APPLICATION NOTE

Softstarter Motor Starting & Protection Solutions for Pumping in Mixed-Use Farming

Commercial and Industrial Applications (UL)

Are you searching for Motor Starting & Protection solutions for pumping in a mixed farming (agriculture and livestock) setting? Using this guide, you can easily find the best solution to fit your use case in center-pivot irrigation, livestock water systems, drainage, dredging, and waste removal. Quickly configure your installation thanks to our Application Bundle based on concrete examples.

What is a Softstarter?
Nearly all electric motor circuits can benefit from using a softstarter. A softstarter is a thyristor-based switching device that gently ramps up voltage to an electric motor, thereby limiting current, torque, and acompanying electromagnetic stresses on the motor and equipment. This is in constrast to a combination motor controller, which is a direct-on-line starting solution. Whatever your motor load, the equipment can generally benefit from increased switching life, electronic control, and monitoring brought by a softstarter.

Why you need a Softstarter
Basic motor starting solutions, such as NEMA pump panels and IEC-style combination motor controllers are affordable and reliable, however, lack many features required for modern industrial applications, such as communications, remote operation, and diagnostics. Conversely, softstarters provide all of the protection benefits of traditional starting solutions, while adding switching life to the power chain, reducing wear and tear on electrical and mechanical components, while enabling remote control, and enhanced monitoring and cloud-based services.

Main benefits

Smarter protection
Increase the reliability of your installation and reduce OPEX by using the complete range of softstarting solutions from ABB.

Speed up your projects
Speed up projects and reduce CAPEX using a range of products with compact sizes and excellent performance suitable for harsh environments, varying temperatures, and humidity.

Safety
Water hammering can cause hazardous conditions for animals and personnel. Further, malfunctioning equipment can lead to distress, injury, or death in livestock. Reliable systems are essential to ensuring the safety of all life in agricultural and farming settings.

Smarter metering and monitoring
Increase system efficiency, and improve yields with enhanced measuring, control, and condition-based monitoring enabled by ABB.

Mixed Farming Pumping Applications

Background

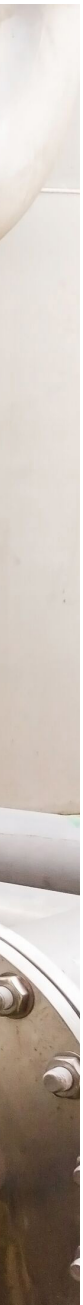
Pumping systems are ubiquitous in agriculture and farming (including animal husbandry), and for a variety of purposes. Pumping water is common, from irrigation systems, to managing canals, livestock watering systems, and more. But pumping is also required for potentially viscous fluids—those which contain solids—and are used under extremely demanding conditions. Mixed farming pumping applications require high reliability and safety, since both revenues and lives are on the line. As a result, an intelligent, integrated approach to pumping is required. This document presents circuit templates that can be replicated in various applications to get the job done.

Applications include:
- Center pivot irrigation (pump panel replacement)
- Livestock water systems
- Fixed canal management, flood mitigation, and wastewater drainage
- Dredging of canals and ponds
- Manure and waste removal

Pump types: centrifugal (variable torque, flow depends on pressure; efficient for low viscosity fluids), positive displacement (constant torque, constant flow and pressure; more efficient w/ high viscosity).
While the specific pump technology and use case may vary, all of these systems rely on dependable motor control for small to medium pump sizes.

Softstarter Benefits

- **Clogged or blocked pumps:** ABB PSTX softstarters have a built-in pump cleaning function with reverse and forward motion to provide the best chance of resolving clogging or blockage in the pump without manual cleaning being required. In addition, back and forth motion improves clogged pipes and enhances pump efficiency.
- **Dry running pump:** PSTX and PSE have dry pump protection thanks to a feature in the softstarter called underload protection, which helps to detect when a pump or application has no load. The softstarter can then send a warning or stop the pump to prevent damage.
- **Obstructions:** PSTX and PSE have blocked pump protection thanks to a feature in the softstarter called locked rotor protection, which helps to detect when a pump is blocked. The softstarter can then send a warning or stop the motor to prevent it from overload, and subsequent damage.
- **Harsh environments:** PSTX keeps your motor running reliably even in cold and damp environments. It removes condensation from idle motors. It prevents the motor from freezing and is perfect for damp installations and cold environments. The ABB softstarter is suitable in harsh conditions thanks to features such as motor heat to always keep the motor dry, conformal coated circuit boards, IP66 rating and Type 4X outdoor-rated external keypad. The benefits are prolonged system life and increased uptime.



Enclosed Softstarters

- **General**
  Enclosed softstarters offer a viable alternative to building a pumping solution yourself. They include all the features of PSTX open-type softstarters, but with outdoor enclosures rated Type 3R/4. They can weather the elements, and provide integrated circuit protection and controls out of the box.
  ABB offers two types of enclosed softstarter:
  - ND – Normal Duty
  - XD – Extreme Duty.

- **Normal Duty Enclosed Softstarter**
  - MCCB-protected softstarter
  - Basic controls including pilot devices, HMI, and external disconnect handle.

