

The image shows a screenshot of the DriveSize application window. The window title is "DriveSize" and it features the ABB logo in the top right corner. On the left side, there is a vertical navigation menu with the following items: "New" (highlighted), "Existing", "Recent", "Help", "About", and "Close". Above the menu is an image of a motor and a drive unit. The main content area is titled "New" and includes a version selector: "Version: Global US". The main area contains six product category cards, each with an image and a description:

- Industrial drives**: Complete AC drives having a rich set of variants and options with following constructions: wall-mounted, cabinet built and modules. In most cases controlling one induction or synchronous motor. Normal two quadrant drives are complemented with regenerative and low harmonic series.
- Industrial multidrives**: AC drives supplying multiple motors and controlled by multiple control units. Principle is based on common DC bus enabling single power entry with diode, thyristor or IGBT Supply unit and enabling multiple inverters from the same DC bus. Drives are air or liquid cooled. The construction selection is done at supply level and inherited to inverters.
- General purpose drives**: Complete AC drives to control typically one motor or multiple equal size induction motors having the same speed and load. Standard drives are easy to buy and configure. Drives are in following constructions: wall-mounted, cabinet built and modules.
- Drives for HVAC and Water**: Complete AC drives to control typically a HVAC fan or pump motor or multiple equal size motors. Drives are in following constructions: wall-mounted and cabinet.
- Machinery drives**: AC drive modules designed to be included into machines utilizing variable speed control. Used together with induction, permanent magnet or reluctance motors.
- Motion control drives**: Motors and drives for control of cyclic linear or angular position. Wide power range with servo and induction motors starting from compact servo drives to 3 phase drives with DC sharing.

List of related manuals

User manual

Code (English)

MCSIZE manual for equations of motion mechanics

00462877

User manual

DriveSize

DriveSize

 <p>Industrial drives Complete, well enclosed AC drives having a rich set of variants and options with following constructions: wall-mounted, free standing, cabinet built, liquid cooled and modules. In most cases controlling one induction or permanent magnet motor. Normal two quadrant drives are complemented with regenerative and low harmonic models.</p>	 <p>Industrial multidrives AC drives supplying multiple motors and controlled by multiple control units. Principle is based on common DC bus enabling single power entry with diode, thyristor or IGBT Supply unit and enabling multiple inverters from the same DC bus. Drive construction is air or liquid cooled. Multidrive module computing is supported too. The construction selection is done at supply level and inherited to inverters.</p>
 <p>General purpose drives Complete AC drives to control typically one induction motor or multiple equal size motors having the same speed and load. Standard drives are easy to buy and configure. Drives are in following constructions: wall-mounted, free standing and modules.</p>	 <p>Drives for HVAC and Water Complete AC drives to control typically a HVAC fan or pump motor or multiple equal size motors. Drives are in following constructions: wall-mounted and free standing.</p>
 <p>Machinery drives AC drive modules designed to be included into machines utilizing variable speed control. Used together with induction, permanent magnet or reluctance motors.</p>	 <p>Motion control drives Motors and drives for control of cyclic linear or angular position. Power range from 1 kW to more than 100 kW with servo and induction motors. Starting from compact servo drives to 3 phase drives with DC sharing.</p>

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Introduction to the manual

Applicability

DriveSize has a long history and it is nowadays available as a Web version and a PC App that consists of Global/IEC and US/NEMA versions.

Technically the DriveSize desktop application contains a framework and variable speed drives (VSDSize) and a motion control sizing component (MCSize) having its own section in this manual – the chapters 8, 9 and 10. This manual is mainly for desktop application version. Anyway, the web version has about the same layout and functionality. This manual instructs you to effectively use DriveSize for selecting motors and drives.

DriveSize assists in selecting optimal motors and drives for variable speed drives applications from ABB low voltage AC drives and 3 phase AC motors – but not including the smallest drives nor motors. MCSize is for motion control motors and drives.

Compatibility

DriveSize is compatible with 32bit/64bit Windows PCs and modern browsers.

Target audience

Target audience is anyone who has to select/propose/decide motor and drive types and ratings. The starting point is usually load torque, power and speed requirements at motor shafts or drive load given in amps.

You are expected to know the terminology of AC drives and ABB product names thanks to marketing literature.

Terms and abbreviations

Term/Abbreviation	Description
Drive	Frequency converter for controlling AC motors
DSU	Diode supply unit
Generating	The operating mode of the IGBT supply unit when converting power from the drive back to the AC supply.
IC	International Cooling
IP	International Protection
ISU	IGBT supply unit
LC	Liquid cooling
Line-up	Consists of the supply unit and inverters which have a common DC bus.
Motoring	The operating mode of the IGBT supply unit when converting power from the AC supply into the drive DC link.
Overload	Defines the maximum required power for short durations. The power is overload in percent x base power. The overload in percent is normally positive, but a negative value means the overload has a different sign than the base power.
One-time at start overload	This overload type happens for instance at start. Before the next start, it is assumed that the drive has cooled down to the ambient temperature.
RMS	Root mean squared
Temp. rise	Temperature rise class of the motor.
VSD	Variable speed drives
Temp reserve	Difference of 80 or 105°C temperature rise of motor compared to type tested temperature rise θ .
Global products and regional variants	In contrast to global products regional variants are marketed on named regions.
Quick selection	Selecting drives without defining drive load. Drive is selected based on nominal current and motor power listed on catalogues. Selection is based on nominal ratings.



Overview of DriveSize

DriveSize installation instructions

Version-specific installation instructions for DriveSize desktop application are given in the **readme** file. The file contains also hardware and system requirements. Read the **readme** file carefully before installing the software.

Online update

Since version DriveSize 4.9 this PC App has online update capability. Availability of updates on the web is checked once DriveSize has first time installed and then always when started. Update dialog pop-up window appears with OK/Cancel options when update exists. Select OK for immediate update or push Cancel if you want to postpone installation. Administrator rights are not required!

Program structure

DriveSize consists of a user interface, computing part and product databases. The databases contain about 85 000 data rows for catalog motors with many voltages, thousands of drive types and the modules of the drives. The computing of customer-specific motors is based on ABB Sophiè, which has been developed by ABB Oy / Machines.

The program follows the common user interface guidelines of Microsoft Windows.

The dimensioning cases are called projects. You can save the selection results for the project into a project file (XML file). You can generate OpenXML based technical reports and you can attach the reports to project and drive documentation.

DriveSize functions

DriveSize contains the following relevant items for electric drive dimensioning:

- Ambient conditions for drives and motors
- Four different mechanical load types for motor:
 - ✓ Constant power
 - ✓ Constant torque
 - ✓ Constant torque and power
 - ✓ Squared torque (Pump/fan)
- Overload types available:
 - ✓ One-time at start
 - ✓ Simple cyclic
 - ✓ Multiform cyclic
- Drive selection based on loading currents
 - ✓ Simple cyclic
 - ✓ Multiform cyclic
- Selecting an alternative inverter, a motor and a line supply unit manually
- Drive and motor selection with sine filter
- Network harmonics calculation for drives or supply units and combined harmonics
- Harmonics calculations for mixed single drives systems
- Heat loss calculations for most motors and drives
- Show IEC61800-9-2/EN50598-2 loss numbers for most new drives
- Mass flow and thermal loss for liquid cooled multidrives
- Results in numerical form
- Results in graphical form (load, motor, inverter)
- Generating reports in openXML format for saving or printing
- Saving and retrieving projects with *.AC and *.MAC files
- Save information in XML format to be used with other software
- Option to consider motor load RMS or not
- Option to Utilize temperature reserve of IEC34 motors or not.
- Handling of regional variants of drives
- Transformer selection results and reserves
- Lock option to keep selected motor

DriveSize Help

The HTML help includes information on using the program. You can access the Help through the **Help** menu or by pressing F1. The Help is context sensitive and when F1 is pressed, it automatically opens a help window associated with the active function of the program.



Dimensioning of drive system

Contents of this chapter

This chapter describes how to create a new project or open existing one and then how to select one or more motor drives for known motor loads or currents loading the drives or by quick selection.

To start a new project

The following is an overview of the tasks for project level.

