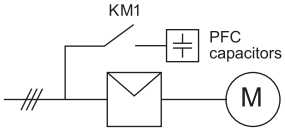
Power factor correction: Can power factor correction be used with soft starters?

Power factor correction (PFC) capacitors can be used with soft starters, provided they are switched in using a dedicated contactor when the motor is running at full speed. PFC must always be installed on the input side of the soft starter; connecting PFC capacitors to the output of a soft starter causes resonance between the inductance of the motor and the power factor capacitance, resulting in severe overvoltage and equipment failure.



The contactor should be AC6 rated for the motor full load current. PFC capacitors can be sized using the following formula:

$$\text{kVA (Cap)} = \frac{\sqrt{3} \times V_{line} \times 0.8 \times \text{motor no load current}}{1000}$$

Motor thermal capacity: What is it?

Thermal capacity, also called “maximum locked rotor time” or “maximum DOL start time”, describes the maximum time a motor can run at locked rotor current from cold. This information is usually available from the motor datasheet.

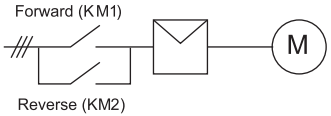
The MCD 202 overload protection can be set to match the motors thermal capability using the motors locked rotor time (cold).

Jog: What is the jog function?

Jog runs the motor at reduced speed, to allow alignment of the load or to assist servicing. The motor can be jogged in either forward or reverse direction. The maximum available torque for jog is approximately 50% - 75% of motor full load torque (FLT) depending on the motor. Available jog torque in reverse is approximately 50% - 75% of the jog torque in forward direction. This is ideal for positioning of loads such as mixers or hopper bins ready for unloading.

Reversing: Can soft starters be used to reverse motor direction?

On their own, soft starters cannot run motors in reverse direction at full speed. However, an arrangement of forward and reverse contactors can be used to provide the same effect.



MCD 500 soft starters offer a part speed function that runs the motor at slow speed in either forward or reverse direction, without a reversing contactor. Reverse operation is limited to short periods at a fixed slow speed.

Sealed enclosures: Can soft starters be installed in sealed enclosures?

Soft starters can be installed in sealed enclosures, provided the ambient temperature within the enclosure will not exceed the soft starter's rated temperature.

All heat generated within the enclosure must be dissipated, either by ventilation or through the enclosure's walls. This includes heat not only from the soft starter but also from other components such as fuses, cabling and switchgear. Heating from the soft starter can be minimised by installing the starter in a bypassed configuration. To minimise external heating, protect the enclosure from direct sunlight.

WinStart includes a function to help design enclosure ventilation.

Primary Resistance Starters: How does soft start compare to primary resistance starting?

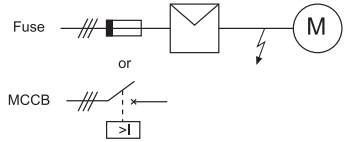
Soft starters are more flexible and reliable than primary resistance starters.

Primary resistance starters cannot accommodate varying load conditions (e.g. loaded or unloaded starts) and the start torque cannot be fine-tuned to match motor and load characteristics. Performance may vary with multiple starts in close succession, because the start profile changes as the resistance heats up. Damaging torque and current transients still occur at the steps between voltages, and primary resistance starters are not capable of providing soft stop. Primary resistance starters are large and expensive, and liquid resistance starters require frequent maintenance.

Short Circuit Protection: What is required for Type 1 short circuit protection of a soft starter?

Type 1 protection requires that in the event of a short circuit on the output of a soft starter the fault must be cleared without risk of injury to personnel. The soft starter may or may not be operational after the fault.

Type 1 protection is provided by HRC fuses or a MCCB within the motor branch circuit, which must be able to bear the required motor start current.



Typical selection criteria are as follows:

		Rating (% Motor FLC), Start Current	
Starter type	**Protection Type**	**< 350% FLC 15 seconds**	**> 350% FLC 15 seconds**
MCD 200	Fuse (non time delayed)	175%	200%
	Fuse (time delayed)	150%	175%
	MCCB*	150 – 200%	
MCD 500	Fuse (non time delayed)	150%	
	Fuse (time delayed)	125%	
	MCCB*	150 – 200%	

** Consult the manufacturer's specification.*

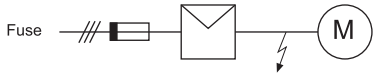
Maximum fuse ratings for Type 1 motor protection are specified in UL and IEC standards.

