequency is fixed and equal to the mains frequency
- Softstart with SCR technology controls
  - Current (I) - reduced in direct ratio to V
  - Torque (T) - reduced in ratio to I^2
- For most applications (pumps, compressors…) reducing voltage is a good solution - reducing current, while still having enough torque
- Slip (S) starts at 1.0 and reduces during start process to ≈0.006 for large motors.
- Motor efficiency is lower than 1-S
- Motor efficiency is very low, accompanied by motor heating
- Usually, maximum necessary starting current ≈ 250%-400% of the rated current
- Solcon has manufactured soft starters for rated currents up to 3000A and 13.8kV.

MV MOTOR TORQUE VS. LV MOTOR TORQUE DURING START

Very significant difference between LV and MV motor torque behavior during start



CLASSIC SOFT STARTER

Loads that require **high torque** and therefore cannot allow significant voltage reduction

Applications that require **both high starting torque and low starting current**

Ex: **Marine applications** using local generators as a power source

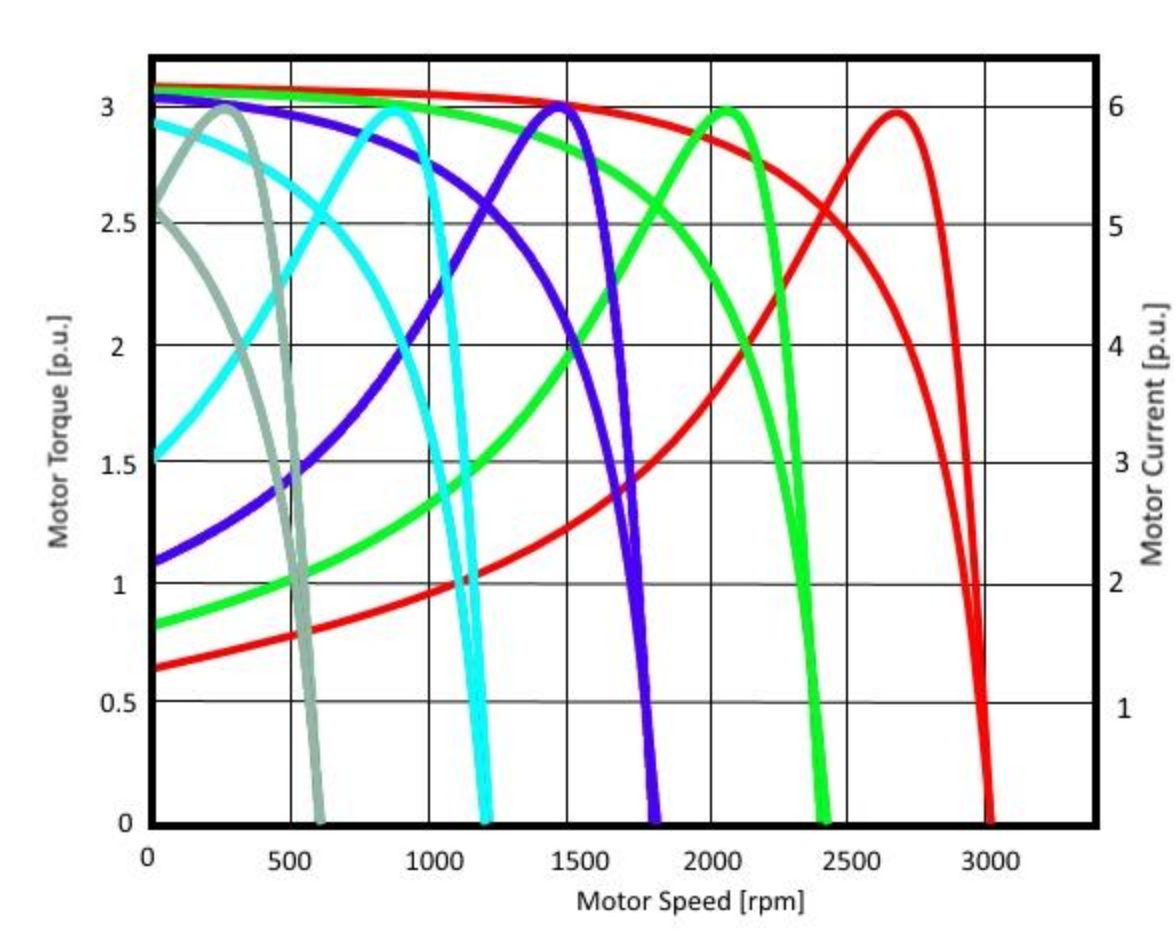
Even **mains applications** sometimes require low starting current

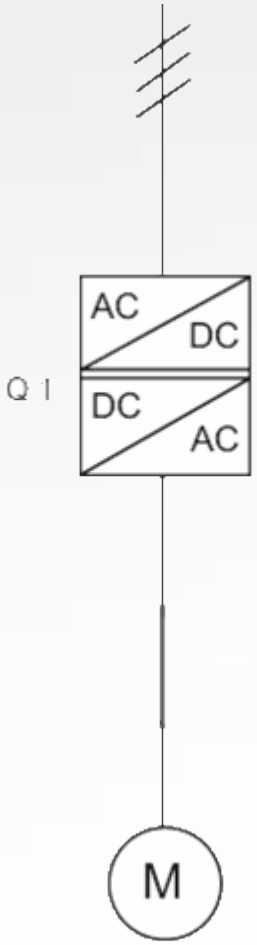
Starting capacitors are often incorporated in the Input Side of soft starters to reduce the starting current