1. Double-click a product category in the New project selection. Within each category you can select drives series within that category. Then enter the general project information and check optional regional variants with **Project Info** on the File menu.
 2. If ambient conditions deviate from normal, select **Ambient Conditions** on the Data menu or toolbar and set new ones. Quick selection assumes nominal ambient conditions.
 3. If the network data, voltages and frequency deviate from your previous settings, change them from main window. Highlight a network/transformer in System configuration.
 4. Then start to fill in load requirements for first motor or drive or use for example copy paste to get all drives listed. The drive series can be changed within the limits of category selection. The Tools/Option setting for “Quick selection” determines the selection method of first drive in system configuration.
-

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When you start DriveSize without a project file, the **New** view opens. Select the interesting tile, which describes best your needs.

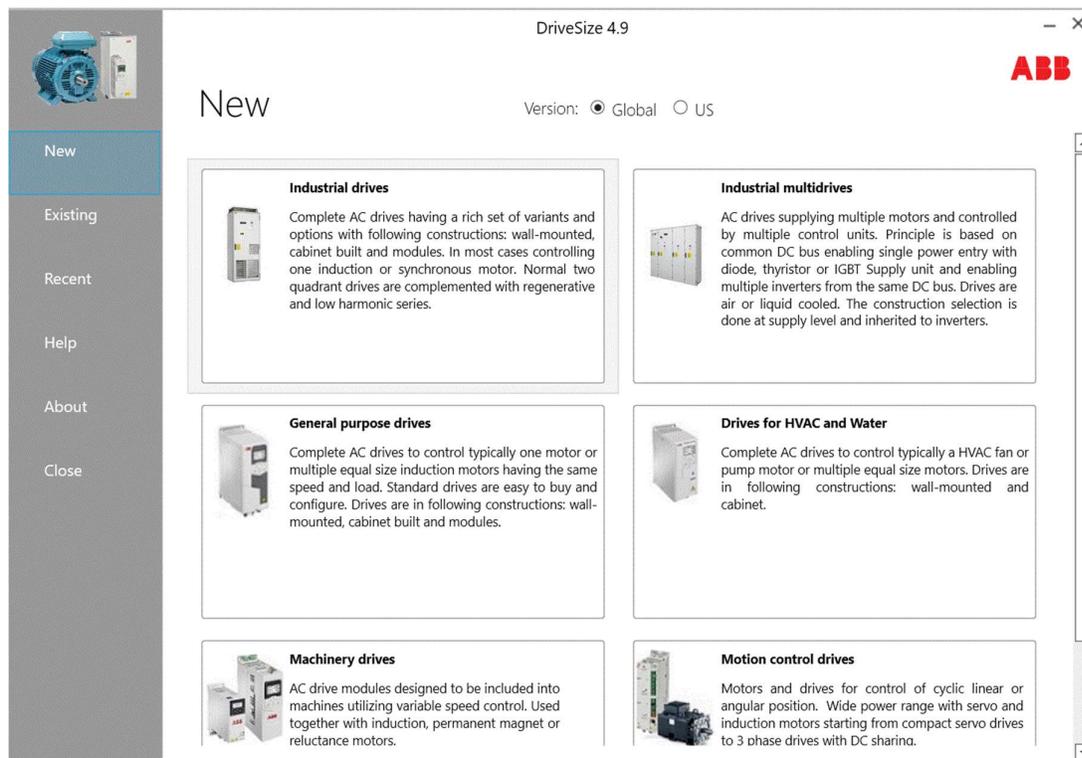


Figure 1: Start new project: desktop application and web versions.

To change project information

Use **Project Info** on the **File** menu to enter new project data. DriveSize saves this information when you save your project and includes it in your reports. The possible regional variant selection is also saved for your convenience.

Figure 2: Project information

To set ambient conditions

Use **Ambient Conditions** on the **Data** menu if you need to change the default ambient conditions. The dependency of the altitude to the loadability varies with different components. The practical range of ambient temperature is usually from 30°C to 50°C. This varies with the component. For example, a temperature up to 55°C is accepted for ACS880 single drives and marine drives but Ex motors are not selected at all if the ambient temperature exceeds 40°C.

Figure 3: Ambient conditions

The main dimensioning window

After opening or creating a project the main window opens.

Motors, drives, inverters, line supply units, transformers and the network have different data input displays. When you select an item in the **System configuration** field, the related input data displays are shown.

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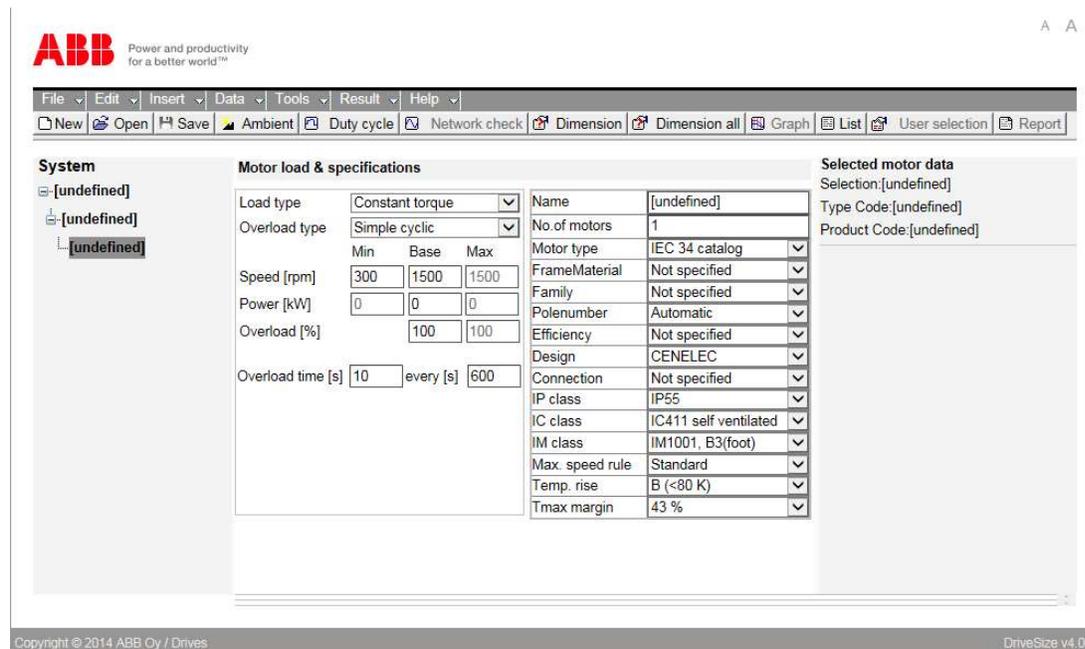
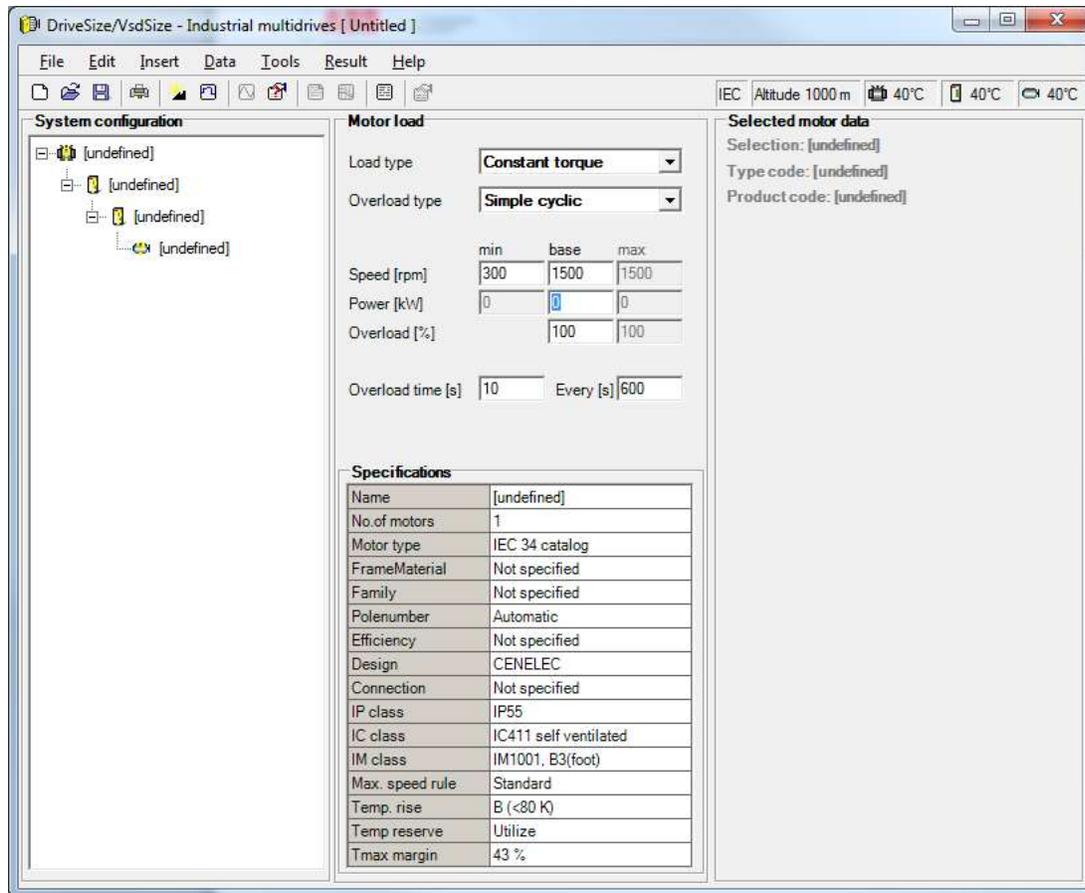