Fuse	Rating (% Motor FLC)
Fuse (non-time delayed)	300%
Fuse (time delayed)	175%

Type 2 protection requires that in the event of a short circuit on the output of a soft starter the fault must be cleared without risk of injury to personnel or damage to the soft starter.

Type 2 protection is provided by semiconductor fuses, which must be able to carry motor start current and have a total clearing I2t less than the I^2t of the soft starter SCRs.

Semiconductor fuses for Type 2 circuit protection are additional to HRC fuses or MCCBs that form part of the motor branch circuit protection.



Refer to the soft starter's Design Guide for semiconductor fuse recommendations.

- Semiconductor fuses may be used with MCD soft starters. Use of semiconductor fuses will provide Type 2 coordination and reduce the potential of SCR damage due to transient overload currents and short circuits. MCD soft starters have been tested to achieve Type 2 coordination with semiconductor fuses. The following table provides a list of suitable Bussman fuses. If selecting alternate brands ensure the selected fuse has a lower total clearing I2t rating than the SCR, and can carry start current for the full start duration.

MCD 200	200~575 V		SCR I^2t (A^2s)
	Bussmann Fuse Square Body (170M)	Bussmann Fuse British Style (BS88)	
MCD200-007	170M-1314	63 FE	1150
MCD200-015	170M-1317	160 FEE	8000
MCD200-018	170M-1318	160 FEE	10500
MCD200-022	170M-1318	180 FM	15000
MCD200-030	170M-1319	180 FM	18000
MCD200-037	170M-1321	250 FM	51200
MCD200-045	170M-1321	250 FM	80000
MCD200-055	170M-1321	250 FM	97000
MCD200-075	170M-1322	500 FMM	168000
MCD200-090	170M-3022	500 FMM	245000
MCD200-110	170M-3022	500 FMM	320000

- Semiconductor fuses listed below are manufactured by Bussman and should be ordered directly from Bussman or their local supplier. Instruction for selection for alternative semi-conductor fuses is available from Danfoss.

1.1.1. Bussman Fuses – Square Body (170M)

MCD 500	SCR I^2t (A^2s)	Supply Voltage ≤ 440 VAC	Supply Voltage ≤ 575 VAC	Supply Voltage ≤ 690 VAC
MCD5 0021B	1150	170M1314	170M1314	170M1314
MCD5 0037B	8000	170M1316	170M1316	170M1316
MCD5 0043B	10500	170M1318	170M1318	170M1318
MCD5 0053B	15000	170M1318	170M1318	170M1318
MCD5 0068B	15000	170M1319	170M1319	170M1318
MCD5 0084B	51200	170M1321	170M1321	170M1319
MCD5 0089B	80000	170M1321	170M1321	170M1321
MCD5 0105B	125000	170M1321	170M1321	170M1321
MCD5 0131B	125000	170M1321	170M1321	170M1321
MCD5 0141B	320000	170M2621	170M2621	170M2621
MCD5 0195B	320000	170M2621	170M2621	170M2621
MCD5 0215B	320000	170M2621	170M2621	170M2621
MCD5 0245C	320000	170M2621	170M2621	170M2621
MCD5 0360C	320000	170M6010	170M6010	170M6010
MCD5 0380C	320000	170M6011	170M6011	--
MCD5 0428C	320000	170M6011	170M6011	--
MCD5 0595C	1200000	170M6015	170M6015	170M6014
MCD5 0619C	1200000	170M6015	170M6015	170M6014
MCD5 0790C	2530000	170M6017	170M6017	170M6016
MCD5 0927C	4500000	170M6019	170M6019	170M6019
MCD5 1200C	4500000	170M6021	--	--
MCD5 1410C	6480000	--	--	--
MCD5 1600C	12500000	170M6019*	--	--

* Two parallel connected fuses required per phase.

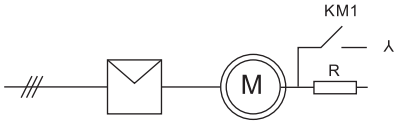
1.1.2. Bussman Fuses – British Style (BS88)