Certain applications require **speed control** during the starting process

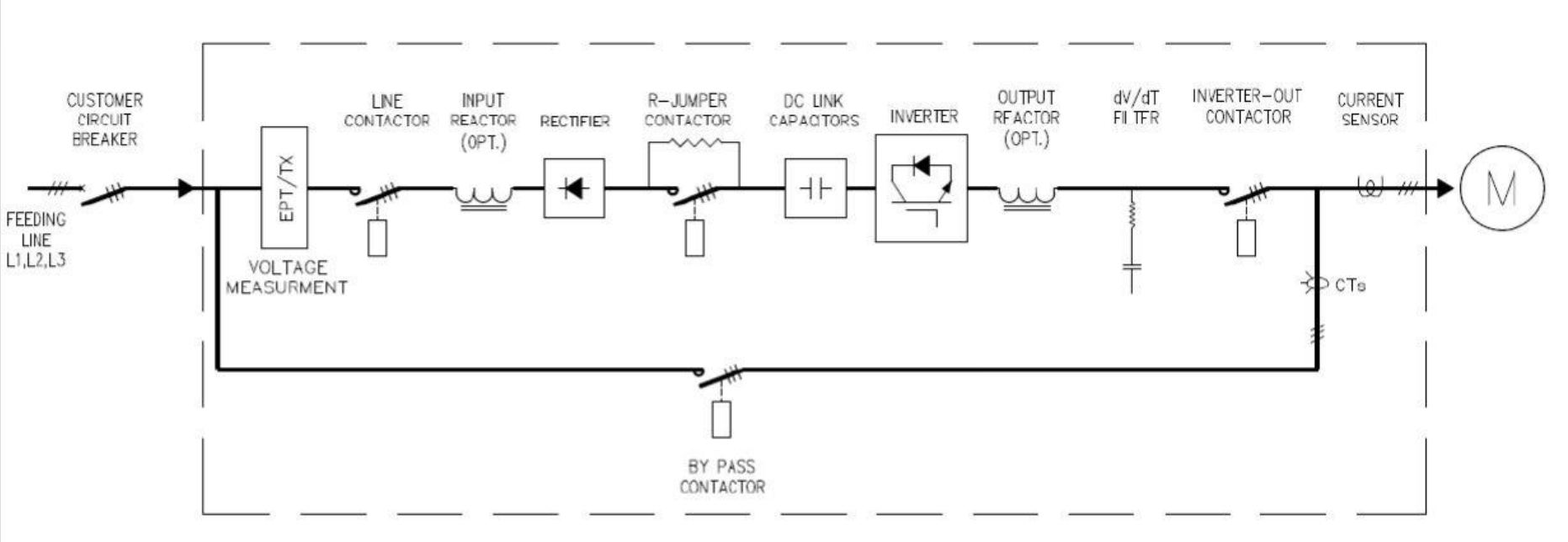
- Conveyor belts require “S” profile, long starting process and high torque
- High pressure water pumps in desalination plants require monitoring of the rate of pressure change. A value greater than 1 bar per second can damage membranes.
- Classic soft starters with tacho generator feedback can be used, but heat developing in the rotor during a long start often requires forced cooling or special more expensive motors.

WHY DRIVESTART?





DRIVESTART TOPOLOGY



DriveStart (DST) Principles

Soft Starter based on IGBT technology

3 Level, 6 Pulse, Neutral Point Clamped (NPC) Inverter

Incoming stage

Mains Voltage is rectified and charges **2** “large” **Capacitors** (a few µF per each Ampere of motor rated current) and creates **double DC BUS**, one positive and one negative.

Inverter

DC voltages supply, 3 branches of transistors, one branch per phase
Each Branch includes (for 3300V & 4150V mains) 4 power transistors
The switching elements are Insulated Gate Bipolar Transistor (IGBT)

WHY DRIVESTART

Advantages over SCR starting technology

- Starting at very **low current** (+/- Nominal current)
- Much **higher** starting **torque** available
- Greatly **reduced Heating** in Motor Rotor
- Nearly **unlimited** number of **starts** per hour
- Low Speed operation – **Inching/Jogging**
- Change Rotation Direction **without** additional external contactor