Figure 4: The main VSDSize window – desktop application and web versions.

The main window of desktop application version contains

- **System configuration** field
- **Input data and specification** field
- **Selected data** field to show component data

The **title bar** displays the name of the project.

Select from **System** the item to be selected. Use a toolbar icon, a menu command, context sensitive menus or press **Ctrl+E** to start the selection process. You can make the dimensioning one by one (**Ctrl+E**) or dimension all units at the same time (**Ctrl+A**).

The **toolbar** provides quick click access to common commands. The purpose of buttons is shown on tool tips in desktop application version and text in Web version. On desktop application version the ambient information is shown on toolbar as well.

System configuration

The **System configuration** show an overview of the drive system as well as the type designation or name of each unit in the Tree structure. Figure 4 shows an example of a multidrive tree where selections have not yet been made. Multidrive tree is more complicated than others.

The **Motor load**, **Inverter load**, **Line supply unit load**, **Network data** and **Transformer load** views appear in the input data field depending on which unit you select in the **System**. The respective catalog data for the motor, the inverter, the line supply unit or the transformer also appear in the selected data field upon selection.

Mains and transformer data

The primary voltage does not have effect on motor and drive choices but if you select a value that is too high, it prevents you from selecting a transformer. The default system frequency is 50 Hz or 60 Hz. The system frequency has a direct effect on possible secondary voltage levels as well as on the motor databases. The logic of DriveSize assumes that in the 60 Hz countries the standard motors are 60 Hz motors only. This limitation is not valid with the AC Drives. Three winding transformers go together with 12-pulse drives only.

Short-circuit power is essential when network harmonics are calculated.

DriveSize calculates the transformer load power from the motor base powers and efficiencies and power factors. You can allow DriveSize to use these values, but you can use your own values.

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The software includes **Oil immersed** and **Vacuum Cast Coil Dry** types of transformers.

Network data	
Frequency [Hz]	50
Short-circuit power [MVA]	200

Transformer load	
Primary voltage [V]	21000
Secondary voltage [V]	400
Fundamental power [kVA]:	Calculated
DSU load	114 114

Specifications	
Name	[undefined]
Type	Auto selection
No of windings	2
IP class	IP00 with bushings

Figure 5: Network/mains data and Transformer load definition

Input data for motor or for drive

A new project has one drive on System configuration, but idea is to have all drives and motors supplied from one transformer into one project. DriveSize limits the possible drive types according main category but within one category a mixture of different drives is supported. For example, a mixture of ACS550 and ACS580 is valid. There is also Single drive combination category where drive types from other single drive categories can be mixed. This is useful when drives from different drives categories are connected to one common transformer. Then it is possible to calculate harmonics content or select the correct size of transformer for that combination.

Each motor drive is independent. But with multidrives the supply unit effect the inverter and motor selections. The supply unit type is usually chosen manually based on the required functionality and it also dictates the inverter types (air/liquid cooled; ACS800/ACS880, ISU/DSU). Also, three winding transformers go together with 12-pulse drives or supply units only.

There is basically three ways to get a drive selected: a) select first the motor and then drive or b) select the drive based on known drive currents or c) quick select the drive based on catalogue nominal current and/or nominal motor power.

Procedure to enter motor load and then select drive

1. To enter load for motor, highlight motor in System. Give at least the base power for motor shaft. Then you use DriveSize to select the motor.
2. Let DriveSize to select the drives or inverters once the motors have been selected. You can also manually select the drives. And you can overwrite the calculated currents as well.

Procedure to enter drive currents to select drive

1. To enter load only for drive, highlight drive/inverter in System and don't give even base power for motor. Drive currents are typed directly to Drive load screen or into Overload currents. Then DriveSize ignores all motor parameters and computes the drive based on given currents, $\cos\phi$ and frequency range only.
2. This stage is identified by DriveSize by greying the Motor power values.
3. To be able to change to motor mode clear all overload inputs or delete the System configuration branch.

Quick selection procedure

1. Insert Drive form menu and type in required Current rating [A] and/or Motor power [kW].
 2. Let DriveSize to select the drive. You can also manually select the drives.
-

Load data for motor

DriveSize supports four characteristic load types for motor:

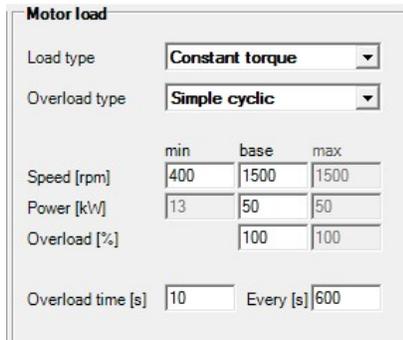
- A) **Pump/fan load** (Squared torque)
- B) **Constant torque**
- C) **Constant power**
- D) **Const. torque/power** (combination)

DriveSize supports the following overload types for motors:

- A) **Simple cyclic** = Cyclic duty will continue forever without interruptions, repeating itself at least a time where both motor and drive are thermally stable.
- B) **Multiform cyclic** = Cyclic duty to have multiple (max 10) overload definitions in sequence, repeating all of them at least a time where both motor and drive are thermally stable. If motor has N overloads, then multiform overloads for drive has also N overloads.
- C) **One-time at start** = Not cyclic, the drive has cooled effectively down prior starting.

Ex motors have special limitations for overload lengths.

If you select **Multiform cyclic** and you have already given base Power, the **Overload definitions** dialog opens. You can also open it on the toolbar by selecting, for example, **Duty cycle**. The Overload definitions are explained in detail in chapter [Special features](#).



	min	base	max
Speed [rpm]	400	1500	1500
Power [kW]	13	50	50
Overload [%]		100	100

Overload time [s] 10 Every [s] 600

Figure 6: Motor load data

To enter motor speeds and loads

The **Motor speed** and **Motor load** input fields vary with different load types.

ABB does not sell gears and DriveSize/VSDSize assumes all speed and load are converted at motor shaft. Therefore DriveSize/VSDSize does not offer gear ration optimization, but that is an important part of good drive system design.

DriveSize/VSDSize does not consider dynamic torques. When remarkable dynamic torque exists, include it as short-term overloads.

Base speed

Base speed is the shaft speed of a motor where the base power is required. Use exact values for base speed. Use all digits like 1456 (**not** 1500) because the rated speeds of motors are also exact. In the US the tradition has been to use round numbers.

Base power

Base power is the required mechanical power from motor shaft. This is used as the base value for all overloads. Note that motor thermal selection is based on worst 10 min RMS by default. Do not include the overload twice. It is possible to skip RMS computing for motor selection. Select **Skip RMS-computing of overloads** from **Tools** menu's **Options**. If you have problem with Base power but know the overloads accurately you can use a round or convenient number like 10 kW, 50 kW or 100 kW and type in overload% based on the base value you selected. Base power is normally positive but negative values are acceptable.