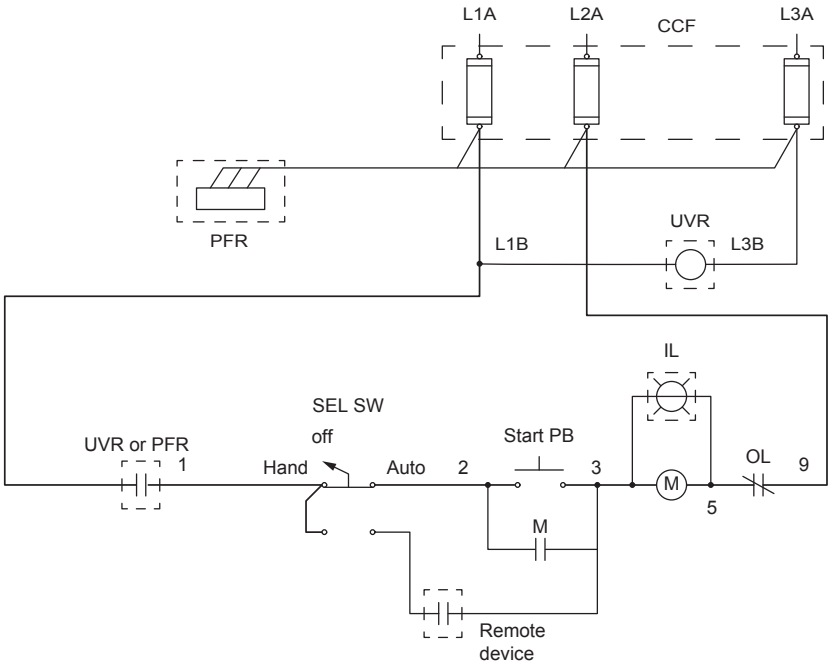
- **Extreme Duty Enclosed Softstarter**
  - MCCB-protected softstarter
  - Basic controls including pilot devices, HMI, and external disconnect handle
  - Contactor-based emergency bypass.

Pumping in Industrial Mixed Farming

General
Products like pump panels provide full-voltage control of squirrel-cage pump motors. They offer protection from motor burnouts due to overloading, protection against untimely restarts after power failure and protection of the motor circuit against damage from short circuits. By substituting the classic pump panel with a softstarter, for example, the user achieves greater motor and mechanical component life, increased visibility into electrical performance and system operation, in addition to remote control capabilities.

Primary benefits:
- Reduce wear & tear on electrical and mechanical components (prolong system life)
- Diagnose problems remotely with ABB Ability
- Modify / update irrigation schedules and system operating parameters
- Reduce on-site maintenance duration, or avoid truck-rolls altogether
- Achieve reduced total cost of ownership and realized greater yields / ROI on capital assets and investments.

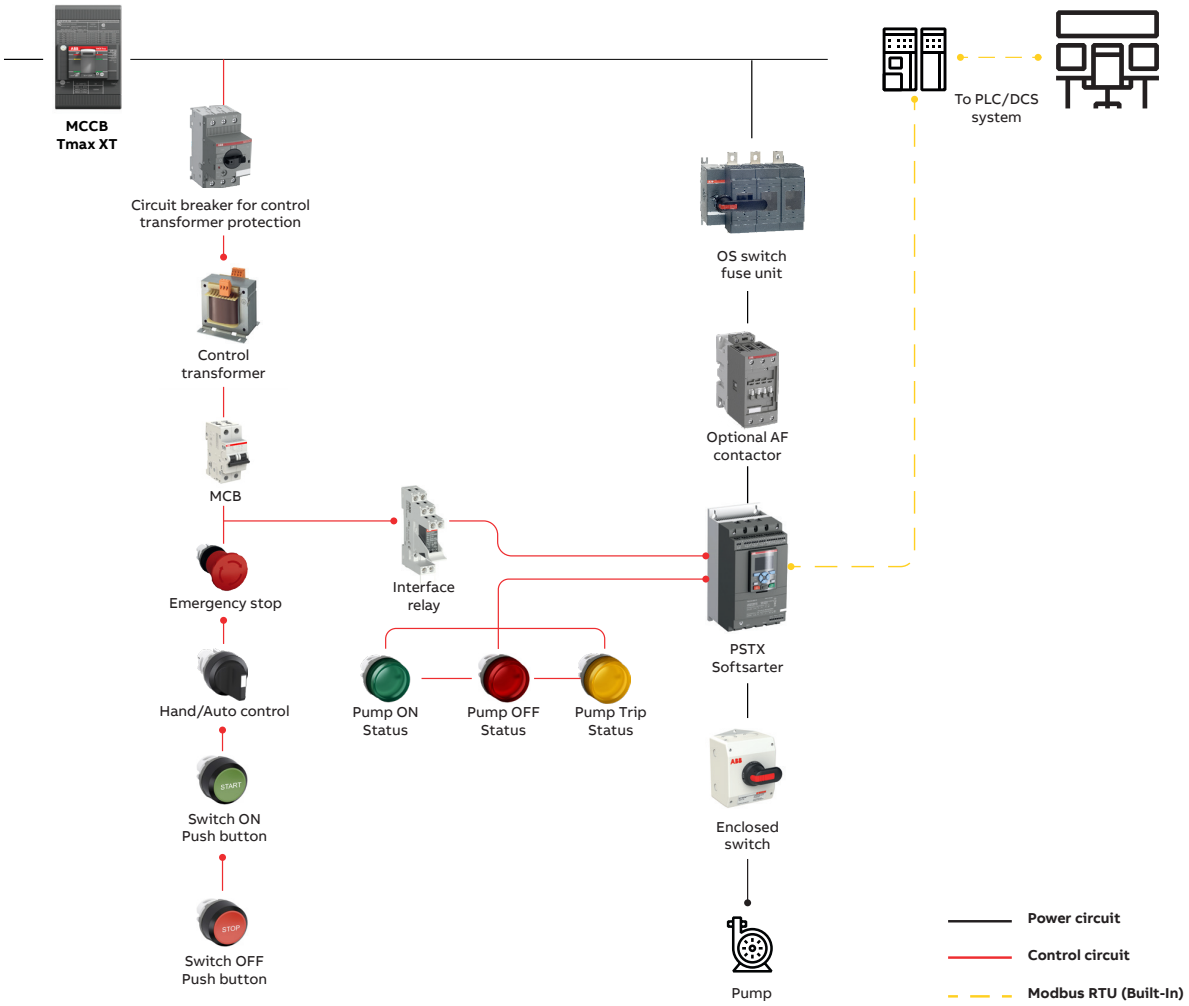
Classic Pump Panel



Nomenclature:

M: Motor contractor	CCF: Control circuit fusing
IL: Indicating light	PFR: Phase failure relay
LO: Late opening	UVR: Undervoltage relay
RES: Holding resistor	Dotted line box: if used

Softstarter-Enhanced Pump Panel

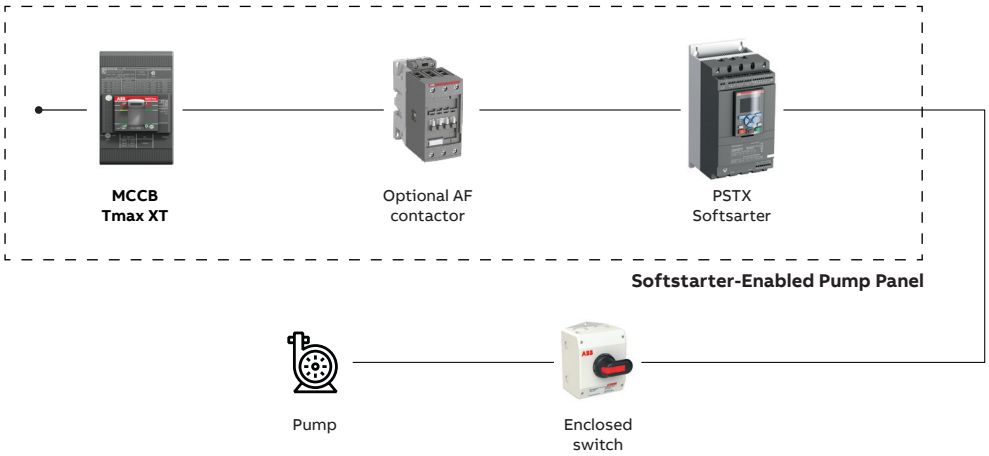


Motor Starting & Protection for Pumps in Mixed Farming

Fundamentals, main components & functionalities

Pumping in mixed farming involves circulating clean water, dirty water, or viscous fluids through a network of long pipes and hoses, with accompanying friction (resistive losses) and pressure drops. Typically, basic motor starting solutions involve using some arrangement of contactors, overload, disconnect and short circuit protection, found in products like a combination motor controller or a NEMA “pump panel.”

However, there are a number of ways to start an electric motor, and for low horsepower pumping applications, electronic starters and softstarters can add digital capabilities such as remote operability and monitoring, while reducing wear and tear on motor circuits, and reducing harmful effects like water hammering. We present a solution for a 25 hp pumping application using a softstarter as our example.



Main components	
MCCB	Softstarter
Contactor (optional)	

Primary Functional Requirements

- Starting / stopping pumps of varying sizes (up to 100 hp typical)
- Reducing torque and current to protect mechanical, motor, and circuit insulation systems
- Reduce / prevent water hammering and associated damage by ramping up/down flow
- Provide overload protection to the pump / motor circuit, to prevent damage even when pumping dirty or viscous fluids
- Provide short circuit protection and a disconnect means to the pump circuit
- Provide enhanced pump protection via locked-rotor, underload protection features

Secondary Optional Requirements

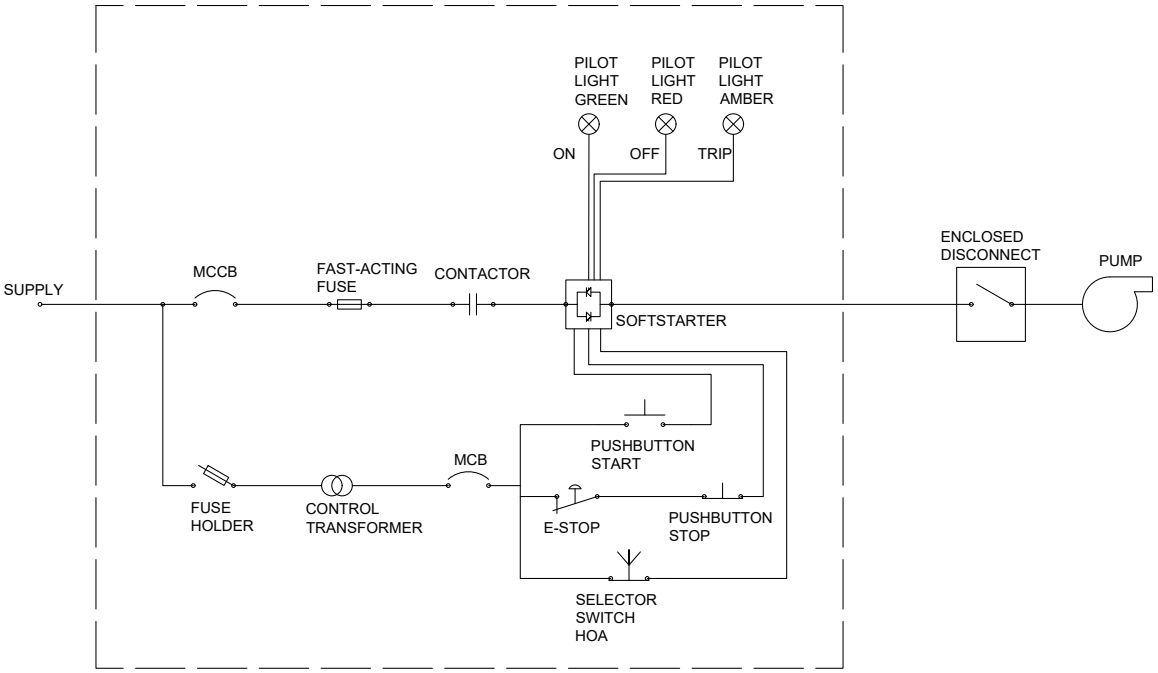
- Monitoring: where any interruption in service or reduction in performance may represent a significant economic loss.
  - Voltage, current, and cycles / duty monitoring
  - Communication: to communicate parameters to centralized monitoring system.
- Remotely-operated: need for remote control
- Surge protection
- Self-cleaning of a pump and clog management