DRIVESTART VS. STANDARD VFD STARTER

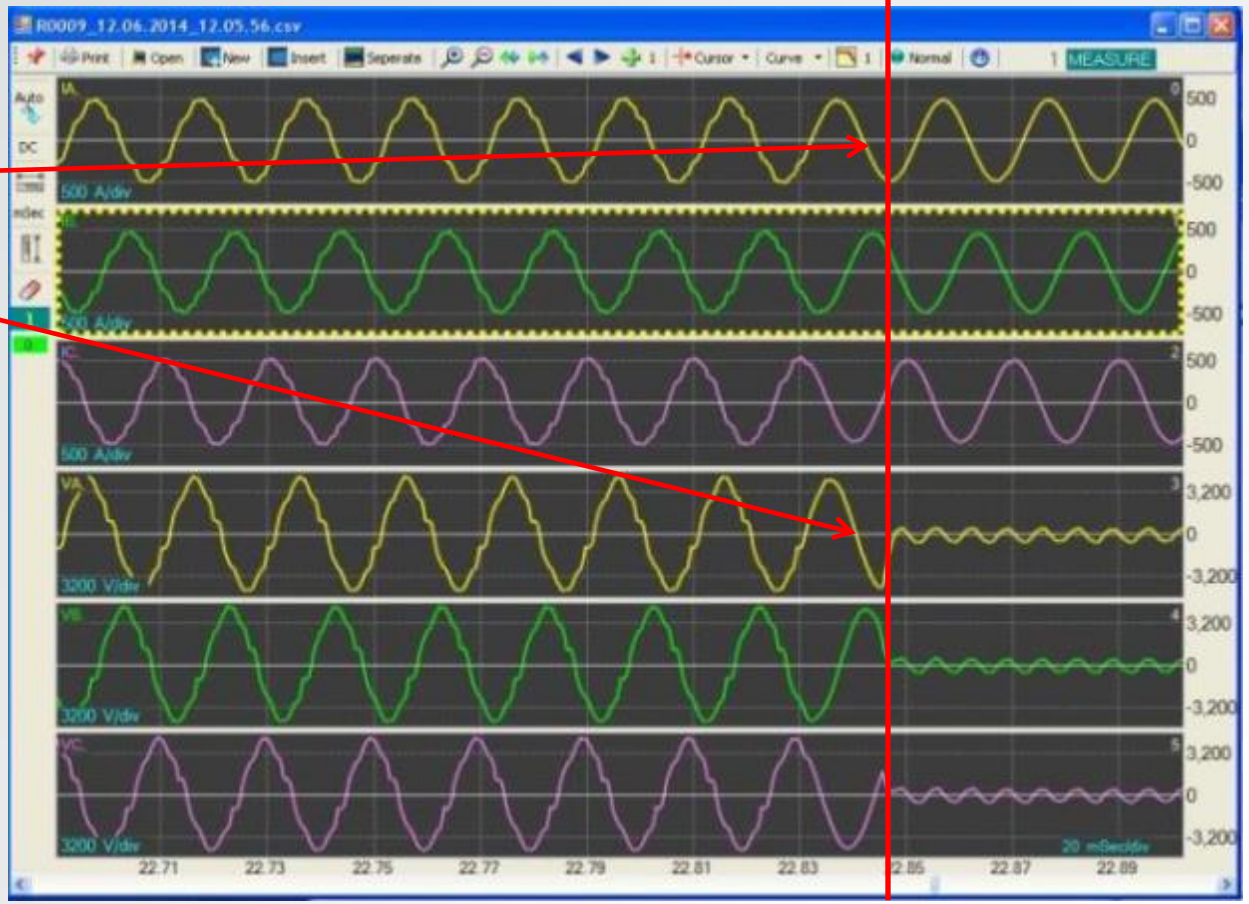
- **Synchronised** closing of **Bypass** Contactor at end of acceleration **soft start**
- **Synchronised** opening **of Bypass** for **soft stop**
- **Closed Transition** Bypass – No spikes or Dips Frequency, Phase and Voltage level
- **Minimal Transients** after Bypass - only few cycles
- **Air Cooled** cooling system
- Very **Low Maintenance** schedule (on Bypass IGBT's are not energized)
- Very **small part Count**
- **Uncomplicated design** utilizing **Fiber optic Control Technology** (as in HRVSDN)
- **Simple Multistart/stop** design philosophy