MCD 500	SCR I^2t (A^2s)	Supply Voltage ≤ 440 VAC	Supply Voltage ≤ 575 VAC	Supply Voltage ≤ 690 VAC
MCD5 0021B	1150	63FE	63FE	63FE
MCD5 0037B	8000	120FEE	120FEE	120FEE
MCD5 0043B	10500	120FEE	120FEE	120FEE
MCD5 0053B	15000	200FEE	200FEE	200FEE
MCD5 0068B	15000	200FEE	200FEE	200FEE
MCD5 0084B	51200	200FEE	200FEE	200FEE
MCD5 0089B	80000	280FM	280FM	280FM
MCD5 0105B	125000	280FM	280FM	280FM
MCD5 0131B	125000	280FM	280FM	280FM
MCD5 0141B	320000	450FMM	450FMM	450FMM
MCD5 0195B	320000	450FMM	450FMM	450FMM
MCD5 0215B	320000	450FMM	450FMM	450FMM
MCD5 0245C	320000	450FMM	450FMM	450FMM
MCD5 0360C	320000	--	--	--
MCD5 0380C	320000	400FMM*	400FMM*	400FMM*
MCD5 0428C	320000	--	--	--
MCD5 0595C	1200000	630FMM*	630FMM*	--
MCD5 0619C	1200000	630FMM*	630FMM*	--
MCD5 0790C	2530000	--	--	--
MCD5 0927C	4500000	--	--	--
MCD5 1200C	4500000	--	--	--
MCD5 1410C	6480000	--	--	--
MCD5 1600C	12500000	--	--	--

* Two parallel connected fuses required per phase.

Soft starters are suitable for use with slip-ring motors provided that the motor can still deliver the torque required to accelerate the load. Soft starters are not suitable if the load requires extremely high start torque, or if the slip-ring motor is intended to provide speed control. When considering a soft starter for slip-ring applications, a trial should be conducted to verify the performance.

To develop starting torque, some resistance must remain in the rotor circuit during motor starting. This resistance must be bridged out using a contactor (AC2 rated for rotor current) once the motor is running close to full speed.



Rotor resistance (R) can be sized using the following formula:

$$R \text{ (per phase)} = 0.2 \times \frac{V_R}{\sqrt{3} \times I_R}$$

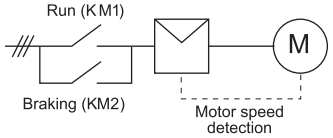
Where V_R = open circuit rotor voltage
I_R = full load rotor current

$$\text{Power (per phase)} = \frac{20\% \times \text{motor kW}}{3}$$

Soft braking is a technique used by the soft starter to reduce motor stopping time, unlike soft stopping which increases the stop time on frictional loads. Soft braking requires the use of reversing contactors.

When the soft starter receives a stop command, it operates the reversing contactor connected on its input side to soft start the motor in the reverse direction. This applies braking torque to the load.

Motor speed detection is required to shut down the braking at motor standstill.



Soft starters can also use 'DC braking' to reduce the stopping time, but soft braking causes less motor heating and provides more braking torque for a given current, and is better for extremely high inertia loads (e.g. band saw and circular saw applications).

Star/Delta Starters: How does soft start compare with star/delta starting?

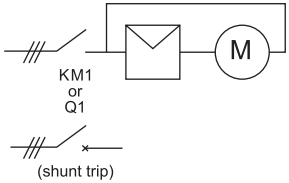
Soft starters are much more flexible than star/delta starters and provide a smooth start with no risk of transients.

Star/delta starters cannot accommodate varying load conditions (e.g. loaded or unloaded starts) and the start torque cannot be adjusted to match motor and load characteristics. In addition, the open transition between star and delta connection causes damaging torque and current transients. Star/delta starters are not capable of providing soft stop.

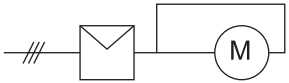
However, star/delta starters may be cheaper than a soft starter and they may limit the start current to a lower level than a soft starter when used on an extremely light load. However, severe current and torque transients may still occur.

Star/Delta Starters: Can soft starters be used to replace star/delta starters?

If the soft starter supports inside delta connection, simply connect it in place of the star/delta starter.



If the soft starter does not support inside delta connection, connect the delta connection to the output side of the soft starter.



MCD 500 soft starters include built-in support for inside delta connection.

Thermal Model Protection: How is a motor thermal model different from other forms of overload protection?

The motor thermal model used in MCD soft starters offers precise motor protection normally only available from high-end motor protection relays. The thermal model constantly models motor temperature, based on information on the motor's design characteristics and actual operation. The thermal model accounts for different heating and cooling rates when the motor is starting, running or stopped. Accurate modelling allows the motor to be used to its maximum potential without nuisance tripping.

The MCD 500 uses an advanced second order thermal model, which models iron and copper losses separately. This gives more precise modelling and provides greater protection for the motor.

Compared with a motor thermal model, thermal overload relays are less precise.