Motor Starting & Protection solutions for Mixed Farming Systems

Commercial and Industrial scale

Discover our Motor Starting & Protection solutions for easy pump panel configuration considering a 25 hp submersible pump

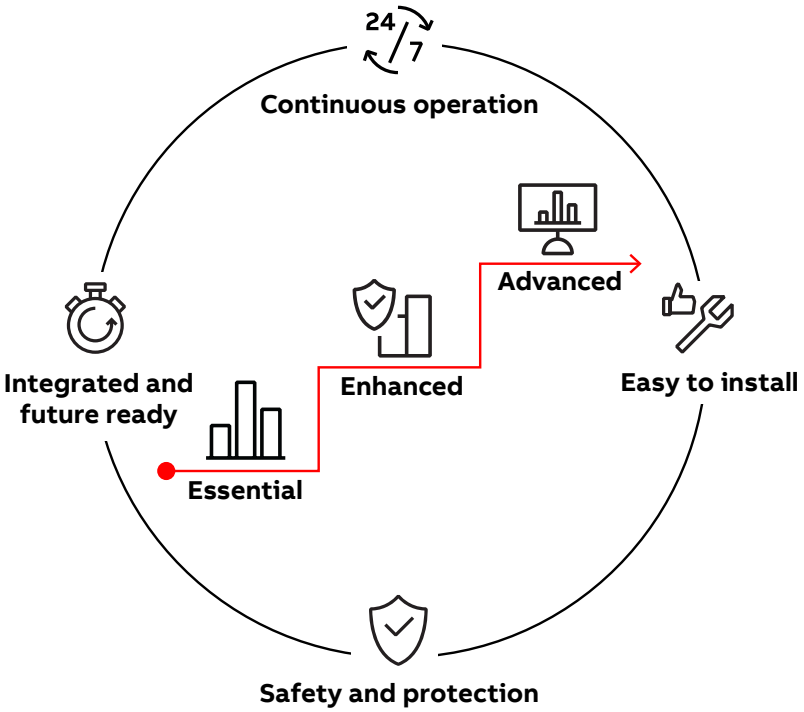
Single-line diagram of one 25 hp pumping circuit using ABB Softstarters.



Specifications of electrical quantities with one 25hp pump

Softstarter Pump Panel - Circuit Data	
Parameter	**Value**
Pump Rated Power (hp)	25
Rated System Voltage (V)	480
Prospective Short Circuit Current (kA)	65
Nominal Overcurrent Device Rating (A)	30
Nominal Softstarter Rating (hp)	30

Discover our Motor Starting, Protection, and Control solutions designed for pumping in a mixed farm setting. Three tiers of functionality are provided for ease of selection.



The table below provides an overview of the possible functions in our different solution offerings for digital switching and protection for pump circuits.

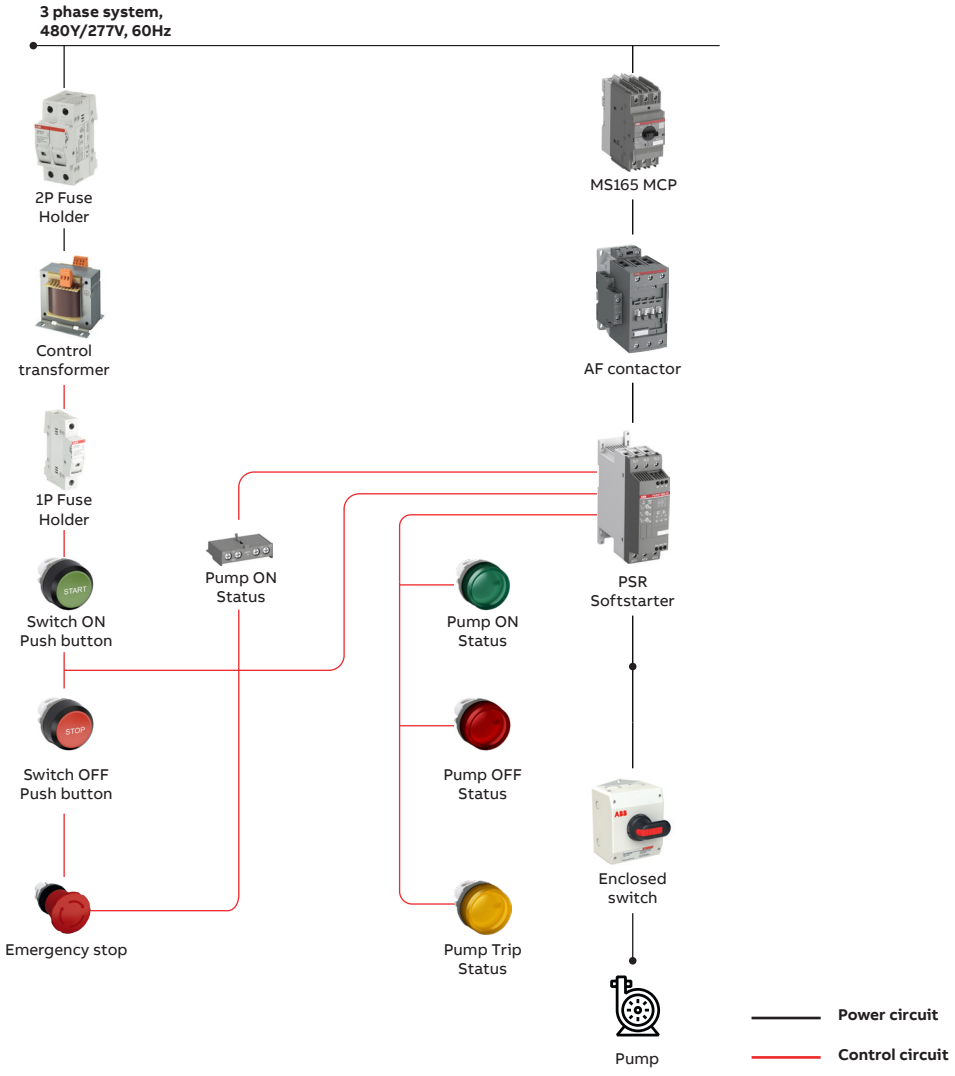
Solution level	Basic protection functions	Monitoring of additional protection functions	Digital connectivity and cloud monitoring
Essential	●		
Enhanced	●	●	
Advanced	●	●	●