DriveStart Internal Bypass – Closed Transition

Synchronised Closed transition

No Network Spike

- ✓ Current
- ✓ Voltage



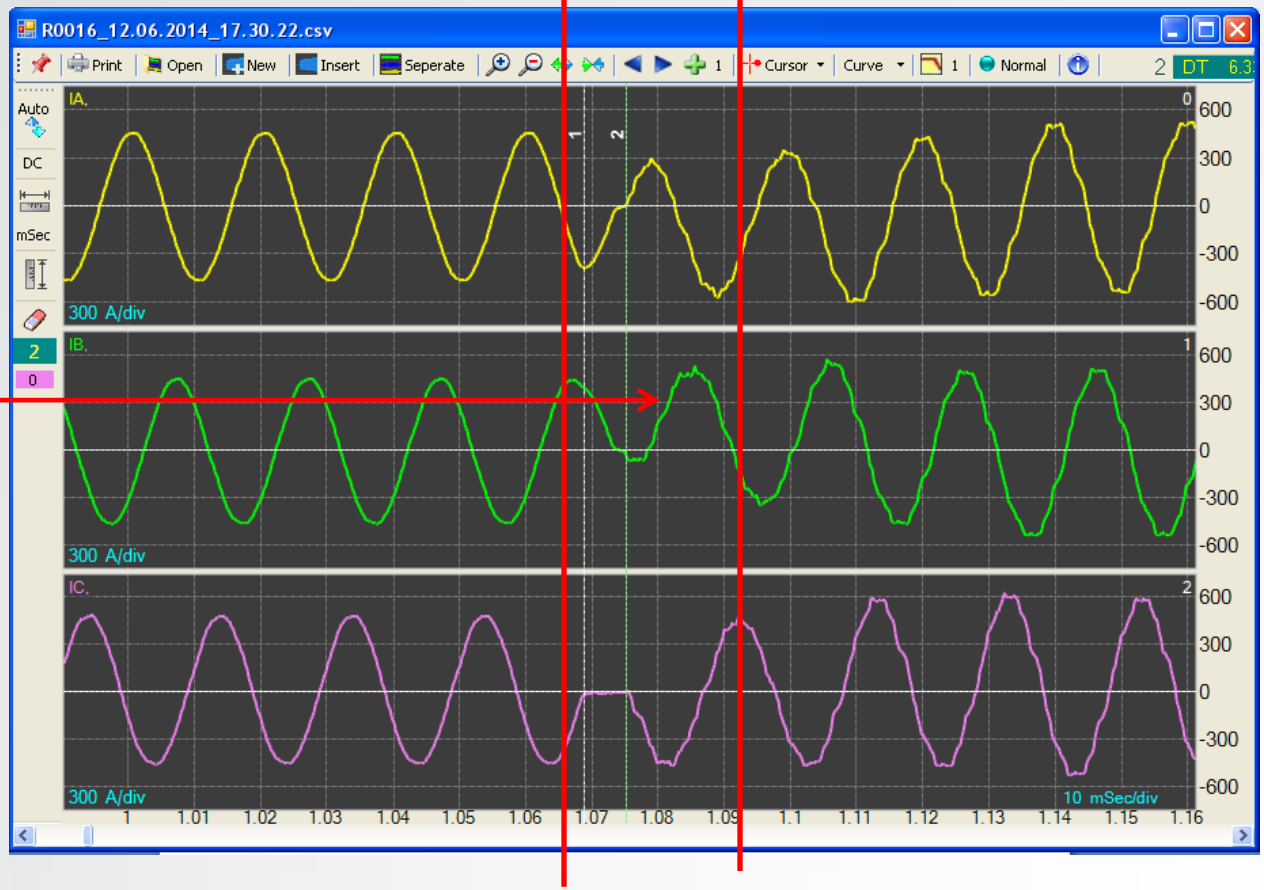
DriveStart Internal Bypass – Closed Transition

