

ENGINEERING  
TOMORROW

*Danfoss*

# Danfoss VLT® Soft Starter **The single speed drive**

**3–1600 A**

For any soft start situation. VLT® Soft Starters cover the full range – from simple start-stop operation to high end performance.

[www.danfossdrives.com](http://www.danfossdrives.com)

**VLT**®  
THE REAL DRIVE

# Soft starts: Protects processes, products and equipment with smooth motor control

**An AC motor switched directly on to the mains power supply will struggle to reach its nominal speed as quickly as possible.**

This draws maximum current from the power supply and accelerates the application with its maximum torque. Depending on the application, this can cause different problems.

Applications like pumps, conveyers, centrifuges and bandsaws must be started slowly, and sometimes stopped slowly, to prevent mechanical shocks such as water hammer, and strains on bands, couplings and shafts.

## **Principle of Phase Angle Control**

A soft starter is an electronic device that regulates the voltage to the motor and this provides a smooth transition from standstill to full speed operation of the application.

VLT® Soft Starters all use the principle of phase angle control: Back-to-back coupled thyristors ramp up the motor voltage.

In some VLT® Soft Starters, current transformers measure the motor current, providing feedback for starting current control but also for numerous motor and application protection functions.

## **VLT® Soft Starters cover a comprehensive range**

Soft starting and stopping can be controlled in a number of ways depending on the application. Some applications require non-linear voltage ramp-up and the voltage ramp is therefore related to the actual current drawn. Conversely, a band-saw usually requires a quick stop function provided by a DC brake.

Then again, a number of applications require a kick-start torque for an instantaneous period of time followed by a soft ramp-up acceleration. VLT® Soft Starters cover all of these applications and much more.



### VLT® Soft Starter MCD 500

- Fully featured Soft Starter for motors up to 1100 HP
- Total motor starting solution
- Advanced protection features
- Adaptive Acceleration Control
- Inside Delta connection
- 4 line graphical display
- Multiple programming setup menus

### VLT® Compact Starter MCD 200

- Compact Soft Starter for motors up to 150 HP
- Voltage ramps, current limit start and integrated motor protection
- Integral bypass design reduces heat dissipation
- Wide power range with advanced accessory modules

### VLT® Soft Starter MCD 100

- Micro Soft Start controller for motors up to 15 HP
- Extremely robust SCR design with heavy ratings as standard
- Unlimited number of starts per hour
- Contactor style design for easy selection, installation and commissioning



# VLT® Soft Starter MCD 500

**VLT® Soft Starter MCD 500 is a total motor starting solution. Current transformers measure motor current and provide feedback for controlled motor ramp profiles.**

AAC, the Adaptive Acceleration Control, automatically employs the best starting and stopping profile for the application. Adaptive Acceleration Control means that for each start and stop, the soft starter compares and adapts the process to the chosen profile best suited to the application.

The VLT® Soft Starter MCD 500 has a four-line graphical display and a logic keypad making programming easy. Advanced setup is possible displaying operational status.

Three menu systems: Quick Menu, Application Setup and Main Menu provide optimum programming approach.

## The perfect solution, also for more severe applications:

- Pumps
- Conveyors
- Fans
- Mixers
- Compressors
- Centrifuges
- Mills
- Saws
- And many more

## Power range

21 – 1600 A, 10-1100 HP  
(1.2 MW inside Delta Connection)  
Versions for 200 – 690 VAC