ABB's offering (UL) - Essential

General Pumping Panel

Softstarter Pump Panel w/ Basic Protection Features

To upstream branch circuit protective device



Softstarter Pump Panel Components

Main Power Circuit Components

- ABB MS-series motor circuit protector for short circuit and overload protection
- AF-series contactor for remote control and circuit isolation
- ABB PSR softstarter

Control Circuit Components

- ABB modular or compact 22mm pilot devices (E-stop, start/stop pushbuttons, and pilot lights)
- E90 series fuseholders
- ABB open-type machine-tool or control power transformers.

Bill of Materials

Essential

Considered parameters	
480Y/277V / 3ph	25 hp pump / motor load
42A short circuit protective device	65kA SCCR

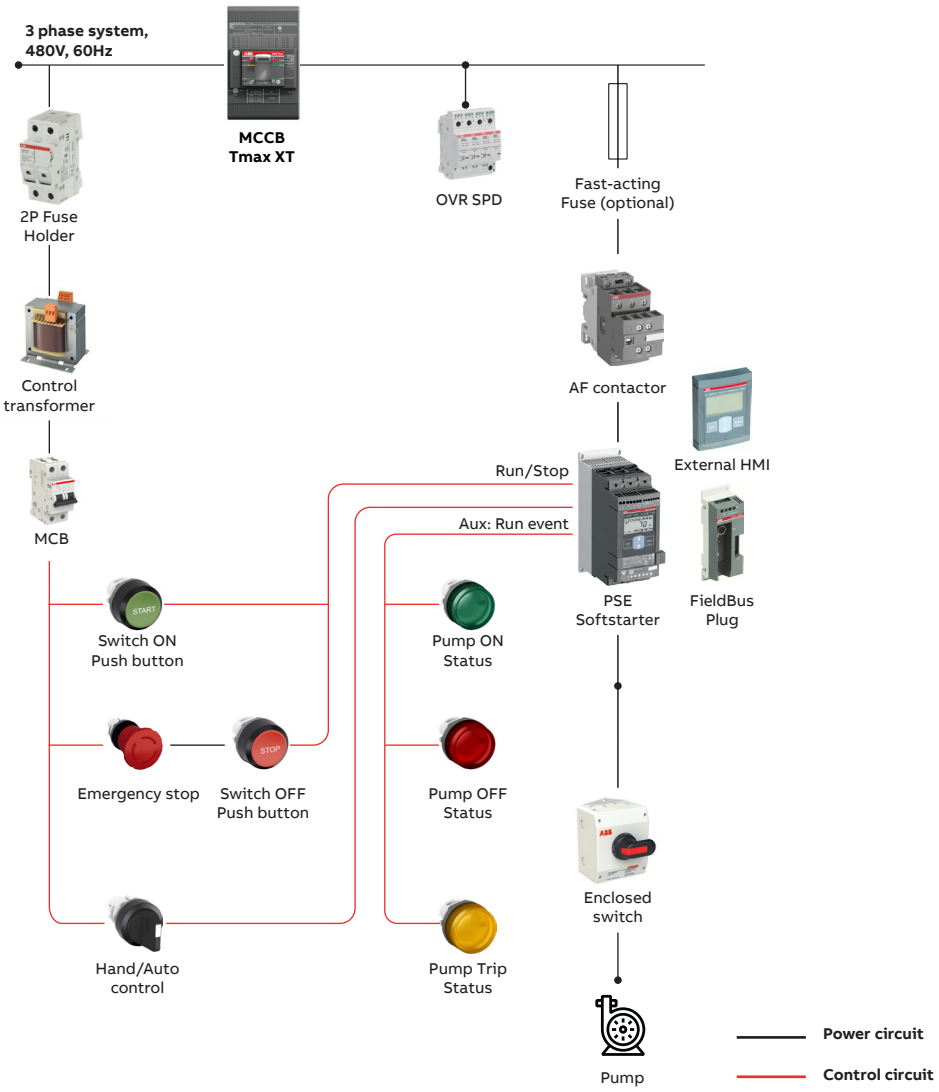
Product ID	Part Number	US product code	Description	Quantity
Power circuit components				
1SAM451000R1015	MS165-42		MANUAL MOTOR STARTER 3P 600V 30-42A	1
1SBN083406R1000	BEA65-4		CLOSE COUPLER AF40-65/MS165 (optional)	0
1SBL347001R1311	AF40-30-11-13		CTR,3P,42A,100-250VAC/DC,1/1 (contactor)	1
1SFA896110R7000	PSR37-600-70		PSR SSTR,600V/240VAC,34.0A (softstarter)	1
1SFA896216R1001	PSR45-MS165		CLOSE COUPLER MS165 PSR37-45 (optional)	0
1SAM201901R1001	HKF1-11		MS116/132 FRONT MOUNT AUX ,1NO/1NC	1
Control circuit components				
2CSM299922R1801	E 92/30s CC		E90 CC 2P W/BFI (fuseholder)	1
N/A	9T58K0501G30		1C,0.06kVA,480-120,55C,C&C,2CC1HK,MEB,IP	1
2CSM299882R1801	E91/30SCC		E90 CC 1P W/BFI	1
1SFA619500R1071	CE3T-10R-11		30MM TW-REL RED 1 NO/1NC (pushbutton; E-stop)	1
1SFA619100R1072	CP1-10G-11		COMPACT FLUSH PB MOM. GREEN 1NO+1NC (pushbutton; green)	1
1SFA619100R1071	CP1-10R-11		COMPACT FLUSH PB MOM. RED, 1NO+1NC" (pushbutton; red)	1
1SFA619403R5132	CL2-513G		PILOT LIGHT CL2 GREEN 110-130V AC	1
1SFA619403R5131	CL2-513R		PILOT LIGHT CL2 RED 110-130V AC	1
1SFA619403R5133	CL2-513Y		PILOT LIGHT CL2 YELLOW 110-130V AC	1