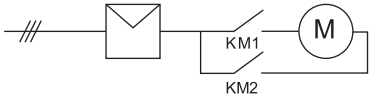
They do not account for iron loss or for different cooling rates at different stages of motor operation, and cannot be adjusted to match the characteristics of the individual motor because the mass of the bimetal strips is fixed. The bimetal strips are also affected by their own ambient temperature, which may be different from the motor's ambient temperature.

Thermal modelling is also superior to inverse time-current and I2T electronic overloads, which do not account for iron loss or for different cooling rates at different stages of motor operation. They offer only limited adjustment and the trip curves do not closely match motor heating. Inverse time-current protection also does not allow for motor temperature before the overload.

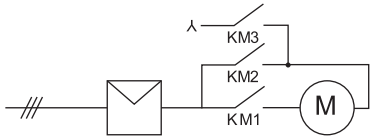
Two-Speed Motors: Are soft starters suitable for use with two-speed motors?

Soft starters are suitable for use with Dahlander and dual winding motors, provided that separate motor protection is used for both low and high speed operation.

Dual-winding motors have one shaft with two separate pole configurations (e.g. 4 pole and 8 pole), providing two different speeds. The speed is selected using external contactors (AC3 rated).



Dahlander motors are often used for two-speed compressor or fan applications. The motor windings are externally configured using contactors for high speed (dual star) and low speed (delta) operation.

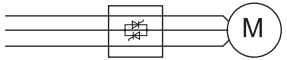


KM1, KM3 = High speed
KM2 = Low speed

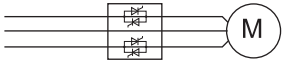
MCD 201 soft starters are designed for use with external motor protection devices and are ideal for two-speed motor applications. MCD 202 soft starters have motor protection built in and are less suitable for two-speed applications.

There are three different types of soft starter which offer different features and control the motor in different ways.

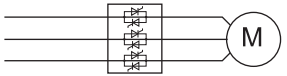
1. Torque controllers control only one phase during start. This reduces the torque shock at start but does not reduce start current. Torque controllers must be used in conjunction with a direct on-line starter.



2. Soft starters which control two phases can reduce start current as well as eliminating torque transients, and are suitable for normal and heavy duty loads, but not severe loads. The start current on the uncontrolled phase is slightly higher than the two controlled phases.



3. Soft starters which control all three phases provide the maximum level of soft start control and are the only soft start solution that is suitable for severe duty applications.



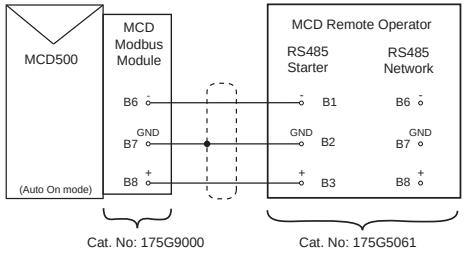
All bus options have the ability to:
- Control the soft starter
- Monitor the soft starter status
- Monitor the soft starter trip state
- Monitor the soft starter current (not available on MCD 201)
- Monitor the soft starter thermal model overload temperature (not available on MCD 201)

Parameters can also be uploaded to or downloaded from MCD 500 soft starters on Modbus, DeviceNet or Profibus networks.

In order for the MCD 500 to accept commands from the serial network, the soft starter must be in Auto On mode and links must be fitted to terminals 17 and 25 to 18. In Hand On mode, the starter will not accept commands from the serial network but the starter's status can still be monitored.

The following information is a general guide to MCD 500 and MCD 200 bus options. Refer to the relevant installation instructions and users manual for more detail.

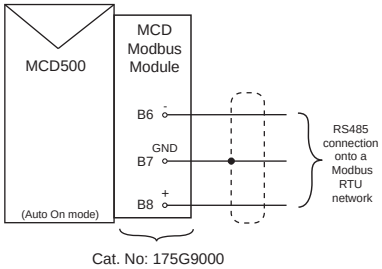
This requires a MCD Modbus Module which clips onto the side of the MCD 500. The MCD Modbus Module is ordered using Cat. No: 175G9000 and the Remote Operator is ordered using Cat. No: 175G3061.