| Features   | Benefits  |
|--|---|
| <b>User friendly</b>   |   |
| AAC Adaptive Acceleration Control  | – Automatically adapts to the chosen starting and stopping profile  |
| Adjustable bus bars allow for both top and bottom entry on 360-1600 amp models (200-1100 HP) | – Space saving, less cable cost and easy retrofitting   |
| DC injection braking distributed evenly over three phases                                    | – Less installation cost and less stress on the motor   |
| Inside Delta (6-wire connection)   | – Smaller soft starter can be selected for the application  |
| Log menus, 99 events and trip log provide information on events, trips and performance       | – Eases analysis of the application   |
| Auto Reset   | – Less down-time  |
| Jog (slow-speed operation)   | – Application flexibility   |
| Second-order thermal model   | – Allows motors to be used to their full potential without damage from overloading  |
| Internal bypass contactors (21 – 215 A, 10-150 HP)   | – Save space and wiring compared to external bypass<br>– Very little heat dissipates when running. Eliminates costly external fans, wiring or bypass contactors |
| Auto-start/stop clock  | – Application flexibility   |
| Compact size – amongst the smallest in their class   | – Saves space in cabinets and other application setups  |
| 4-line graphical display   | – Optimum programming approach and setup for viewing operational status   |
| Multiple programming setup (Standard Menu, Extended Menu, Quick Set)                         | – Simplifies the programming, allowing maximum flexibility  |
| 8 language display options   | – Serving the whole world   |

## Dimensions

| Current rating [A]    | Weight [lbs] | Height [inches] | Width [inches] | Depth [inches] | Frame size |
|-----------------------|--------------|-----------------|----------------|----------------|------------|
| 21, 37, 43 and 53     | 9.25         | 11.61           | 5.90           | 7.20           | G1         |
| 68                    | 9.92         |                 |                | 8.38           |            |
| 84, 89 and 105        | 10.8         |                 |                |                |            |
| 131, 141, 195 and 215 | 32.8         | 17.24           | 10.82          | 9.84           | G2         |
| 245                   | 52.6         | 18.11           | 15.35          | 10.98          | G3         |
| 360, 380 and 428      | 77           | 27.12           | 16.92          | 11.82          | G4         |
| 595, 619, 790 and 927 | 100          |                 |                |                |            |
| 1200, 1410 and 1600   | 264          |                 |                | 33.70          |            |

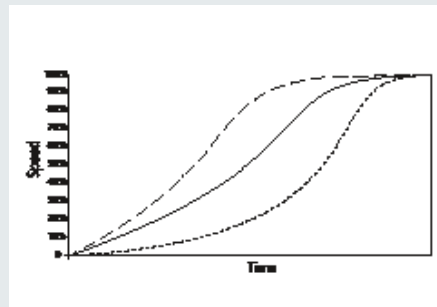
## MCD 500 operation options

### Starting:

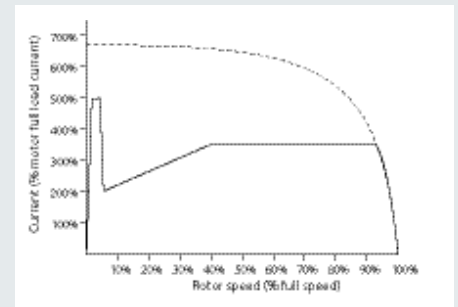
- AAC Adaptive Acceleration
- Control
- Current Ramp
- Constant Current
- Kickstart

### Stopping:

- Coast to stop
- TVR soft Stop
- AAC Adaptive deceleration Control
- Brake



Three Adaptive Acceleration Control (AAC) start profiles; early, constant and late acceleration



Constant current/ current ramp – here shown with kickstart

## Control Panel VLT® LCP 501



With the Control Panel VLT® LCP 501 being a full function interface, everything you can do on the VLT® Soft Starter MCD 500 is possible via the LCP 501.

The screen view set-up is selected from 8 views. Options include 7 standard and 1 user programmable view.

### Language selection:

English, Chinese, German, Spanish, Portuguese, French, Italian, Russian.

The VLT® LCP 501 is connected to the MCD 500 by using a 10 ft cable using 9 pin (D-sub) plug and 10 ft cable provided with the IP 65 (NEMA 12) door-mount kit.

Once connected, the soft starter asks whether you want to copy parameters from LCP to starter or starter to LCP (if different).