APPLICATION FINDER

We've made it simpler for you to set up your project!
Click here to find the reference architecture that best fits your needs and download the Bill of Materials.

ABB's offering (UL) - Enhanced
General Pumping Panel

Softstarter Pump Panel w/ Enhanced Protection and Basic Communications
To upstream branch circuit protective device



Softstarter Pump Panel Components

Main Power Circuit Components

- ABB Tmax XT MCCB inverse-time circuit breaker or motor circuit protector for short circuit protection
- (optional) fast-acting / semiconductor fuses for Type II protection of the softstarter (not suppliedby ABB)
- (optional) AF-series contactor for remote control and circuit isolation
- PSE efficient softstarter w/ FieldBus Plug accessory (FBPA) for DeviceNet, Profibus DP, MODBUS, and CANopen communication protocols

Control Circuit Components

- ABB modular or compact 22mm pilot devices (E-stop, hand/off/auto selector switch, start/stop pushbuttons, and pilot lights)
- E90 series fuseholders
- SU200M (UL 489) or ST200M (UL 1077) miniature circuit breakers (MCB)
- ABB open-type machine-tool or control power transformers.

Bill of Materials
Enhanced

Considered parameters	
480V / 3ph	25 hp pump / motor load
30A short circuit protective device	65kA SCCR

Product ID	Part Number	US product code	Description	Quantity
Power circuit components				
1SDA075224R1	XT4HU3030AFF000XXX	XT4HU3030AFF000XXX	XT4H 250 TMF 30-400 3P F F UL/CSA	1
1SBL297001R1311	AF38-30-11-13	AF38-30-11-13	AF38 3P 1NO1NC 100-250V50/60HZ-DC C (contactor)	0
1SFA897104R7000	PSE37-600-70	PSE37-600-70	PSE, 600V, 100-250VAC (softstarter)	1
Control circuit components				
2CSM299922R1801	E 92/30s CC		E90 CC 2P W/BFI (fuseholder)	1
N/A	9T58K0507G37		1C,0.3kVA,480-120,80C,C&C,CLO,MEB,IP (control power transformer)	1
2CDS271334R0034	ST201M-C3		MCB ST200M 1P C 3A UL1077 (mini breaker; supplementary protector)	1
1SFA619500R1071	CE3T-10R-11		30MM TW-REL RED 1 NO/1NC (pushbutton; E-stop)	1
1SFA619100R1072	CP1-10G-11		COMPACT FLUSH PB MOM. GREEN 1NO+1NC (pushbutton; green)	1
1SFA619100R1071	CP1-10R-11		COMPACT FLUSH PB MOM. RED, 1NO+1NC (pushbutton; red)	1
1SFA619211R1026	C3SS2-10B-20		SELECTOR 3 POSITION MOM. BLACK, 2NO (selector switch; hand-off-auto)	1
1SFA619403R5132	CL2-513G		PILOT LIGHT CL2 GREEN 110-130V AC	1
1SFA619403R5131	CL2-513R		PILOT LIGHT CL2 RED 110-130V AC	1
1SFA619403R5133	CL2-513Y		PILOT LIGHT CL2 YELLOW 110-130V AC	1
1SFA899300R1020	PS-MBIA		PSE MODBUS ADAPTER (included w/ softstarter)	1
1SFA896312R1002	PS-FBPA		PSE/PSR FIELDBUS PLUG ADAPTER (required for ext comms)	1
1SAJ250000R0010	MRP21-FBP.100		FIELD BUS PLUG MODBUS RTU (required for ext comms; plugs for other protocols available)	1
1SFA897100R1001	PSEEK		PSE ELECTRONIC REMOTE KEYPAD (optional, external HMI)	1
1SFA897201R1001	PSECA		PSE SERVICE CABLE (optional, external HMI)	1