Fill in the required load that is on the shaft – **not** the rated power of the motor. Specify the real required shaft power of the loading machine. In VSD applications, the motors are always slightly derated.

Base overload

Base overload defines the maximum required power together with base power for the overload time. The power is overload in percent x base power. Overload in percent is normally positive. A negative value means that the overload has a different sign than the base power. The overload is assumed to exist anywhere between the minimum speed and maximum speed.

Min speed

If the minimum speed is too low compared to the real need, DriveSize selects for the motors and drives a size that is larger than necessary. In DriveSize, the minimum speed is not exactly the minimum speed of the motor but a speed that is used without interruptions of, for example, 30 minutes. DriveSize assumes that the duty cycle continues without stopping and DriveSize selects the motor and drive accordingly. If the minimum speed is critical, you can see it from the results/graphs. The default minimum speed is provided due to usability reasons, but you should consider this in every case.

Max speed

A maximum speed that is too high can have a negative impact on the motor size. If the maximum speed is much higher than the base speed and the overload in percent is high, the absolute maximum torque of the motor can be a limiting factor.

Overload at max speed

Due to the reasons stated above, the overload in percent at maximum speed can be given a different – normally lower - value than the overload in percent at base speed. This is valid for constant power load types.

One-time overload at start

Motor load

Load type:

Overload type:

	min	base	max
Speed [rpm]	400	1500	1500
Power [kW]	13	50	50

One-time overload at start

OL [%]:

OL time [s]:

OL max speed [rpm]:

Specifications

Name	[undefined]
No. of motors	1
Motor type	IEC 34 catalog
FrameMaterial	Not specified
Family	Not specified
Polenumber	Automatic
Efficiency	Not specified
Design	CENELEC
Connection	Not specified
IP class	IP55
IC class	IC411 self ventilated
IM class	IM1001, B3(foot)
Max. speed rule	Standard
Temp. rise	Not specified
Temp reserve	Keep
Tmax margin	43 %

Figure 7: Motor input data

OL [%]

The starting torque is $OL\% \times \text{base torque}$. The base torque is calculated from the base power and base speed. The valid range for OL% is from 1% to 1000%.

OL time is the duration of the starting overload in seconds.

OL max speed tells DriveSize at which speed the overload ceases. Use low values. If the OL maximum speed is equal to the base speed and OL% is high, the power limit of the inverter can force DriveSize to select a larger drive.

To change motor specifications

You can specify the preferred motor type, frame material, IP class, IC class, temperature rise class and so on. Click the item to change a selection. Refere to Table 1.

Table 1: Options for Motor Specifications

Name	Name of motor, to display Name in System configuration, go to Tools -> Options-> Unit name. DriveSize displays the type codes of motors by default.
No. of motors	1...100 per inverter unit. A factor DriveSize considers when it selects an inverter. The load is given for one motor.
Motor type	The list varies according to supply voltage and Drive product series. Existing = means there is no need to reselect motor IEC 34 motor = IEC600034 type HXR, AMI, NXR Motors – customer-specific with industrial drives NEMA catalog – North American, US version Marine motors Water cooled PM motors Flameproof, Non-sparking, Dust ignition protection SynRM (reluctance motor), Low inertia HDP High speed motors (M3BC) User defined
ProductionUnit	Production unit filter with dynamical behaviours. Not specified, CN, PL, FI, ES. Any combination of production units is possible!
FrameMaterial	Not Specified, Aluminium, Cast iron, Welded steel.
Family	Limits the search to one family only, such as M3BP.
Pole number	Pole number can be Automatic or one of the following: 2,4,6,8,10 or 12
Term. box location	The location of terminal box. Top, Side or N-end.
Efficiency	Not Specified, IE1, IE2, IE3, IE4. You can limit the motor efficiency class. Any combination of IE classes is possible!
Winding	Motor voltage code selection. Standard and restamp, All winding. Motors with special design are included in All winding option.
Design	Read more about Design from the motor user manuals.
Connection	Connection with rated motor data. Not specified, Y, D.
IP Class	IP55 , this does not impact the selection. IP23 and IP54 options available for Low inertia HDP.
IC Class	IC411 self ventilated = cooling fan on motor shaft; means lower loadability at partial speeds IC416 forced ventilated = separate cooling fan. Select this option for constant torque cases where the minimum speed is very low. For large motors there are other selections available. TEFC etc for US
Max speed rule	Standard = Standard maximum speeds is used. Metal fan = The higher speed limit of the metallic fan is used. Separate fan = Higher maximum speed is available when force ventilated. For low inertia motors 4 different choices.
Insulation	Standard or Special insulation. Special winding insulation is required in VSD use when voltage is higher than 600V. Optional for other voltages.

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Temp. rise	B, F or not specified. Not specified means that DriveSize will use the temperature class given in motor catalogues.
Temp reserve	Keep = traditional loadability curves Utilize = Utilize temperature reserves based on measured temperature rise in database and the Temp rise just selected above.
Tmax margin	43%, 30% or 20% . Motor catalogues give rough maximum torque values and some margin must be provided. The margin from actual overload torque to Tmax must be 43%, 30% or 20%.

User Profile

DriveSize has default settings. Certain default settings can be changed. These options are available in Tools menu's User Profile. The following motor specifications can be changed

1. Winding
2. Design
3. Temp rise
4. Tmax margin
5. Temp reserve

Motor selection

DriveSize usually selects the most suitable motor from the technical point of view considering specifications. However, if you want to select another motor you can choose an optional motor from the Manual selection list. Figure 20: Manual selection view for drive shows the alternative selections. Filter options are available for **Code** and **PU** items i.e. generation code and production unit.

Lock motor

Activate **Lock** checkbox from System configuration/Selected motor data to keep certain motor regardless of load settings.

Note: the thermal load capability of motor can be exceeded, and negative margins are possible.

Utilize temperature reserves of IEC 34 motors

On the catalogues ABB motors are labelled as Class B or Class F temperature rise. The insulation system and materials are normally good for Class F temperatures to guarantee long lifetime of motors. The demand of high efficiency has forced the designers to use more and better iron and conductor materials and effective cooling. The result is that the temperature rise with nominal load is less than 80 °C. Together with rated ambient temperature 40°C the stator winding temperature is less than 120°C. Motor has by design temperature reserve which can be used without harmful effects to windings.

When motors are running 24h/7d per week - year after year - the energy cost tend to be main part of total cost. In this case it is natural to use best possible motors, and in power

levels, where the efficiency is best. To compute the losses of motor is relatively easy because the winding temperature of motor is same as during type test. Select the Keep temperature reserves choice on DriveSize.

But for example, for intermittent or short time or burst duty the most economical selection can be compact motor where the temperature reserves are fully utilized. One way to describe this kind of duty is that motor is idling or in standstill a lot per year. Select the Utilize option. Estimate the losses and together with running hours determine the lost energy. Now this should be one selection criteria together with optionally more compact motor. Sometimes the smaller motor will help to reduce the drive rating –normally not. The reason is that the electrical power required by motor depends on motor load not the motor parameters so much.

In DriveSize the measured temperature rise is shown on Motor data. This reserve is not a global parameter but is individually given to each motor and supply voltage. The reserves are measured during type tests of motors.

Instead of standard temperatures 80°C and 105°C DriveSize use as target temperatures 78°C and 95°C. If for example the real temperature rise is only 55°C then the difference between Keep and Utilize is about

$$\sqrt{78/55} = 1,19$$

As a conclusion, this motor able to handle 19% more load compared to a motor with assumed temperature rise of Class B. Considering also the time constants of motor this means technical advantage but requires know-how.

If Utilize is selected DriveSize will scale the loadability curves upwards and result torque numbers upward provided the measured temperature rise is less than 80C.

Utilize is as a default setting of Temp reserve in motor specifications. Default setting can be changed from User Profile under Tools menu.

Additional derating requirements

Note: Check the availability of force ventilation and accessories from the motor manufacturer.

Load data for drive or inverter

This section describes how to enter the single drive/multidrive inverter load and specifications in two cases with motor or without.