Notes

- A single MCD Remote Operator and MCD Modbus Module is required for each MCD 500.
- No set-up or configuration is required for the MCD Remote Operator.
- The MCD Modbus Module DIP switches must be set for ASCII, Address 20, Baud Rate 9600, No Parity, No Timeout.
- If two Remote Operators are required, the RS485 Network side of the first Remote Operator (terminals B6, B7, B8) must be connected to the RS485 Starter side of the second Remote Operator (terminals B1, B2, B3).
- The Modbus Module is powered by the MCD 500. The Remote Operator requires an external 18-30 VAC/DC auxiliary supply.
- For more information on the MCD Remote Operator, refer to the User Manual (MG.17.Ex.02)) located at www.danfoss.com/drives.

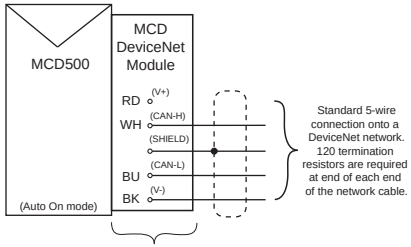
This requires an MCD Modbus Module which clips onto the side of the MCD 500 (Cat. No: 175G9000).



Notes:

- A single Modbus Module is required for each MCD 500.
- Modbus Module settings are provided using two 8-way DIP switches on the module.
- Up to 31 Modbus Modules can be used as Modbus slave devices on a single Modbus RTU network.
- The Modbus Module is powered by the MCD 500.
- For more information about operating the MCD Modbus Module, refer to the Installation Instructions (MG.17.Fx.02), located at www.danfoss.com/drives.

This requires an MCD DeviceNet Module which clips onto the side of the MCD 500 (Cat. No: 175G9002).

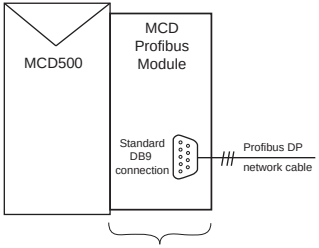


Cat. No: 175G9002

Notes

- A single DeviceNet Module is required for each MCD 500.
- DeviceNet node address (MAC ID) and data rate are selected using three rotary switches on the DeviceNet Module.
- Up to 63 DeviceNet Modules can be used as DeviceNet slaves on a single DeviceNet network.
- The DeviceNet Module is powered via the network cable.
- The MCD DeviceNet Module is ODVA tested and certified.
- For more information on the MCD DeviceNet Module, refer to the Installation Instructions (MG.17.Hx.02), located at www.danfoss.com/drives.

This requires an MCD Profibus Module which clips onto the side of the MCD 500 (Cat. No: 175G9001).

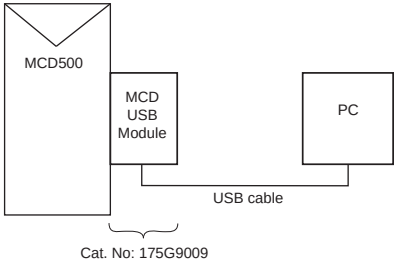


Cat. No: 175G9001

Notes:

- A single Profibus Module is required for each MCD 500.
- Profibus node address is selected using two rotary switches. Data rate is automatically detected.
- Up to 31 Profibus Modules can be used as Profibus slaves on a single Profibus DP network.
- The Profibus Module requires an external 24 VDC auxiliary supply.
- The MCD Profibus Module is Profibus tested and certified.
- For more information on the MCD Profibus Module, refer to the Installation Instructions (MG.17.Gx.02) at www.danfoss.com/drives

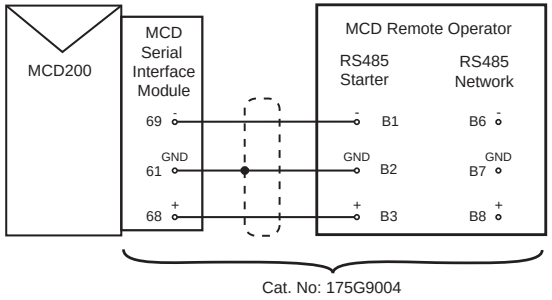
This is achieved using the MCD USB Module (Cat. No: 175G9009).



Notes

- A single USB Module is required for each MCD 500
- The USB Module acts as a physical interface when using PC based Master software such as WinMaster V4.x or MCT10
- Driver software must be installed before the USB Module can be used (supplied with the module on CD-ROM).
- For more information on the MCD USB Module, refer to the Installation Instructions (MI.17.Cx.02) located at www.danfoss.com/drives

This requires an MCD Serial Interface Module which clips onto the side of the MCD 200. It is supplied with the MCD Remote Operator when ordering Cat. No: 175G9004.