Synchronised Closed transition

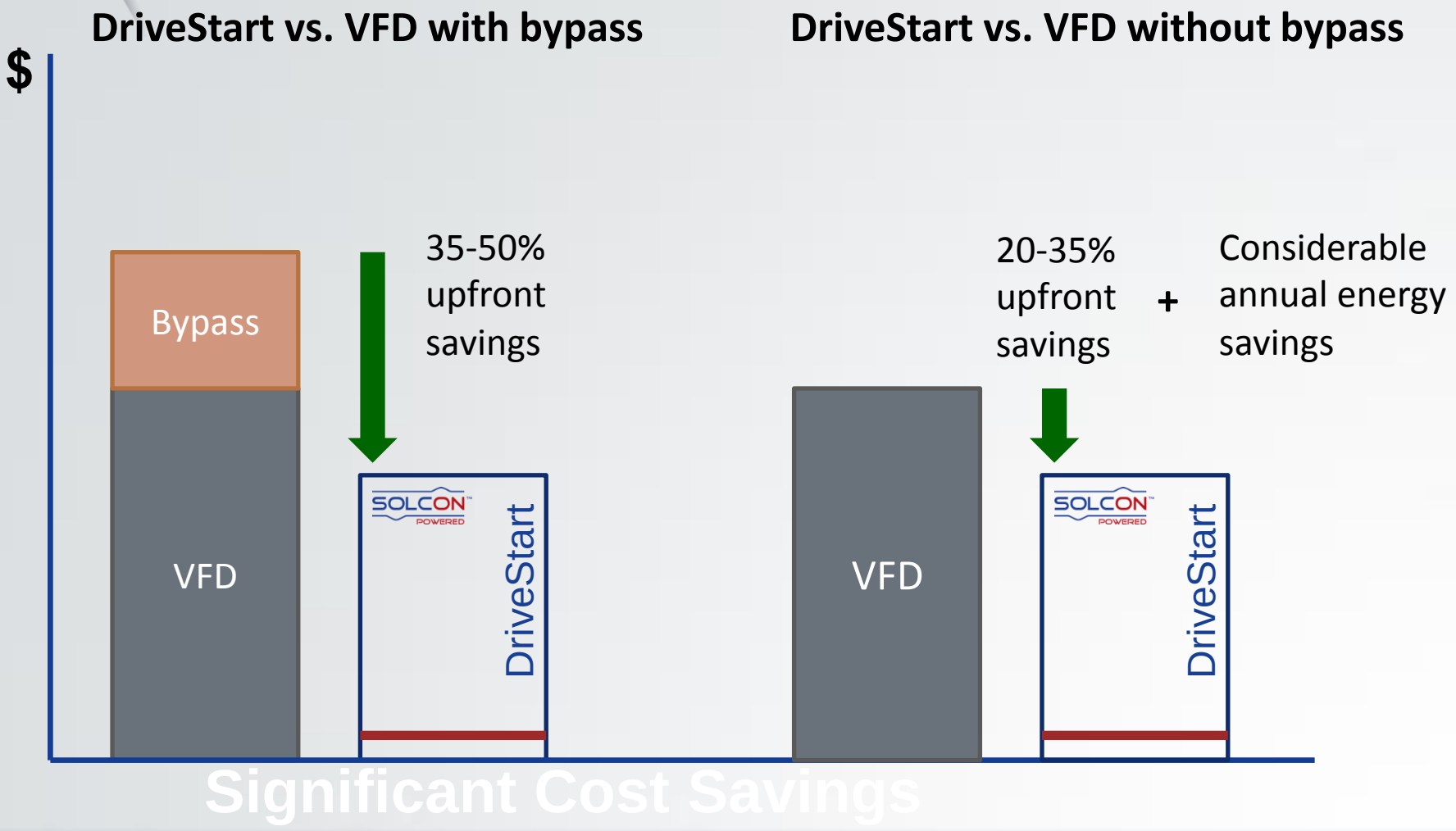
Soft Stop

Transients very short (few cycles)