APPLICATION FINDER

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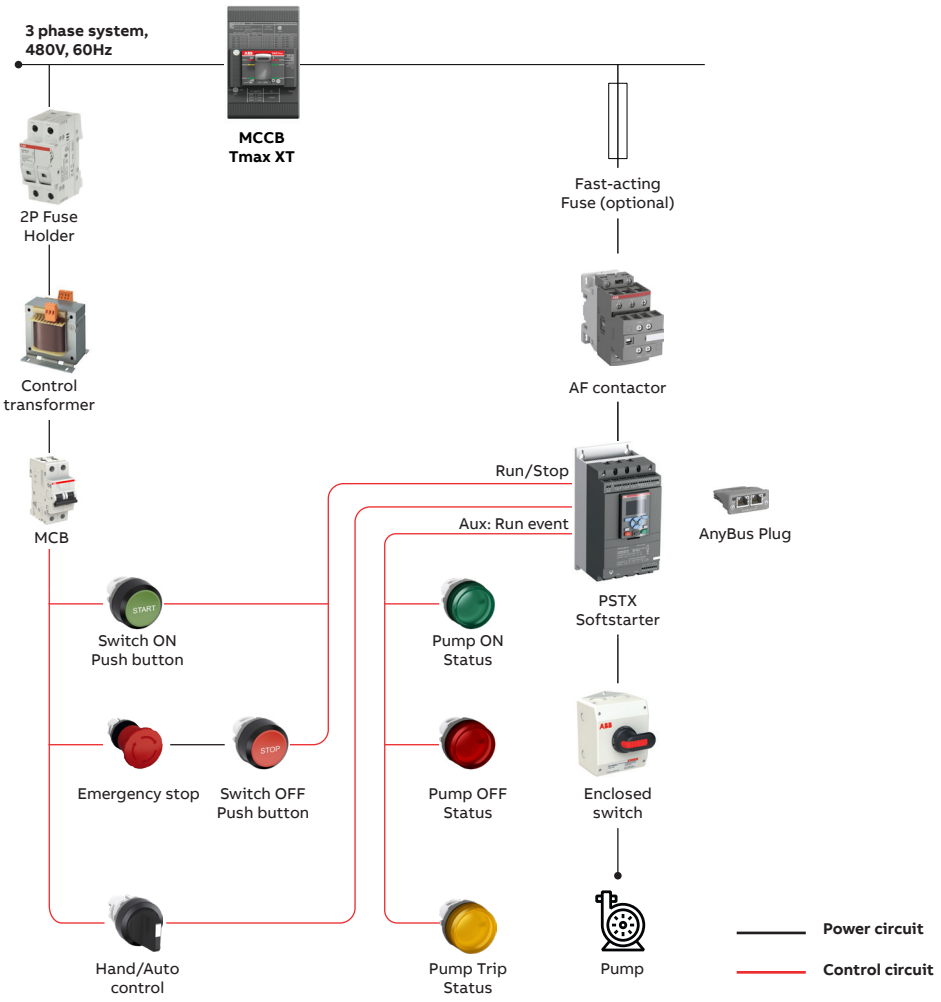
ABB's offering (UL) - Advanced
General Pumping Panel

Softstarter Pump Panel w/ Digital/Cloud Compatibility



Softstarter Pump Panel Components

Main Power Circuit Components

- ABB Tmax XT MCCB inverse-time circuit breaker or motor circuit protector for short circuit protection
- (optional) fast-acting / semiconductor fuses for Type II protection of the softstarter (not supplied by ABB)
- (optional) AF-series contactor for remote control and circuit isolation
- PSTX intelligent softstarter equipped w/ AnyBus comm support for protocols like Modbus RTU/ TCP, Profibus, DeviceNet, BACnet, and more
- ABB OVR surge protective device (SPD)

Control Circuit Components

- ABB modular or compact 22mm pilot devices (E-stop, hand/off/auto selector switch, start/stop pushbuttons, and pilot lights)
- E90 series fuseholders
- SU200M (UL 489) or ST200M (UL 1077) miniature circuit breakers (MCB)
- ABB open-type machine-tool or control power transformers.

Bill of Material

Advanced

Considered parameters	
480V / 3ph	25 hp pump / motor load
30A short circuit protective device	65 kA SCCR

Product ID	Part Number	US product code	Description	Quantity
Power circuit components				
1SDA074792R1	XT2HU3030AFF000XXX	XT2HU3030AFF000XXX	XT2H 125 TMF 30-400 3P F F UL/CSA (thermal-mag MCCB)	1
1SDA074885R1	XT2HU3030MFF000XXX	XT2HU3030MFF000XXX	XT2H 125 MCP INCH=30 3P F F UL/CSA (mag ONLY MCP; alternate)	0
1SBL297001R1311	AF38-30-11-13	AF38-30-11-13	AF38 3P 1NO1NC 100-250V50/60HZ-DC C (contactor)	1
1SFA898104R7000	PSTX37-600-70	PSTX37-600-70	PSTX37, 600V, 100-250VAC	1
2CTB802346R2500	OVR T2 3N 40-320 P TS U	OVRT23N40320PTSU	OVR SPD 3P+N 40KA 320V P TS (surge protective device)	1
Control circuit components				
2CSM299922R1801	E 92/30s CC		E90 CC 2P W/BFI (fuseholder)	1
N/A	9T58K0507G37		1C,0.3kVA,480-120,80C,C&C,CLO,MEB,IP (control power transformer)	1
2CDS271334R0034	ST201M-C3		MCB ST200M 1P C 3A UL1077 mini breaker; supplementary protector)	1
1SFA619500R1071	CE3T-10R-11		30MM TW-REL RED 1 NO/1NC (pushbutton; E-stop)	1
1SFA619100R1072	CP1-10G-11		COMPACT FLUSH PB MOM. GREEN 1NO+1NC (pushbutton; green)	1
1SFA619100R1071	CP1-10R-11		COMPACT FLUSH PB MOM. RED, 1NO+1NC" (pushbutton; red)	1
1SFA619211R1026	C3SS2-10B-20		SELECTOR 3 POSITION MOM. BLACK, 2NO (selector switch; hand-off-auto)	1
1SFA619403R5132	CL2-513G		PILOT LIGHT CL2 GREEN 110-130V AC	1
1SFA619403R5131	CL2-513R		PILOT LIGHT CL2 RED 110-130V AC	1
1SFA619403R5133	CL2-513Y		PILOT LIGHT CL2 YELLOW 110-130V AC	1
1SFA899300R1008	AB-MODBUS-TCP-2		PSTX ANYBUS, MODBUS TCP, 2 PORT	1