### 100% easy connection

- The Modbus, Profibus and Device net modules use another port on the MCD 500 (at the side of the soft starter)
- Separate LCP 501 output at the bottom for 9 pin plug and 10 ft cable
- One ordering number (LCP with door-mount kit and cable)
- Plug & play connection (also if soft starter is powered up)
- One cable for power and communication
- Powered up by soft starter
- Copy of parameter set- up

# VLT® Compact Soft Starter MCD 200

**Danfoss VLT® Compact Soft Starter series MCD 200 includes two families of soft starters in the power range from 10 – 150 HP.**

The series offers easy DIN rail mounting for sizes up to 40 HP, 2-wire or 3-wire start/stop control and excellent starting duty ( $4 \times I_e$  for 6 seconds).

Heavy starting ratings at  $4 \times I_e$  for 20 seconds.

Compatible with grounded delta power systems.

## The perfect match for:

- Pumps
- Fans
- Compressors
- Mixers
- Conveyors
- And many more

## Power range:

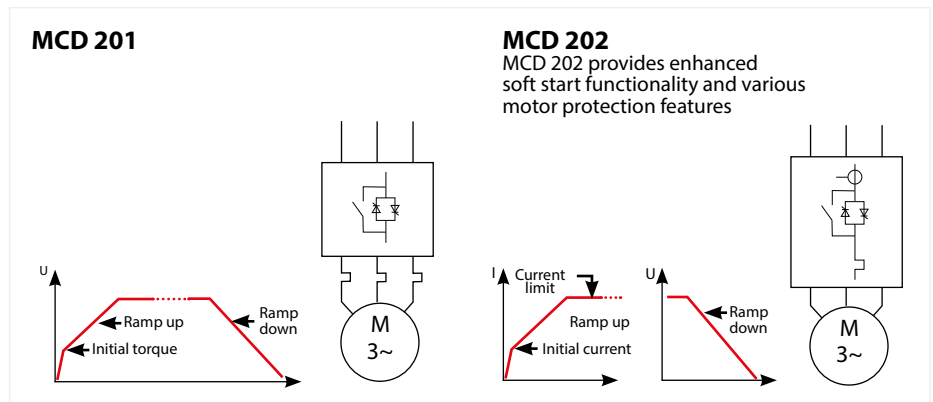
- 10 – 150 HP



## Remote operation

Remote operation of MCD 201 and MCD 202 is facilitated by the dedicated remote operator kit.

The operator (IP 54/NEMA 12) is mounted on the cabinet front and allows remote control, status indication and motor monitoring of an individual VLT® Soft Starter using RS485 serial communication.



| Features  | Benefits   |
|---|--|
| Small footprint and compact size                        | – Saves panel space  |
| Built-in bypass   | – Minimizes installation cost and eliminates power loss<br>– Reduces heat build up. Savings in components, cooling, wiring and labor |
| Advanced accessories                                    | – Allows enhanced functionality  |
| Advanced SCR control algorithms balance output waveform | – Allowing more starts per hour, accepting higher load   |
| Reliable  | Maximum up-time  |
| Essential motor protection (MCD 202)                    | – Reduces overall project investment   |
| Max. ambient temperature 50°C without derating          | – No external cooling or oversizing necessary  |
| User friendly   | Save commissioning   |
| Easy to install and use                                 |  |
| Easy DIN rail mounting for sizes up to 40 HP            | – Saves time and space   |



## Dimensions

| Power range (575 V) | 10 – 40 HP | 50 – 75 HP | 100 – 150 HP |
|---------------------|------------|------------|--------------|
| Height [inches]     | 7.99       | 8.46       | 9.44         |
| Width [inches]      | 3.85       | 5.70       | 7.9          |
| Depth [inches]      | 6.49       | 7.59       | 8.42         |

# VLT® Soft Starter MCD 100

**Danfoss VLT® Soft Start Controller MCD 100 is a cost effective and extremely compact soft starter for AC motors up to 15 HP, due to a unique semiconductor design.**

MCD 100 is a true “fit and forget” product. Selection can be made on the basis of the motor power – exactly as with traditional contactors.