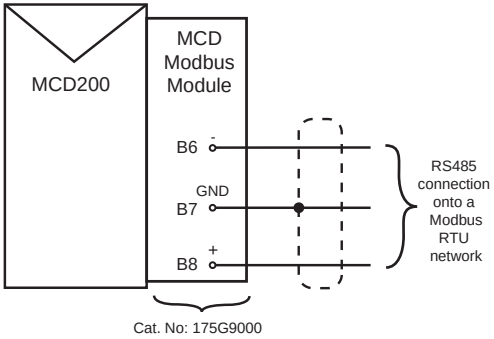


Notes

- A single MCD Remote Operator and MCD Serial interface Module is required for each MCD 200.
- No set-up or configuration is required for operation.
- If two Remote Operators are required, the RS485 Network side of the first Remote Operator (terminals B6, B7, B8) must be connected to the RS485 Starter side of the second Remote Operator (terminals B1, B2, B3). The first Remote Operator is ordered using Cat. No: 175G9004 and the second Remote Operator is ordered using Cat. No: 175G3061.
- The Serial Interface Module is powered by the MCD 200. The Remote Operator requires an external 18-30 VAC/DC auxiliary supply.
- For more information on the MCD Remote Operator, refer to the User Manual (MG.17.Ex.02)) located at www.danfoss.com/drives.

There are two options to connect an MCD 200 to a Modbus network.

Option 1: Using an MCD Modbus Module (Cat. No: 175G9000)

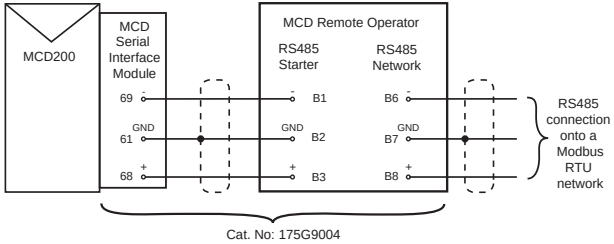


Notes

- A single Modbus Module is required for each MCD 200.
- Modbus Module settings are provided using two 8-way DIP switches on the module.
- Up to 31 Modbus Modules can be used as Modbus slave devices on a single Modbus RTU network.
- The Modbus Module is powered-up by the MCD 200.
- For more information about operating the MCD Modbus Module, refer to the Installation Instructions (MG.17.Fx.02), located at www.danfoss.com/drives.

MCD 200 Modbus Option

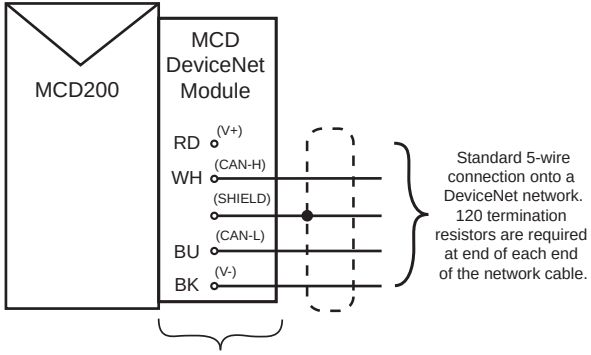
Option 2: Using the MCD Remote Operator as a Modbus RTU Gateway device (Cat. No: 175G9004)



Notes:

- A single Remote operator and Serial Interface Module is required for each MCD 200.
- Parameters 1 to 5 of the Remote Operator are used to set it up as a Modbus slave device.
- Up to 31 Remote Operators can be used as Modbus slave devices on a single Modbus network.
- The Serial Interface Module is powered via the MCD200. The Remote Operator requires an external 18-30 VAC/DC auxiliary supply.
- For more information about operating the MCD Remote Operator as a Modbus RTU gateway, refer to the Installation Instructions (MG.17.Fx.02), Appendix A, located at www.danfoss.com/drives.

This requires an MCD DeviceNet Module which clips onto the side of the MCD 200 (Cat. No: 175G9002).

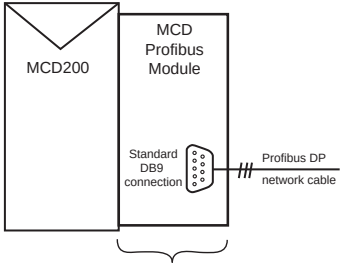


Cat. No: 175G9002

Notes

- A single DeviceNet Module is required for each MCD 200.
- DeviceNet node address (MAC ID) and data rate are selected using three rotary switches on the DeviceNet Module.
- Up to 63 DeviceNet Modules can be used as DeviceNet slaves on a single DeviceNet network.
- The DeviceNet Module is powered via the network cable.
- The MCD DeviceNet Module is ODVA tested and certified.
- For more information on the MCD DeviceNet Module, refer to the Installation Instructions (MG.17.Hx.02), located at www.danfoss.com/drives.