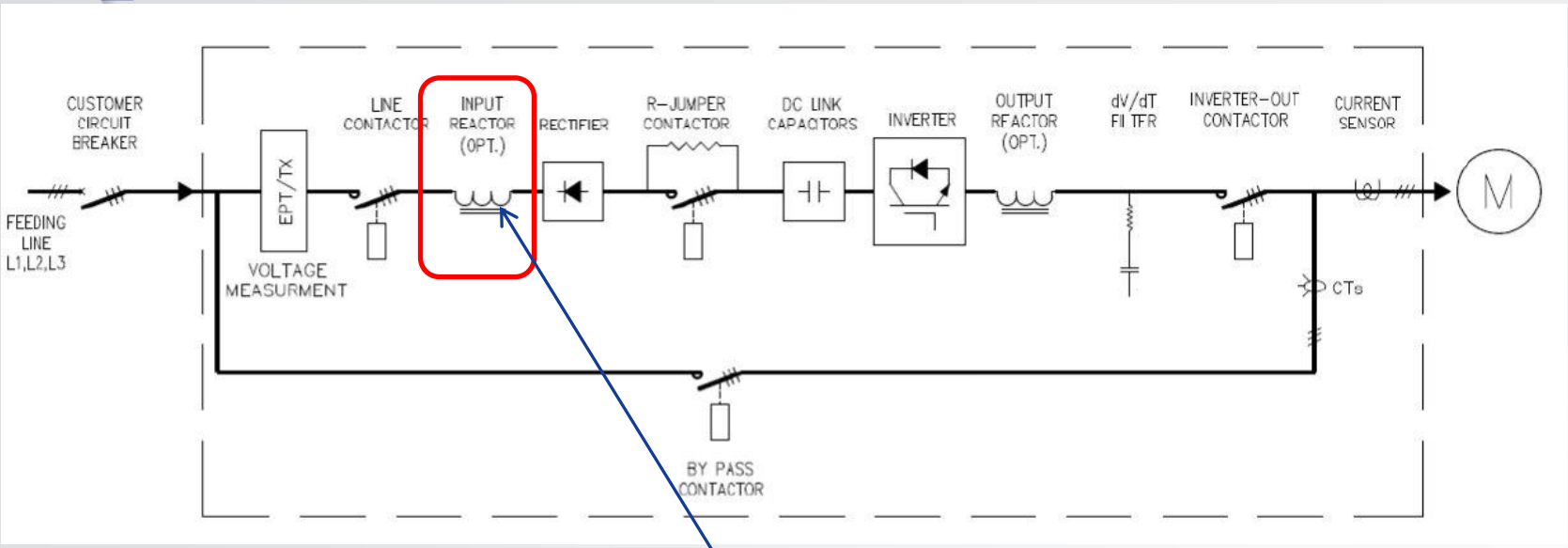
During bypass opening



Value Proposition



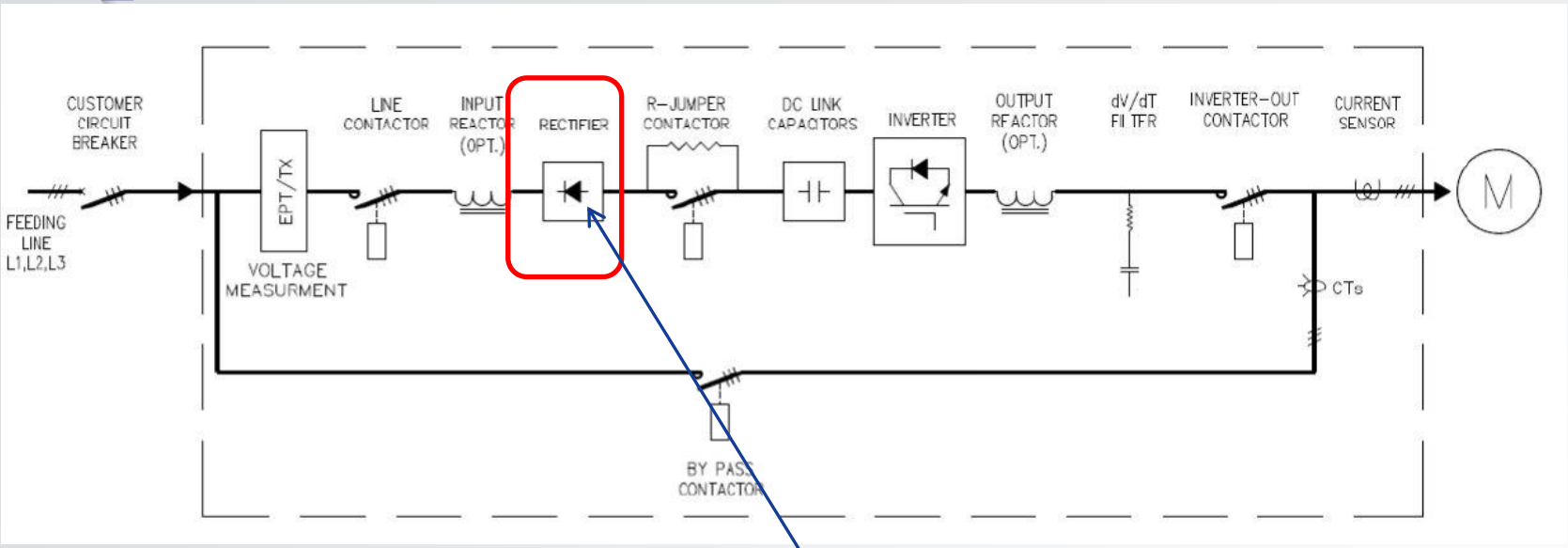
DRIVESTART SOLUTION CASE STUDY



Incoming reactor – When is it needed?

- Protect the Rectifying Bridge Diodes
- Reduce Harmonics in the mains
- Typical value: 2-3% (of Vph/Iph). (3300V/400A): 2.6%=>400µH
- Disconnected at Bypass.

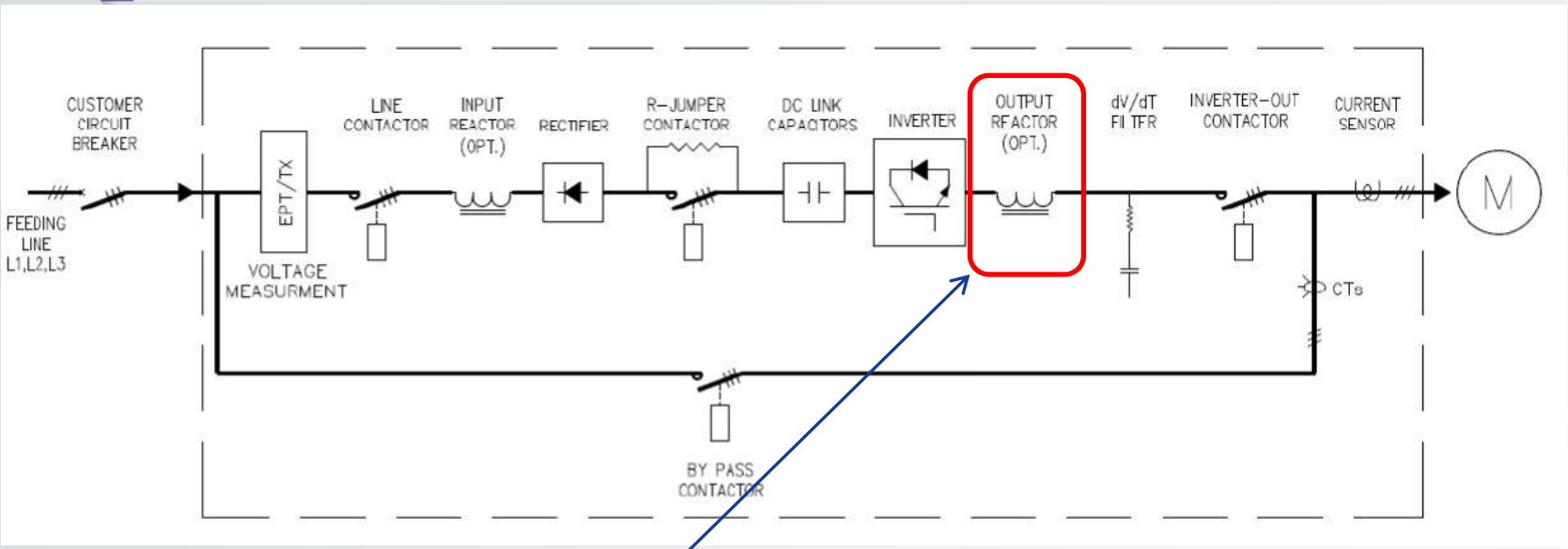
DRIVESTART SOLUTION CASE STUDY



Rectifier – 6 pulse vs. 12 pulse or 24 pulse

- Do we need harmonic mitigation?
- 24 pulse however in this case replacing the incoming transformer may be an issue.