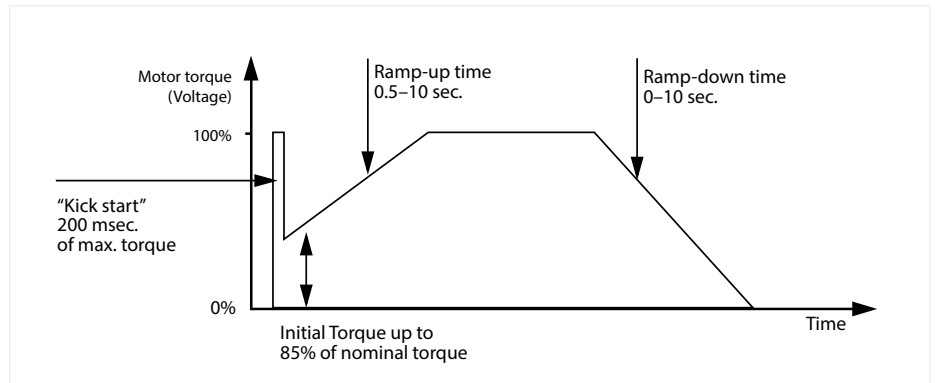
MCD 100 products provide timed voltage ramp up and down. Ramp time can be individually adjusted with rotary switches from 0.4 to 10 seconds.

The start torque can be adjusted from 0 to 85% of the direct on-line torque.

All sizes are rated for line voltage up to 600 V AC.

## The perfect match for:

- Pumps
- Fans
- Compressors
- Mixers
- Conveyors
- and many more



| Features  | Benefits  |
|---|---|
| Small footprint and compact size                            | – Saves panel space   |
| Selection can be based on motor power                       | – Easy selection  |
| Universal control voltage                                   | – Simplifies selection<br>– Keeps stock at a minimum        |
| “Fit and forget” contactor design                           | – Simplifies installation<br>– Reduces required panel space |
| Reliable  | Maximum up-time   |
| Robust semiconductor design                                 | – Reliable operation  |
| Almost unlimited number of starts per hour without derating | – Prevents unauthorized changes                             |
| Max. ambient temperature 50°C without derating              | – No external cooling or oversizing necessary               |
| User-friendly   | Save commissioning and operating cost                       |
| Easy to install and use                                     | – Saves times   |
| Digitally controlled rotary switches                        | – Secures precise settings and simplifies installation      |
| Easy DIN rail mounting for sizes up to 40 HP                | – Saves time and space                                      |



## Dimensions

| Model   | Power size (HP) | Rated current (Amps)                                   | Dimensions (inches) H x W x D | Approvals   |
|---------|-----------------|--|-------------------------------|-------------|
| MCD 100 | 2               | 3 A<br>AC-53b: 4-10: 110                               | 4.01 x 0.88 x 4.88            | UL, CSA, CE |
|         | 10              | 15 A<br>AC-53a: 8-3: 100-3000<br>AC-58a: 6-6: 100-3000 | 4.33 x 1.77 x 5.03            |             |
|         | 15              | 25 A<br>AC-53a: 8-3: 100-3000<br>AC-58a: 6-6: 100-3000 | 4.33 x 3.54 x 5.03            |             |

# Serial communication

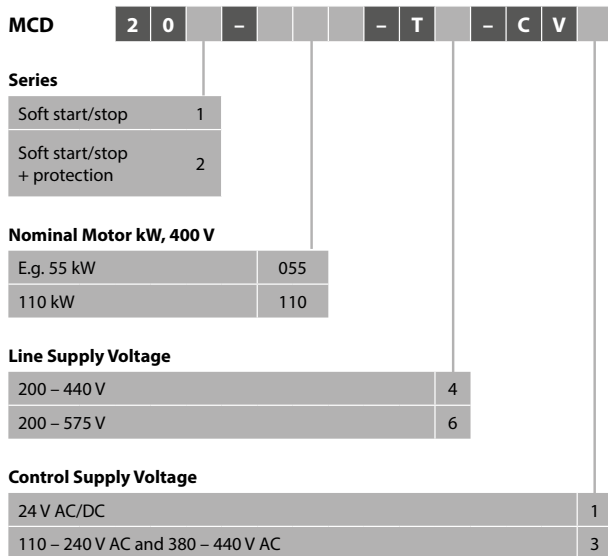
MCD 201, MCD 202 and MCD 500 come with optional plug-in modules for serial communication.