This requires an MCD Profibus Module which clips onto the side of the MCD 200 (Cat. No: 175G9001).

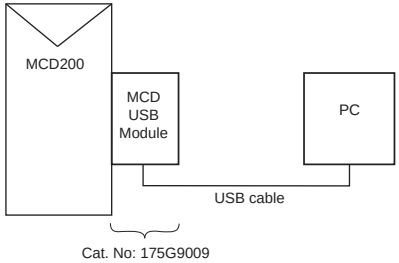


Cat. No: 175G9001

Notes:

- A single Profibus Module is required for each MCD 200.
- Profibus node address is selected using two rotary switches. Data rate is automatically detected.
- Up to 31 Profibus Modules can be used as Profibus slaves on a single Profibus DP network.
- The Profibus Module requires and external 24 VDC auxiliary supply.
- The MCD Profibus Module is Profibus tested and certified.
- For more information on the MCD Profibus Module, refer to the Installation Instructions (MG.17.Gx.02) at www.danfoss.com/drives.

This is achieved using the MCD USB Module (Cat. No: 175G9009).



Notes

- A single USB Module is required for each MCD 200
- The USB Module acts as a physical interface when using PC based Master software such as WinMaster V4.x or MCT10
- Driver software must be installed before the USB Module can be used (supplied with the module on CD-ROM).
- For more information on the MCD USB Module, refer to the Installation Instructions (MI.17.Cx.02) located at www.danfoss.com/drives

AAC – Adaptive Acceleration Control. A new soft start control technique that allows the soft starter to estimate the motor's speed and control it to match a selected acceleration or deceleration profile.

AC53 Utilisation Code – The specification of a soft starter's current rating and intended operating conditions.

Auger – a device which uses a screw-like mechanism to move material or liquid, similar to the process that drives shavings up a drill bit and out of a hole during drilling.

Blower – see Fan.

Bow thruster – a steering mechanism in large ships which uses an impeller to force water through a tunnel in the bow below the waterline, causing the ship to turn.

Centrifuge – a machine which separates materials of different densities (e.g. solids from liquids or liquids from liquid mixtures).

Chipper – a machine which cuts large pieces of wood into chips.

Compressor, centrifugal – a machine which accelerates gas through a housing then converts the velocity energy to pressure energy. Normally used in heavy industrial applications.

Compressor, positive displacement – see Compressor, reciprocating.

Compressor, piston – see Compressor, reciprocating.

Compressor, reciprocating – a machine which compresses gas using pistons driven by a crankshaft. Small reciprocating compressors (up to 30 HP) are suitable for intermittent use and are commonly found in automotive applications. Larger units (up to 1000 HP) may be used for large industrial applications.

Compressor, screw – a machine which forces gas into a smaller space, using two meshed rotating positive-displacement screws.

Crusher – a machine which crushes material into smaller pieces.

Crusher, cone – a crusher consisting of two cones inside each other. Material is fed into the top of the large, outer cone and is broken into progressively smaller pieces by the rotation of the inverted inner cone.

Crusher, jaw – a crusher with one fixed side and one moving "jaw". The crusher is wider at the top than the bottom, and material is fed in at the top and moves down as it is broken into progressively smaller pieces.

Crusher, roller – a crusher with two horizontal rollers which rotate in opposite directions, crushing the material into smaller pieces.

Current limit – (1) a method of soft starting a motor by limiting the maximum amount of current the motor can draw during the start. (2) The maximum amount of current the soft starter will allow a motor to draw during a current limit start.

Current ramp – a method of soft starting a motor by gradually increasing the amount of current from a specified point to the current limit.

Debarker – a machine that strips bark from logs.

Decanter – a type of centrifuge.

Edger – a machine that cuts large pieces of timber into usable sizes.

Escalator – a type of conveyor which is used to move people up or down, much like a moving staircase.

Fan, axial – a fan with blades that turn around a shaft, forcing air along the shaft and across the axis of the fan.

Fan, centrifugal – a fan which pulls air in near the shaft and forces it out through an opening in the outer edge of the fan casing. A centrifugal fan produces more pressure for a given air volume than an axial fan.

Fan, radial – see Fan, centrifugal.

Full load current – the amount of current a motor will draw when operating fully loaded and at full speed.