The load of the inverter consists of currents, frequencies and voltages.

Basic feature is that, DriveSize calculates the load currents based on the selected motor. The plural is used here to indicate different load points namely: min, base and max. You can edit current values without effecting the motor selection with simple cyclic. With Overload currents dialog you may edit inherited frequencies, currents and cos phi values, but you may not add more loading points. See chapter Special features.

The other choice is that you know the loading currents and type those values directly with simple cyclic or Overload currents screen with frequency and cos phi. The drive load is considered cyclic or multiform cyclic. "One-time a start" is not supported. Please notice that a negative cos phi means electrical braking. See chapter Special features.

The screenshot displays the 'Inverter load' and 'Overload currents' configuration windows. The 'Inverter load' window has 'Load type' set to 'Constant torque' and 'Overload type' set to 'Simple cyclic'. It shows 'I continuous [A]' as 211 (calculated value 211 A) and 'I maximum [A]' as 247 (calculated value 247 A). 'Overload time [s]' is 10 and 'Every [s]' is 550. The 'Specifications' table below it shows Name: [undefined], No. of Inverters: 1, and Type: Auto selection.

The 'Overload currents' window shows 'Base speed: 1500 rpm' and 'Load type: Constant torque'. It contains a table for 'Load points' with the following data:

Description	Time [s]	Min.f[Hz]	Max.f[Hz]	Current [A]	Cosφi
Base load	300	10	50	211	0.87
Overload 1	300	10	50	247	0.87
Overload 2	300	20	50	300	-0.88
Overload 3	300	30	40	400	0.88
Overload 4					
Overload 5					
Overload 6					
Overload 7					
Overload 8					
Overload 9					
Overload 10					

Figure 8: Simple load data for inverter with motor and multiform overload currents given by user without motor.

Table 2: Abbreviations used for inverter load

I continuous (A)	Continuous current required from the inverter and calculated value. If you enter this value manually and if the motor is not known, DriveSize assumes that the frequency range is wide.
I maximum (A)	Maximum current required and calculated value. If you enter this value manually and if the motor is not known, DriveSize assumes that the frequency range is wide.

To change Drive/Inverter specifications

You can adjust specifications for the Drive/inverter, such as the IP class and mains pulse number. The multidrive inverter settings are determined by the selections from the supply unit.

Table 3: Options for drive/inverter specifications

Name	Name for the drive.
No. of drives	Number of parallel connected inverter and motor combinations.
Type	Product series. With multidrives the type is automatically selected according to supply unit; please refer to marketing material. With industrial drives Auto, selection includes all drives ACS880 and constructions but not modules and marine types.
Construction	Wall-mounted, Cabinet, Marine, Module, Flange module
Cooling	Air, Liquid. Note: Liquid cooling is available only for the Cabinet construction.
IP Class	IP20 ...IP55. Depends on Type and Construction specifications.
Pulse	6 or 12. When the 12-pulse option is selected, the transformer must be of a three-winding type. For machinery drives this field is used to identify "3-phase 6 pulse" and "1-phase full-wave"
Sine filter	No, Yes. Available for certain ACS880 drives with induction motor.
Grid voltage	Relative grid voltage level from -15 % to +15 % . This is an additional sine filter specification.
Cable length	Cable length when sine filter is used. Adjustable length from 10 m to 300 m . Default is Not Specified.
Cable size	The size of motor cable [mm ²] when sine filter is used. Cable size options are 2.5, 4, 6, 10, 16, 35, 50, 70, 95, 120, 140, 240, 370, 480, 555, 720 . Automatic is a default specification and then size is automatically selected.
Glycol concentration	25%, 50%. For liquid cooled units only.
Liquid temperature	25°C...46°C. For liquid cooled units only.
EMC category Variant	Used to build the complete type code of machinery drive
Min Switching freq.	Some drives have minimum switching frequency as selectable option. Too low values do not prevent drive selection.

Drive/Inverter selection in general and manual selection

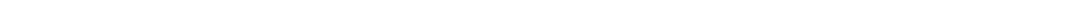
DriveSize usually selects the most suitable inverter/drive from the technical point of view considering specification. However, sometimes you may want to select another drive/inverter. In these cases, you can choose an optional drive/inverter from the Manual selection list. Figure 20: Manual selection view for drive shows this screen for motors but similar screen is available for inverters and drives too.

To select liquid cooled drive/inverter

When you select the liquid cooled drive option in the **Cooling** specification, two new specifications **Glycol concentration** and **Liquid temperature** appear. For a multidrive,

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select liquid cooling for the supply unit first. The cooling method of the supply unit determines also cooling for all the inverters connected to that line-up.



Line supply unit data

This section describes the line supply unit data input for multidrives.

Line supply unit load

Overload type: **Simple cyclic**

Motoring: calculated power

Pcont [kW]: 122 kW

Pmax [kW]: 0 kW

Overload time [s]: Every [s] 240

Generating:

Pcont [kW]: 0 kW

Pmax [kW]: 120 kW

Overload time [s]: Every [s] 60

Total cycle [s]

Specifications

Name	[undefined]
Type	ACS800 ISU cabinet
Cooling	Air
IP Class	IP21

Figure 9: Line supply unit input data and specifications

To enter line supply unit load

If you have selected the motors and inverters, DriveSize calculates the supply unit motoring default powers. The view has also fields for regenerative powers when the supply unit type is RRU or ISU. Please review the numbers in any case.

Table 4: Abbreviations used to describe the supply unit load

Pcont (kW)	Continuous power for the supply unit.
Pmax (kW)	Maximum power for the supply unit.

To change line supply unit specifications

The default supply unit is a 6-pulse DSU cabinet, but other types and pulse numbers and IP classes are available.

To select liquid cooled supply unit

When you select the liquid cooled (LC) supply option in the **Cooling** specification, two new specifications **Glycol concentration** and **Liquid temperature** appear. These specifications also determine all the inverters connected to that supply unit. The cooling method of line supply unit is valid also for all the inverters connected to that line supply unit.

Table 5: **Options for Line Supply Unit Specifications**

Name	Name or string to identify supply unit
Series	ACS800, ACS880 or ACS860
Type	Supply units with different technologies. See the marketing material: DSU, ISU, DxD, DxT and RRU on cabinet and some also as modules.
IP Class	IP00, IP21, IP22, IP42, IP54
Cooling	Air, Liquid. This option determines also the cooling method for all the inverters connected to that line-up.
Pulse	6-pulse, 12-pulse, 18-pulse, 24-pulse. When the 12-pulse option is selected, the transformer must be of a three-winding type.
Glycol concentration	25%, 50%. For liquid cooled units only. The supply unit determines also glycol concentration for all the inverters connected to that line-up.
Liquid temperature	25 °C ... 46 °C. For liquid cooled units only. The supply unit determines also liquid temperature for all the inverters connected to that line-up.

Inputs for quick selection procedure

The category and supply voltage are inherited for these drives in the same way as other drives. Also, the specification part is valid and for example regenerative drives can be selected as well as normal diode bridge drives. Then selection is done based on required Current rating [A] and Motor power [kW]. Motor is assumed be a regular induction motor. The given values are compared to nominal ratings of drives, which are nominal current and typical motor power.

System icons and status

The selection status of **System** item is shown with tooltip and icons (desktop application). Table 6 describes the meaning of the status icons.

Table 6: **Status icons**

Status	Icon	Meaning
MULTIDRIVE SUPPLY UNIT		Line supply unit is not selected.
		Line supply unit is selected.
		Line supply unit selection is not valid.
INVERTER OR DRIVE		Inverter unit is not selected.
		Inverter unit is selected.
		Inverter unit selection is not valid.
MOTOR		Motor is not selected.
		Motor is selected.
		Motor selection is not valid.

System configuration displays the type designation or name of the unit depending on what you have selected in **Options**.

Inserting, copying or deleting components

Use **Insert** and **Edit** on the menu bar when inserting, copying or deleting components in the **System**. For copy-pasting, you must, for example, highlight the drive you wish to copy and paste it on top of a transformer. The pasted drive is displayed as the last item in the tree.

The Insert menu have two choices: Insert Drive and Insert Drive + Load.