- DeviceNet
- Profibus
- Modbus RTU
- USB

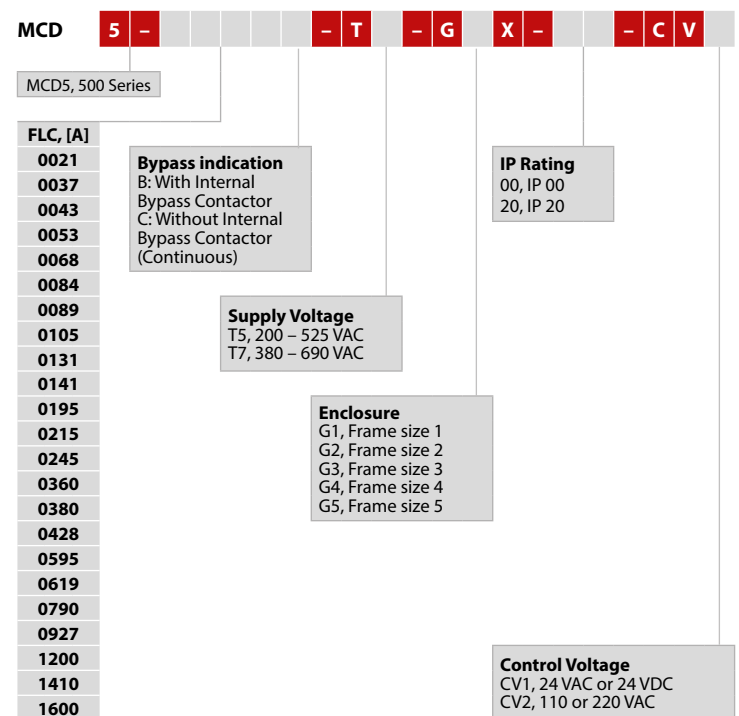
|                                       | MCD 100 | MCD 201 | MCD 202 | MCD 500 |
|---------------------------------------|---------|---------|---------|---------|
| Start/stop, reset                     | ■       | ■       | ■       | ■       |
| LED for start, run, trip              | ■       | ■       | ■       | ■       |
| Trip codes                            | ■       | ■       | ■       | ■       |
| Current display                       |         |         | ■       | ■       |
| Motor temp. display                   |         |         | ■       | ■       |
| 4 – 20 mA output                      |         |         | ■       | ■       |
| Programming keypad, graphical display |         |         |         | ■       |

# Ordering type codes

## VLT® Compact Starter MCD 200



## VLT® Soft Starter MCD 500





# Size indications

## Size indication for VLT® Compact Starter MCD 200

| Model               | Power size (HP) | Rated current AC-53b* (Amps) | Dimensions (inches) H x W x D | Approvals                                     |
|---------------------|-----------------|------------------------------|-------------------------------|---|
| MCD 201/<br>MCD 202 | 10              | 18 A: 4-6: 354               | 7.99 x 3.85 x 6.49            | UL<br>C – UL<br>CE<br>CCC<br>C-tick<br>Lloyds |
|                     | 20              | 34 A: 4-6: 354               |                               |   |
|                     | 25              | 42 A: 4-6: 354               |                               |   |
|                     | 30              | 48 A: 4-6: 354               |                               |   |
|                     | 40              | 60 A: 4-6: 354               | 8.46 x 5.70 x 7.59            |   |
|                     | 50              | 75 A: 4-6: 594               |                               |   |
|                     | 60              | 85 A: 4-6: 594               |                               |   |
|                     | 75              | 100 A: 4-6: 594              | 9.44 x 7.95 x 8.42            |   |
|                     | 100             | 140 A: 4-6: 594              |                               |   |
|                     | 125             | 170 A: 4-6: 594              |                               |   |
| 150                 | 200 A: 4-6: 594 |                              |                               |   |

\*Example: AC 53b: 42 A: 4-6: 354 starting current max. 4 times FLC (42 A) in 6 seconds. 354 seconds minimum between starts.