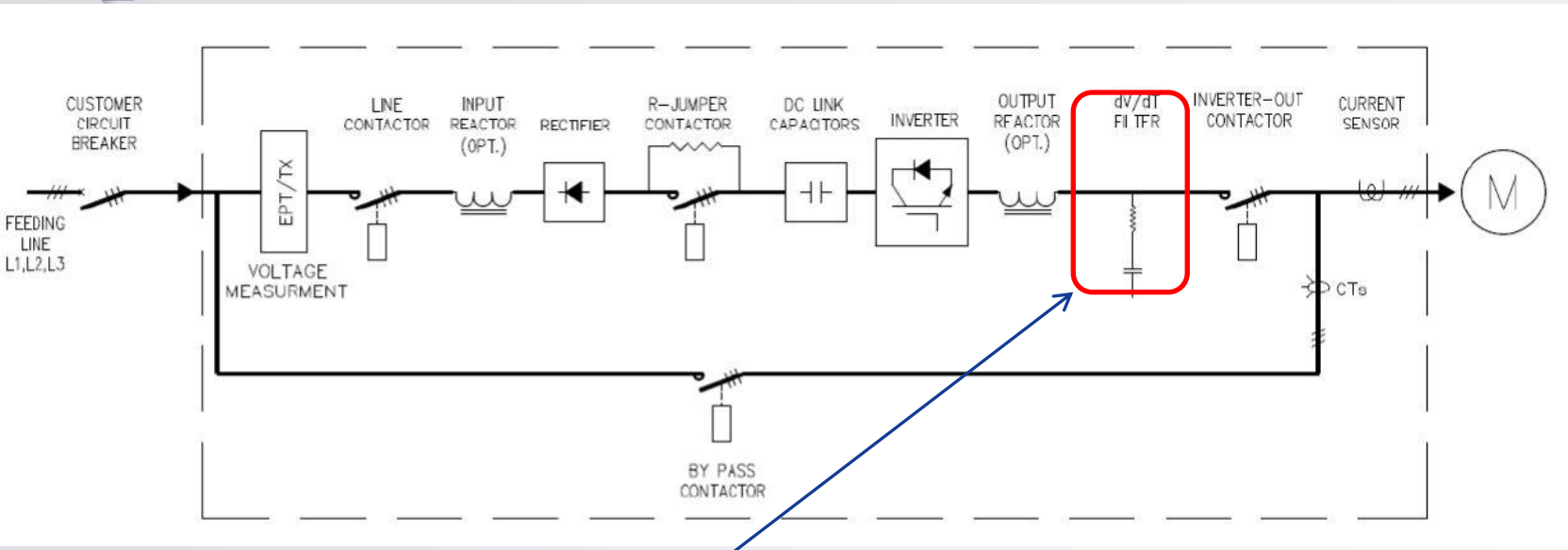
DRIVESTART SOLUTION CASE STUDY



Output Reactor

- Prevent Short circuit between mains and inverter output at closed transition.
- It is part of the dv/dt output filter
- Typical value: Half than Input Inductor
- Disconnected at Bypass.