With multidrives the choices are Insert Inverter, Inverter + Load, Line supply unit + Inverter, Line supply unit + Inverter + Load.

Highlighting components

When you click an item in the **System** tree, it is highlighted as your working item and the input data and possible selected item appear.

Tip: You can highlight several components at one time. When you highlight several components at one time, it is easier to copy (copy-paste) or delete a group of components or move (cut-paste) them from one line to another. To highlight components, use the **Ctrl** key, mouse and left mouse button. Press and hold down the **Ctrl** key when selecting the components.

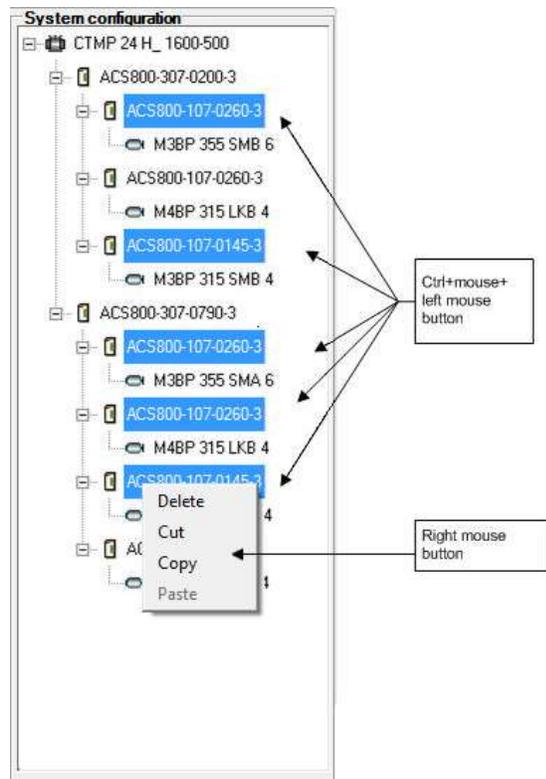


Figure 10: Highlighting several units at a time

Dragging and dropping

You can move an inverter or line supply unit to another location in the **System** tree. Highlight the component you want to move. Press the left mouse button, move the component to a new location and release the mouse button. If you want to drag the unit, each component must be separately moved.

Automatic track

The program always keeps up the sizing status. If you change input data, which can have effect on the other units, then those selections will become invalid.

Table 7: **DriveSize sizing updating**

Changed data	Sizing not valid for
Motor ambient conditions	All motors, inverters and line supply units
Drive ambient conditions	All inverters and line supply units
Network voltage	All motors, inverters and line supply units
Network frequency	All motors, inverters and line supply units
Supply unit load	Only the line supply unit whose load you changed
Line supply unit type, motor voltage or braking voltage	All motors, inverters and line supply units in that line-up
Line supply unit IP class	Only line supply unit whose IP class you changed
Inverter load	Only the inverter and line supply unit where the inverter is connected
Inverter IP class	Only that inverter and line supply unit where the inverter is connected
Motor load	Only that motor and inverter where the motor is connected. Also, that line supply unit in that line-up
Motor number, type, IC class or Temp. rise	Only that motor and inverter where the motor is connected. Also, that incoming unit in that line-up
Inserting motor and inverter	Only the line-up's line supply unit
Deleting or pasting motor and inverter	Only the line-up's line supply unit
Selected motor	The inverter where the motor is connected. Also, that line supply unit in that line-up
Selected inverter	Only the line-up's line supply unit

To open a saved project

1. Select **Existing** to open a previously saved project. The **Existing** view shows all **Recent folders** where project files exist.
2. Click an appropriate folder to see all available projects.
3. Highlight a project file and double-click to preview **Project Info** before opening the project.
4. Click **Load** push button to open that project file. Figure 11: Opening project view shows the **Existing** view. Last saved files are shown in **Recent** view.

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Project file can be opened also by double-clicking it. Then software is started, and project opens directly to the main dimensioning window.

Select **Open** from **File** menu to open a project file through the main dimensioning window. The Existing view appears.

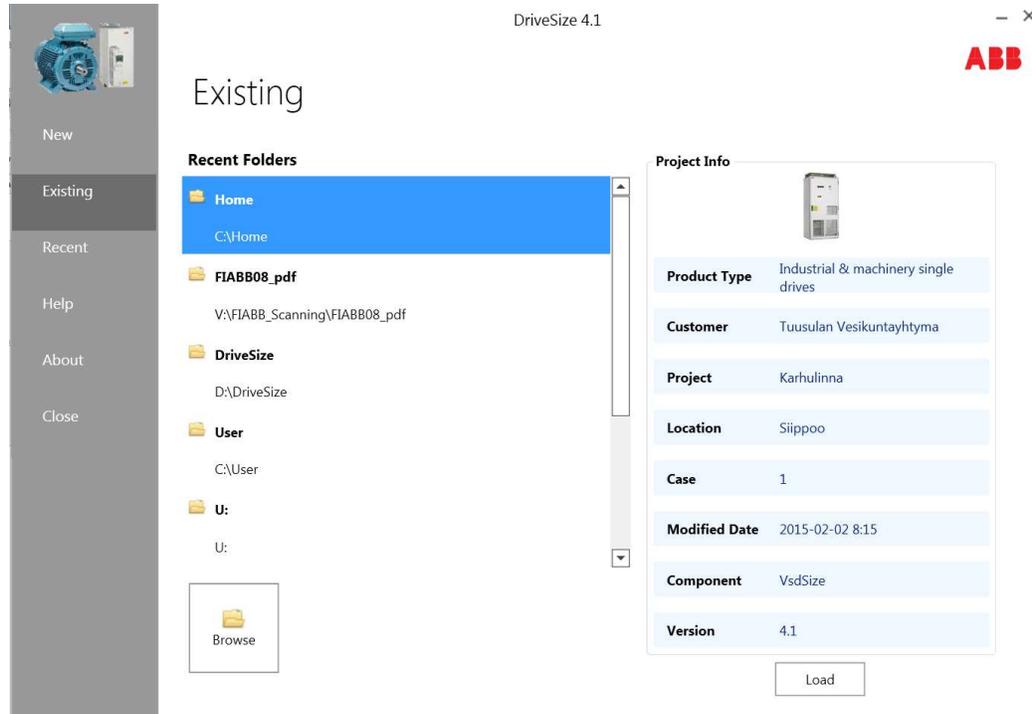
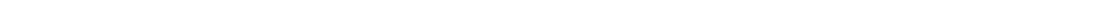


Figure 11: Opening project view

Options and retained settings

DriveSize will save into registry the last supply voltage setting and frequency. Previous version setting Global/US has been stored. And the favourite project directory.

The Tools/options dialog show three settings: a) what names are shown on system tree, b) whether RMS computing is used for motors or not (all of them) and c) whether the default is keep or utilize for the motors temperature reserves. The traditional way is keep and it offers the best efficiency solutions.





Special features

Contents of this chapter

This chapter describes the special features of DriveSize, such as creating more sophisticated load definitions. This section also describes how to use special motors and how to create your motor database.