## Size indication for VLT® Soft Starter MCD 100

| Model   | Power size (HP) | Rated current (Amps)         | Dimensions (inches) H x W x D | Approvals   |
|---------|-----------------|------------------------------|-------------------------------|-------------|
| MCD 100 | 2               | 3 A: 5-5:10 (AC 53b)         | 4.01 x 0.88 x 4.88            | UL, CSA, CE |
|         | 10              | 15 A: 8-3: 100-3000 (AC 53a) | 4.33 x 1.77 x 5.03            |             |
|         | 15              | 25 A: 6-5:100-480 (AC 53a)   | 4.33 x 3.54 x 5.03            |             |

## Size indication for VLT® Soft Starter MCD 500

| Motor size (HP) @ 400 V | Frame size code | Starts per hour | Max. FLC | Rated FLC (104 F, 3,280 ft), outside delta motor connection |                 |                                   |                 |                                  |                 |
|-------------------------|-----------------|-----------------|----------|---|-----------------|-----------------------------------|-----------------|----------------------------------|-----------------|
|                         |                 |                 |          | Light 300%, 30s, Internal bypass                            |                 | Medium 400%, 20s, Internal bypass |                 | Heavy 450%, 30s, Internal bypass |                 |
| 15                      | G1<br>(no fan)  | 10              | 23       | 21  |                 | 17                                |                 | 15                               |                 |
| 25                      |                 | 10              | 43       | 37  |                 | 31                                |                 | 26                               |                 |
| 30                      |                 | 10              | 50       | 43  |                 | 37                                |                 | 30                               |                 |
| 35                      |                 | 10              | 53       | 53  |                 | 46                                |                 | 37                               |                 |
| 40                      | G1              | 6               | 76       | 68  |                 | 55                                |                 | 47                               |                 |
| 50                      |                 | 6               | 97       | 84  |                 | 69                                |                 | 58                               |                 |
| 60                      |                 | 6               | 100      | 89  |                 | 74                                |                 | 61                               |                 |
| 75                      |                 | 6               | 105      | 105   |                 | 95                                |                 | 78                               |                 |
| 80                      | G2              | 6               | 145      | 131   |                 | 106                               |                 | 90                               |                 |
| 100                     |                 | 6               | 170      | 141   |                 | 121                               |                 | 97                               |                 |
| 125                     |                 | 6               | 200      | 195   |                 | 160                               |                 | 134                              |                 |
| 150                     |                 | 6               | 220      | 215   |                 | 178                               |                 | 149                              |                 |
| Motor size (HP) @ 400 V | Frame size code | Starts per hour | Max. FLC | Not bypassed  | External bypass | Not bypassed                      | External bypass | Not bypassed                     | External bypass |
| 175                     | G3x             | 6               | 255      | 245   | 255             | 195                               | 201             | 171                              | 176             |
| 250                     | G4x             | 6               | 360      | 360   | 360             | 303                               | 310             | 259                              | 263             |
| 275                     |                 | 6               | 380      | 380   | 380             | 348                               | 359             | 292                              | 299             |
| 300                     |                 | 6               | 430      | 428   | 430             | 355                               | 368             | 301                              | 309             |
| 400                     |                 | 6               | 620      | 595   | 620             | 515                               | 540             | 419                              | 434             |
| 500                     |                 | 6               | 650      | 619   | 650             | 532                               | 561             | 437                              | 455             |
| 600                     |                 | 6               | 790      | 790   | 790             | 694                               | 714             | 567                              | 579             |
| 700                     | G5x             | 6               | 930      | 927   | 930             | 800                               | 829             | 644                              | 661             |
| 800                     |                 | 6               | 1200     | 1200  | 1200            | 1135                              | 1200            | 983                              | 1071            |
| 900                     |                 | 6               | 1410     | 1410  | 1410            | 1187                              | 1319            | 1023                             | 1114            |
| 1000                    |                 | 6               | 1600     | 1600  | 1600            | 1433                              | 1600            | 1227                             | 1353            |

Note: Optimise your selection with WinStart Soft Starter PC tool.