DRIVESTART SOLUTION CASE STUDY



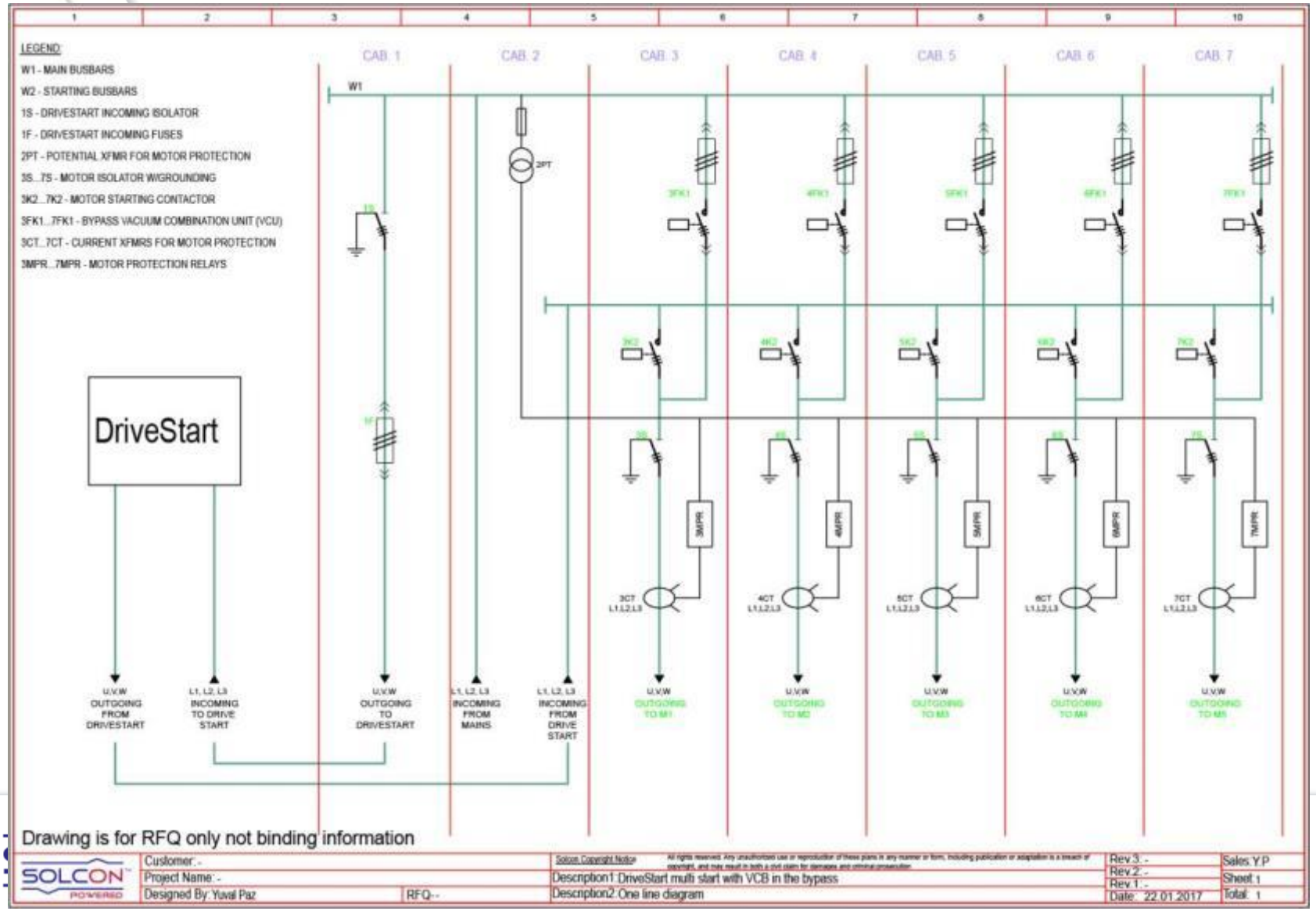
dv/dt Filter

- Reduces the rate of dv/dt mainly for non ”inverter-rated” motors.
- dv/dt<1.5kV/µs
- Disconnected at Bypass.

DRIVESTART SOLUTION CASE STUDY

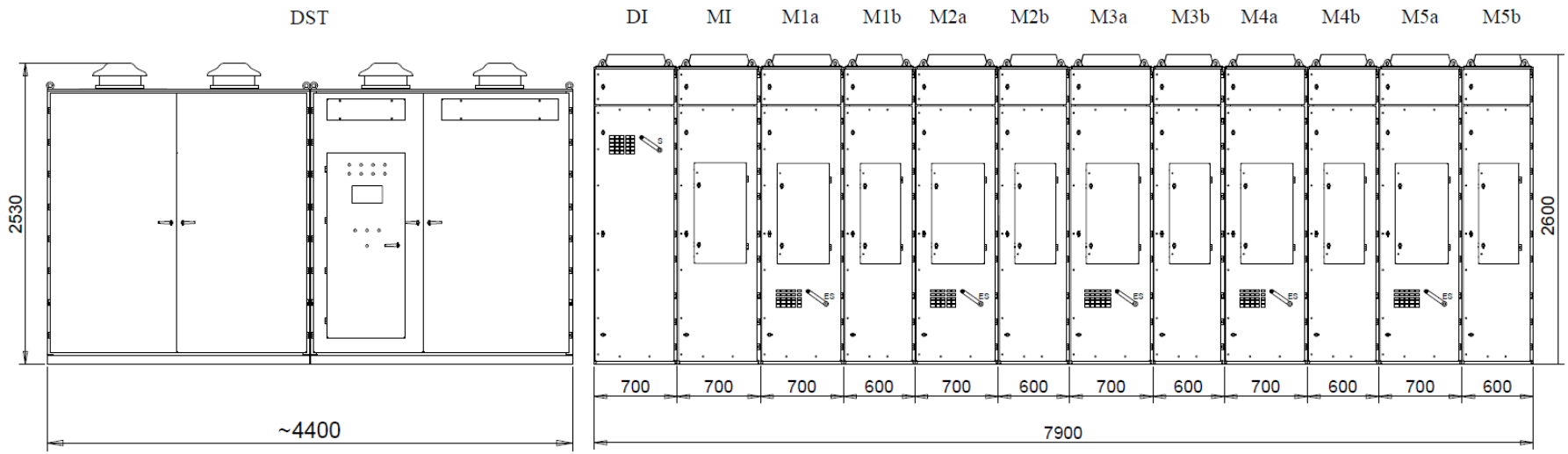
- Weak network
- High torque start (650 tons of sludge)
- 500m cable length
- 5 motors – cost constrained
- Space constrained – existing SWGR room.
- construction Time constrained
- Solcon engineering design according to Solcon ProGear type tested medium voltage SWGR integrated with the DriveStart and motor protection relays.

Multi-Start – Design Philosophy – Internal Bypass



Multi-Start – Design Philosophy – Internal Bypass

Front View



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THANK YOU!