Full load torque – the amount of torque a motor will produce when operating fully loaded and at full speed.

Grinder – a machine which reduces the size of small particles through compression and attrition. For machines operating on larger items, see Crusher.

Gyratory crusher – see Crusher, cone.

Hydraulic power pack – A hydraulic pump which is used to supply pressurised hydraulic fluid.

IP rating – a description of the soft starter's level of physical protection, according to IEC 60529.

Kickstart – a method of soft starting a motor which uses a high level of current for a short period at the beginning of a current limit or current ramp start.

Locked rotor current – the amount of current a motor will draw in locked rotor situations, including full voltage starts. Locked rotor current is described as a percentage of full load current.

Locked rotor time – the maximum amount of time a motor can safely run at locked rotor current.

Locked rotor torque – the amount of torque a motor will produce at locked rotor current (such as a full voltage start). Locked rotor torque is described as a percentage of full load torque.

Mill, ball – a machine which grinds or mixes materials such as ores, chemicals, ceramics and paints. The machine consists of a horizontal cylinder which is rotated, causing the grinding medium, commonly stainless steel balls, to repeatedly crush the material inside into a powder.

Mill, hammer – a machine which crushes material into smaller pieces. Hammers attached to rotating disks repeatedly strike the material until it is small enough to fall through openings at the bottom of the mill.

Mill, roller – a machine which crushes material into smaller pieces. Material is passed between two horizontal rollers which rotate in opposite directions, crushing the material into smaller pieces.

Milliscreen – a machine which separates solids from slurry, using an inclined rotating drum with perforated sides.

Mixer – a machine which combines ingredients.

Nameplate rating – See Full load current.

NEMA – a description of the soft starter's physical format, according to the National Electrical Manufacturers' Association standard.

Pelletiser – a machine which turns powders into pellets.

Planer – a machine which draws boards over a cutting head to reduce them to a specified thickness.

Press – a machine which changes the shape and internal structure of metals (usually steel).

Pump – a machine which moves fluids.

Pump, bore – a submersible pump with a small diameter, suitable for operation down bores.

Pump, centrifugal – a pump with an impeller which causes fluid to rotate and move from the inlet to the outlet under its own momentum. The fluid's velocity increases as it progresses through the impeller passage. Diffuser, ring or volute cavities reduce the velocity of the fluid and convert the energy into pressure energy.

Pump, positive displacement – a pump which reduces the volume of the pump chamber to cause the fluid to move. Positive displacement pumps may be used for viscous fluids, and include rotary (lobe, screw or gear pump) and reciprocating (piston or diaphragm pump) types.

Pump, slurry – a centrifugal pump for pumping slurry.

Pump, submersible – a pump which is submerged in the fluid to be pumped. The sealed motor is close-coupled to the pump body.

Pump, vacuum – a pump which removes gas from a sealed chamber in order to create a partial vacuum. Multiple vacuum pumps may be used together for a single application.

Re-pulper – a machine which re-pulps raw product for further processing.

Rotary table – a large rotating table which is used to sort or move material.

Glossary

Sander – a machine which smooths raw material by abrading the surface.

Saw – a machine which uses a serrated edge to cut materials.

Saw, band – a saw where the cutting edge is a long, thin strip of metal with teeth on one side, commonly used for ripping lumber.

Saw, circular – a saw where the cutting edge is a large rotating disk with teeth on the outer edge.

Screw feed – see Auger.

Separator – a type of centrifuge.

Shredder – a machine that tears objects such as paper, plastic or wood into smaller pieces.

Slabber – a machine consisting of several saws, which cuts edged logs into smaller pieces before further processing.

Slicer – a machine that slices materials, normally using more than one blade.

Travelator – a type of conveyor which is used to move people along a flat or inclined surface.

Tumbler – a machine which rotates to turn material over during drying or other processes.

Vibrating screen – a machine which separates particles of different sizes by vibrating horizontally. Smaller particles fall through gaps in the plane.

Winch – a machine which winds ropes or cables.

Wire draw machine – a machine which draws metal wire through progressively narrower dies to create finer wire.

AC – Alternating Current
DC – Direct Current
DOL – Direct On Line
FLC – Full Load Current
FLT – Full Load Torque
HRC – High Rupturing Capacity
IP – Ingress Protection
kW – Kilowatt
LRC – Locked Rotor Current
MCCB – Moulded Case Circuit Breaker
PFC – Power Factor Correction
SCR – Silicon Controlled Rectifier
TVR – Time Voltage Ramp

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