# Specifications

| Type                  | VLT® Soft Starter MCD 500   | VLT® Soft Starter MCD 100   |
|-----------------------|---|---|
|                       | The total motor starter solution. Provides advanced control methods for starting and stopping and protection of motor and application   | A true "fit and forget" soft starter for DIN rail mount, MCD 100 provides basic soft start and stop function                              |
| <b>Concept</b>        | Enhanced soft start and soft stop<br>Motor and system protection<br>10 – 1100 HP @ 400 V (21-1600A)<br>200 – 690 V mains voltage<br>110 – 220 V AC or<br>24V AC/DC control supply<br>3-phase SCR control  | Soft start<br>Soft stop<br>1/3 – 15 HP @ 400 V<br>208 – 600 V mains voltage<br>24 – 480 V AC/DC<br>control voltage<br>2-phase SCR control |
| <b>Start/stop</b>     | Adaptive Acceleration Control (AAC)<br>Current limit start<br>Current ramp start<br>Dual parameter function<br>Kick-start<br>Jog  | Timed voltage ramp-up<br>Adjustable start torque<br>Selectable kick-start function  |
|                       | Adaptive Deceleration Control (AAC)<br>TVR soft stop (Timed Voltage Ramp)<br>Coast to stop<br>DC brake function – three phase<br>Soft brake function  | Timed voltage ramp-down   |
| <b>Protection</b>     | Same as MCD 202 and:<br>Under current<br>Current imbalance<br>Starter overtemperature<br>Restart delay<br>Warning before trips<br>Adjustable phase imbalance sensitivity<br>– Programmable input trip<br>– Individual phase loss trips<br>– Individual shorted SCR trips<br>– Int. bypass relay overload<br>– Int. bypass relay fail<br>Fully adjustable protections<br>Network communication timeout<br>Heatsink overtemperature<br>Battery/clock failure<br>Supply frequency<br>External trip |   |
| <b>Outputs</b>        | Three programmable output relays:<br>Programmable analogue output<br>Motor thermistor   |   |
| <b>Control</b>        | 8 language graphical display and keypad<br>Quick menu and application menu<br>Buttons for start, stop, reset and remote control<br>Inputs for two- or three-wire control<br><br><b>Optional:</b><br>Modules for serial communication<br>Control Panel VLT® LCP 501<br>PC software   | Universal two-wire control<br>Programmable via 3 rotary switches  |
| <b>Other features</b> | Bypass up to 150 HP<br>Configurable bus bars from 360 A and up<br>Operation timers<br>Jog – slow speed operation<br>Auto reset of fault situations<br>Emergency run<br>99 event log<br>Trip log<br>User programmable metering and monitoring<br>Simulation before connecting line voltage   | Extremely robust SCR design for unlimited number of starts per hour, LED indication, IP 20  |