Motor load

Enter the motor base load in the main window. If the load is more complicated continue with toolbar button **Duty Cycle** or from menu **Overload definitions**. See [Figure 12: Overload definitions](#)

Many overloads

1. Define the duty load by intervals and loads in percent on top of base power or with power or with torque values.
 2. To enter these values, click a cell in the table and type the new value. Use the arrow keys on your keyboard to move inside the table.
 3. To accept your custom duty cycle, click **OK**. If you click **Cancel**, you will lose all your changes.
 4. Upon entering the load's cycle parts, the Load graph shows you the defined custom duty cycle.
-

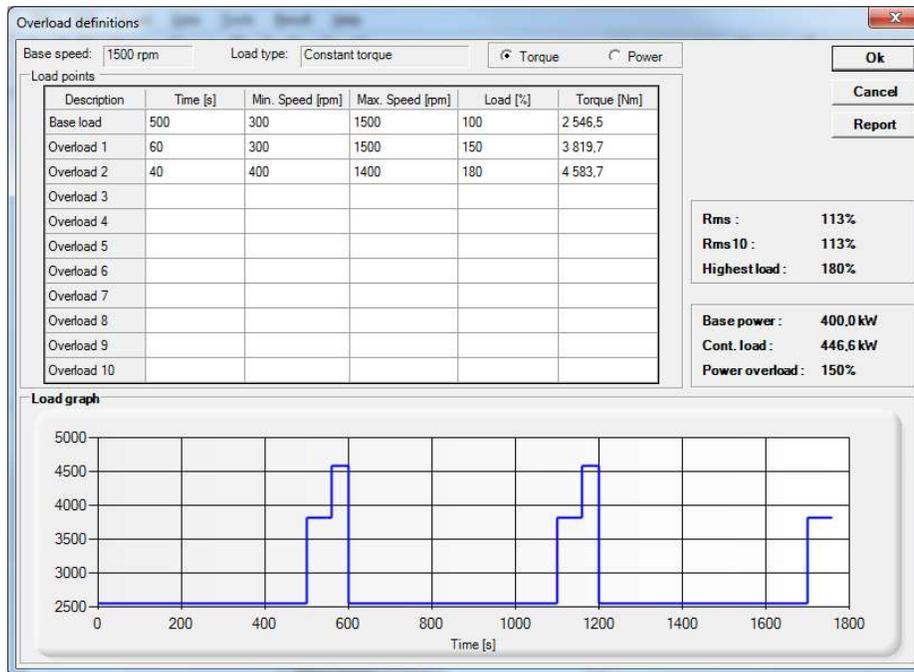


Figure 12: Overload definitions

Rms over the load cycle and **Rms10** during the worst 10 minutes are calculated. When overloads are severe (long lasting) and thermally important, DriveSize computes a higher continuous load value which it uses as the base power later. For motor selection it is possible to skip RMS computing from Tools menu's options. Notice that thermal load capability against overloads is not checked at all when RMS computing is off.

Table 8: Duty cycle view abbreviations

Abbreviation	Meaning
Rms	Rms value for the whole duty cycle
Rms10	Rms value for the duty cycle's worst 10 minutes
Highest load	The highest load for the user's duty cycle
100%	Base power in kW
Cont.load	Calculated continuous load in kW
Overload	Calculated overload in percent

Drive or inverter load

Regardless if motor has many overloads or not the drive load can be viewed with toolbar button **Duty Cycle** or from menu **Overload definitions**. For drive the dialog title is called Overload currents.

Many overloads

1. Define the duty load by intervals, min frequency, max frequency, current and cos phi.
2. To enter these values, click a cell in the table and type the new value. Use the arrow keys on your keyboard to move inside the table.
3. To accept your custom duty cycle, click **OK**. If you click **Cancel**, you will lose all your changes.
4. Upon entering the load's cycle parts, the Load graph shows you the defined custom duty cycle.

Line supply unit load

You often must optimize a line supply unit selection and define the power requirements manually. DriveSize has fields for regenerative power when the supply unit type is RRU and ISU. The **Pmax** motoring power value is the sum of positive Pmax motoring values including losses. The same logic is used for **Pmax** generating, **Pcont** motoring and **Pcont** generating values as well.

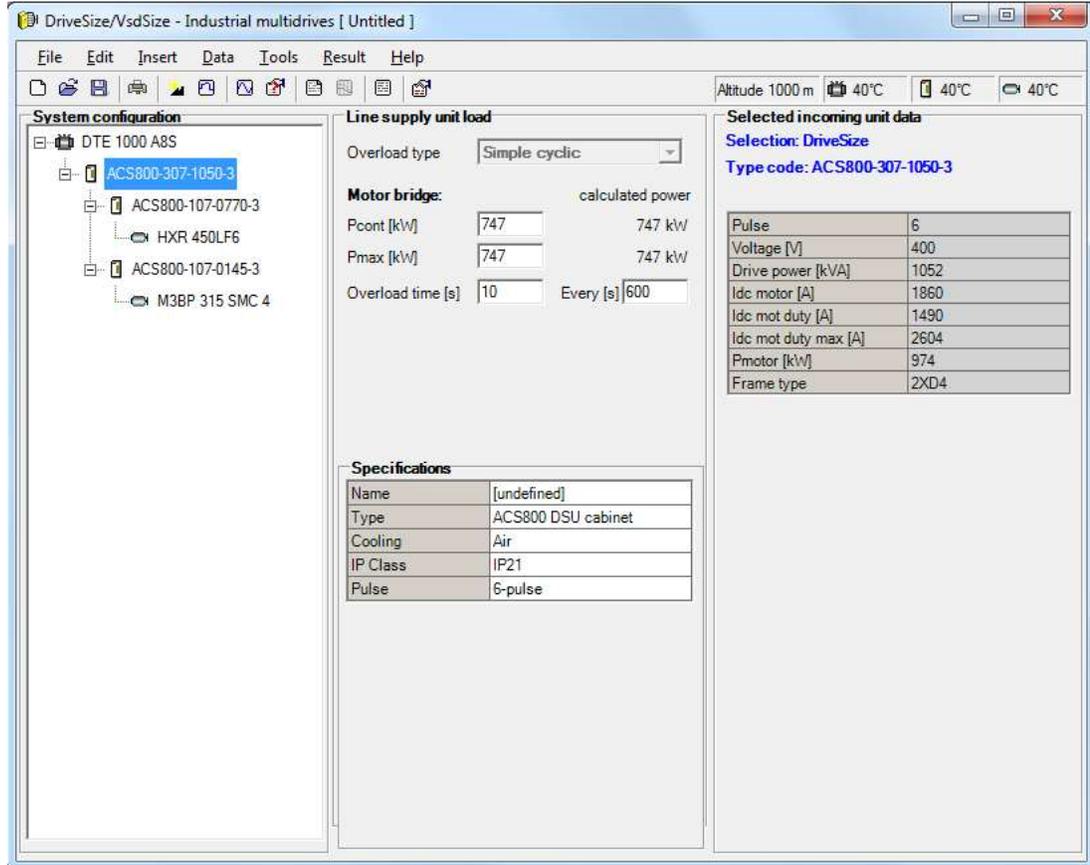


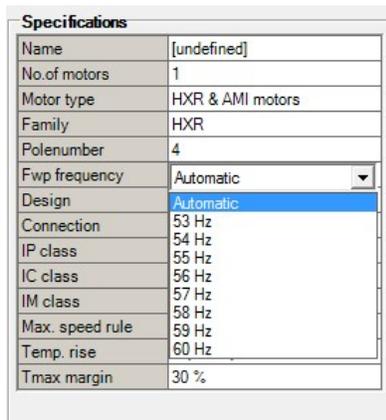
Figure 13: Line supply unit load

DriveSize fills in the time fields with defaults. Check and, if necessary, modify the times and power values. DriveSize does not know the mutual timings of different inverters.

Customer-specific motors

Some motors are called customer-specific because they are not picked from any list, but the rated power and frequency are computed from load requirements. When you select HXR, AMI and NXR motors, ABB Sophiè automatically selects the number of poles and the field weakening point (**Fwp frequency**). After the automatic selection you can alter the value of field weakening frequency between the given limits. The minimum and maximum limits for field weakening are shown in the selected motor data. Additionally, there is also a value for the recommended maximum (Rec). Before you change the value of **Fwp frequency**, select the pole number. When the value of the pole number is changed, the **Fwp frequency** returns to **Automatic**. Figure 14: Drop-down list of field weakening frequency shows the optional field weakening frequencies for a customer-specific motor.

ABB Sophiè starts automatically when the program cannot find any standard motor and the **Motor type** is Auto selection or if you have selected HXR & AMI motors as the motor type.



The image shows a 'Specifications' dialog box with a table of motor parameters. The 'Fwp frequency' parameter is set to 'Automatic' and has a drop-down arrow. The drop-down list is open, showing 'Automatic' as the selected option, followed by a list of frequencies from 53 Hz to 60 Hz. The 'Design' parameter is also set to 'Automatic'.