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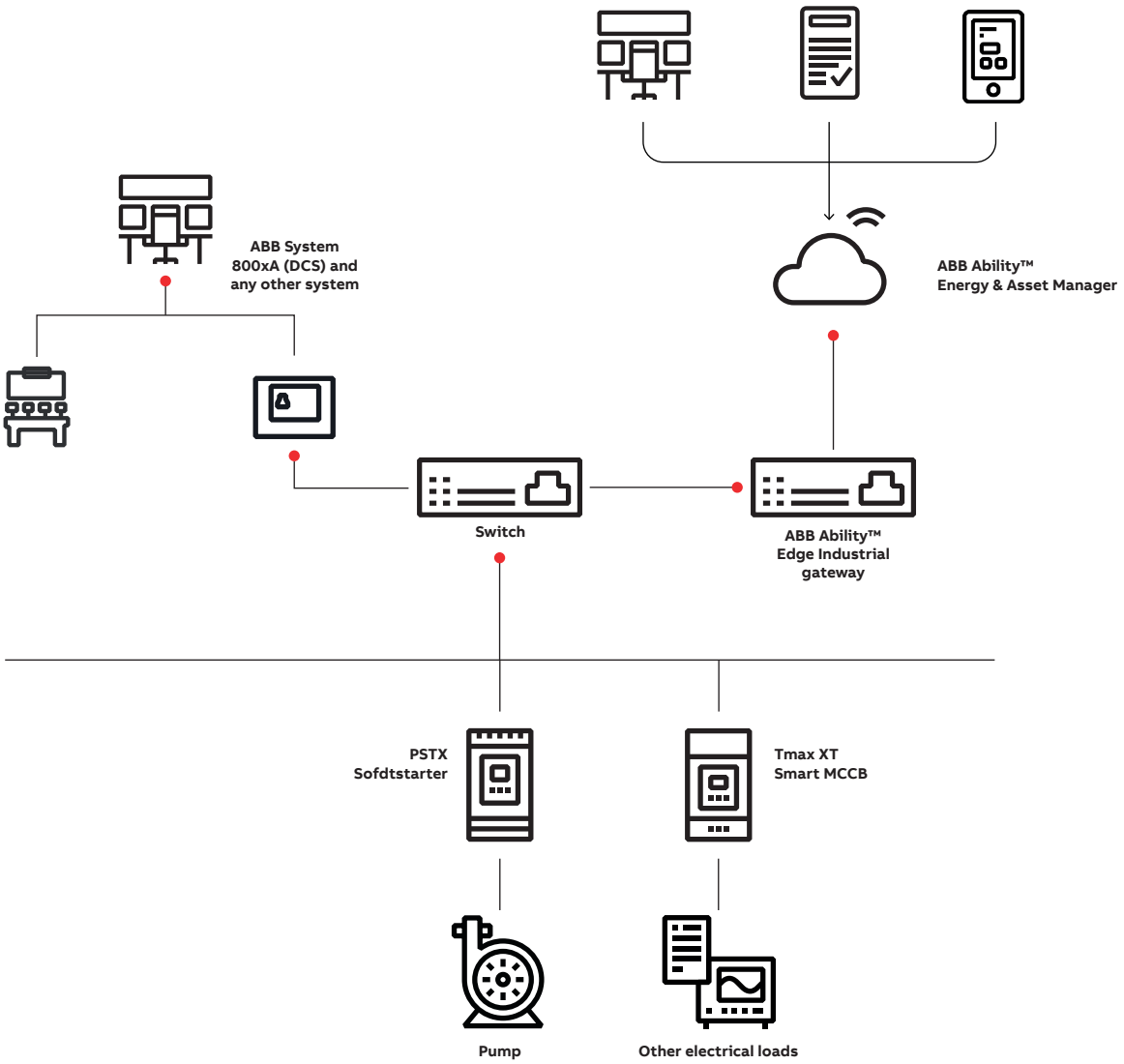
Digital offering

When connecting an ABB Ability™-compatible device like Tmax XT molded case breakers, PSTX softstarters, or TruOne automatic transfer switches, the device can be connected to the ABB Ability™ Edge Industrial Gateway - your portal to cloud-enabled access to all of your energy assets!

Digitalization allows flexible remote control of the motor control equipment.

100% availability of motor measurement data as an aid to predictive maintenance.

Cloud connectivity through ABB Ability™ Energy and Asset Manager, with data always quickly available via web applications.



Product offering

Tmax XT:

WEB PAGE

CATALOG

PSTX Softstarter:

WEB PAGE

CATALOG

PSE Softstarter:

WEB PAGE

CATALOG

PSR Softstarter:

WEB PAGE

CATALOG

AF Contactors & Starters:

WEB PAGE

CATALOG

SU200M/ST200M MCBs:

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OVR SPDs:

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E90 Series Fuseholders:

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Assorted Pilot Devices:

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ND Enclosed Softstarters:

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XD Enclosed Softstarters:

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CATALOG

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