| Type           | VLT® Compact Starter MCD 201   | VLT® Compact Starter MCD 202   |
|----------------|--|--|
|                | A physically compact starter providing basic soft start and stop functionality   | Physically similar to MCD 201 but providing enhanced soft start functionality and various motor protection functions   |
| Concept        | Soft start<br>Soft stop<br>10 – 150 HP @ 400 V<br>3 x 200 – 480 VAC (T6 model)<br>CV1 – 24 VAC / VDC<br>CV3 – 110-240 VAC & 380-440 VAC<br>2-phase SCR control   | Current limit start<br>Soft stop<br>Motor protection<br>10 – 150 HP @ 400 V<br>3 x 200 – 480 VAC (T6 model)<br>CV1 – 24 VAC / VDC<br>CV3 – 110-240 VAC & 380-440 VAC<br>2-phase SCR control                    |
| Start/stop     | Timed voltage ramp-up<br>Adjustable initial torque<br><br>Timed voltage ramp-down  | Current limit start<br>Initial current ramp-up<br><br>Timed voltage ramp-down  |
| Protection     |  | Motor overload (adjustable trip class)<br>Excess start time<br>Reverse phase rotation<br>Motor thermistor input<br>Shorted SCR – no start<br>Supply fault – no start<br>Instantaneous overload                 |
| Outputs        | One output relay:<br>Line contactor control  | Two output relays:<br>Line contactor control<br>Run contactor or trip function   |
| Control        | Two- or three-wire control<br>Programmable via 3 rotary switches<br>Reset push button<br><br><b>Optional:</b><br>Modules for serial communication<br>Remote operator kit<br>PC software                        | Two- or three-wire control<br>Programmable via 8 rotary switches<br>Reset push button<br><br><b>Optional:</b><br>Modules for serial communication<br>Remote operator kit<br>PC software                        |
| Other features | Integral SCR bypass for minimum physical size and heat dissipation during nominal operation<br>LED status indication<br>IP 20 (10 – 75 HP @ 400 V)<br>IP 00 (100 – 150 HP @ 400 V)<br>Protection kit available | Integral SCR bypass for minimum physical size and heat dissipation during nominal operation<br>LED status indication<br>IP 20 (10 – 75 HP @ 400 V)<br>IP 00 (100 – 150 HP @ 400 V)<br>Protection kit available |

# What VLT<sup>®</sup> is all about

Danfoss VLT Drives is the world leader among dedicated drives providers – and still gaining market share.

## Environmentally responsible

VLT<sup>®</sup> products are manufactured with respect for the safety and well-being of people and the environment.

All activities are planned and performed taking into account the individual employee, the work environment and the external environment. Production takes place with a minimum of noise, smoke or other pollution and environmentally safe disposal of the products is pre-prepared.

### UN Global Compact

Danfoss has signed the UN Global Compact on social and environmental responsibility and our companies act responsibly towards local societies.

### EU Directives

All factories are certified according to ISO 14001 standard. All products fulfil the EU Directives for General Product Safety and the Machinery directive. Danfoss VLT Drives is, in all product series, implementing the EU Directive concerning Hazardous Substances in Electrical and Electrical Equipment (RoHS) and is designing all new product series according to the EU Directive on Waste Electrical and Electronic Equipment (WEEE).

### Impact on energy savings

One year's energy savings from our annual production of VLT<sup>®</sup> drives will save the energy equivalent to the energy production from a major power plant. Better process control at the same time improves product quality and reduces waste and wear on equipment.

## Dedicated to drives

Dedication has been a key word since 1968, when Danfoss introduced the world's first mass produced variable speed drive for AC motors – and named it VLT<sup>®</sup>.

Twenty five hundred employees develop, manufacture, sell and service drives and soft starters in more than one hundred countries, focused only on drives and soft starters.

## Intelligent and innovative

Developers at Danfoss VLT Drives have fully adopted modular principles in development as well as design, production and configuration.

Tomorrow's features are developed in parallel using dedicated technology platforms. This allows the development of all elements to take place in parallel, at the same time reducing time to market and ensuring that customers always enjoy the benefits of the latest features.

## Rely on the experts

We take responsibility for every element of our products. The fact that we develop and produce our own features, hardware, software, power modules, printed circuit boards, and accessories is your guarantee of reliable products.

## Local backup – globally

VLT<sup>®</sup> motor controllers are operating in applications all over the world and Danfoss VLT Drives' experts located in more than 100 countries are ready to support our customers with application advice and service wherever they may be.

Danfoss VLT Drives experts don't stop until the customer's drive challenges are solved.



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