Specifications	
Name	[undefined]
No. of motors	1
Motor type	HXR & AMI motors
Family	HXR
Pole number	4
Fwp frequency	Automatic
Design	Automatic
Connection	53 Hz
IP class	54 Hz
IC class	55 Hz
IM class	56 Hz
Max. speed rule	57 Hz
Temp. rise	58 Hz
Tmax margin	59 Hz
	60 Hz

Figure 14: Drop-down list of field weakening frequency

Existing motors

You can define an existing induction motor or existing synchronous motor with multidrives. Figure 15: Existing Motor dialog box shows the dialog for an existing induction motor. The loadability curves of the ABB standard motors are used for existing motors. DriveSize assumes that the existing motor is already installed and driving the load. The loadability of an existing motor is not checked, but the graphs show if it is undersized according to the rules for standard motors. Existing synchronous motors are normally high torque and high power motors and maybe also used in wide operating speed at constant power range. They are electrically excited motors.

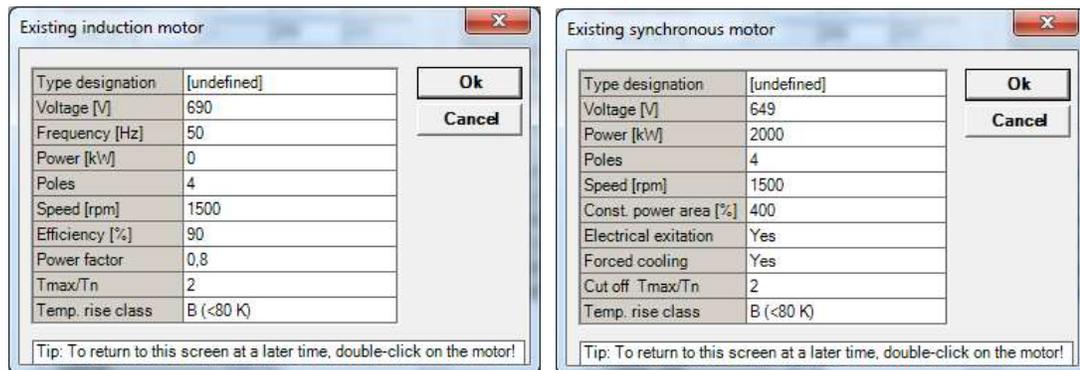


Figure 15: Existing Motor dialog box

Low inertia motors

Low inertia HDP (high dynamic performance) motors have been designed to cool down effectively. The square frame design and high overload capacity gives the motor an excellent dynamic response with Machinery and Industrial drives. The max speeds are high but depend on ball/roller bearing selections and vertical/horizontal mounting selection. Motors are F-class.

User motors

You can let desktop application DriveSize select motors from your own motor list. This section describes how you can import your own motor database.

The format of the motor list is an Excel worksheet with specified column headers and one row for the information of one motor. The motor list is expected to start on the first worksheet in the book and the upper left corner is cell A1. Before you can use the motor list, import it to a UserMotor database in DriveSize. The import is always a full import and all previously existing user motors are removed when you import a new list.

User motors are used independently from supply frequency, but the motor voltage must match the supply voltage. The rating value conversion from one voltage to another is not done for user motors (You can make the conversion in Excel.) Different voltages must have separate rows in the database.

Creating a user motors file

Enter the motor data and loadability curves in **UserMotors.xls**. On 32-bit operating systems you can find this file by default in your working directory in C:\Program Files\DriveWare\DriveSize\VsdSize20\System. On 64-bit operating system the same file is located by default in C:\Program Files (x86)\DriveWare\DriveSize\VsdSize20\System. You can change the file name but not the extension.

Importing from a file

To import new data to the database, select **File -> User motors -> Import from file**. This action overwrites the existing UserMotor database.

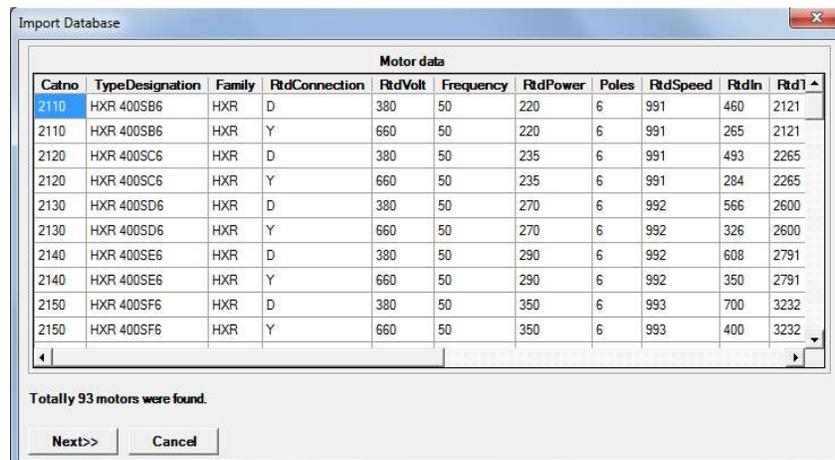


Figure 16: Import Database window

The import function validates the information in the Excel sheet before updating the database. The validation rules are:

- Correct column headers
- Correct data types (text, numeric)
- All numeric values must be > 0
- Text values must fit into a maximum length
- The frequency column must be between 8...400 (Hz) so that also values other than 50 Hz or 60 Hz are accepted.
- The voltage must be known by DriveSize

In case of import errors, the program tells you which values are not accepted, and the import is cancelled. The import date is stored in the **General** table and it is visible in the **About** box.

If there is at least one motor imported to the database, a new item is added to the Motor type list: **User defined** in the motor specification grid. When you select **User defined**, DriveSize updates the **Family** list with all families from the Database. The other specification items are:

- **Family**: "Not specified", + rest of list from the database
- **Pole number**: "Automatic", 2, 4, 6, 8, 10, 12
- **Design**: Not specified, Basic, High-Output
- **Connection**: Not specified, Y, D

- **IC class:** IC411, IC416
- **IM class:** IM10001, ...
- **Max speed rule:** Standard
- **Temp rise:** Not specified, B, F
- **Motor Tmax Margin:** 20%, 30%, 43%

To enter loadability curves

In the Excel list, you can give a reference to an existing loadability curve in the standard databases (for example, IEC, Existing and so on). If an empty loadability curve name is found, the existing motor type is assumed.

You can also import the loadability curves for your motors. Use the same Excel file (UserMotors.xls) to import loadability curves. The loadability curve must start from the zero frequency and extend to 1 (relative). The number of loadability curves is unlimited.

To import motor loads from file

You can import several pre-collected motor loads at once (desktop application). Fill in the motor loads to **MotorLoadData.xlsx**. By default, you can find this file in your working directory in C:\Users\[user]\DriveWare\DriveSize\VsdSize\System. You can change the file name but not the extension.

- **Name:** number of characters 0...24
- **Load type:** Constant power, Constant torque, Constant torque/power or Pump/fan load
- **Speed, min:** number in rpm
- **Speed, base:** number in rpm
- **Speed, max:** number in rpm
- **Power, base:** number in kW
- **Overload, base:** value in percent, relative to base power
- **Overload, max:** value in percent, relative to base power
- **Overload, time:** overload duration in seconds
- **Overload repeating:** total cycle duration in seconds

1. To import the motor loads data, select **File -> Import motor loads**.
2. Select file like MotorLoadData.xlsx.
3. The motor loads appear in the System tree.
4. Continue with DriveSize as usual.

The purpose of importing motor loads is to speed up dimensioning process when motor load list is available and contains several motors.



Results

Contents of this chapter

This chapter describes how to interpret the **Results** shown on screen.

Selection results

DriveSize always tries to select some unit. The selection may not be optimal, but it provides a result quickly. When you change the input data, you get another result. DriveSize computes the selections quickly but you make the final decision. [Figure 17: Main DriveSize/VSDSize window](#) shows an example of the motor results.

The catalog data is on main window, but more detailed information can be found in the **Selection Result** view where results appear numerically or in the **Graph** view where results appear graphically. You can make your own selection in the **Manual selection** view. The **List of Selected** is useful when there are plenty of motor drives.

Result view

The **Result** view shows the results in a numeric form for the item you have highlighted. The view is similar for motors, inverters and incoming units. The **Specifications** data shows the user requirements. The **Catalogue data** displays the name plate/catalog data. The **Selection data** has columns for **Required**, **Result** and **Margin** values. The required data is calculated from the user load demands. The result data is based on selected unit (motor, drive and so on). The margin indicates the percentage of capacity still available.

46 Results

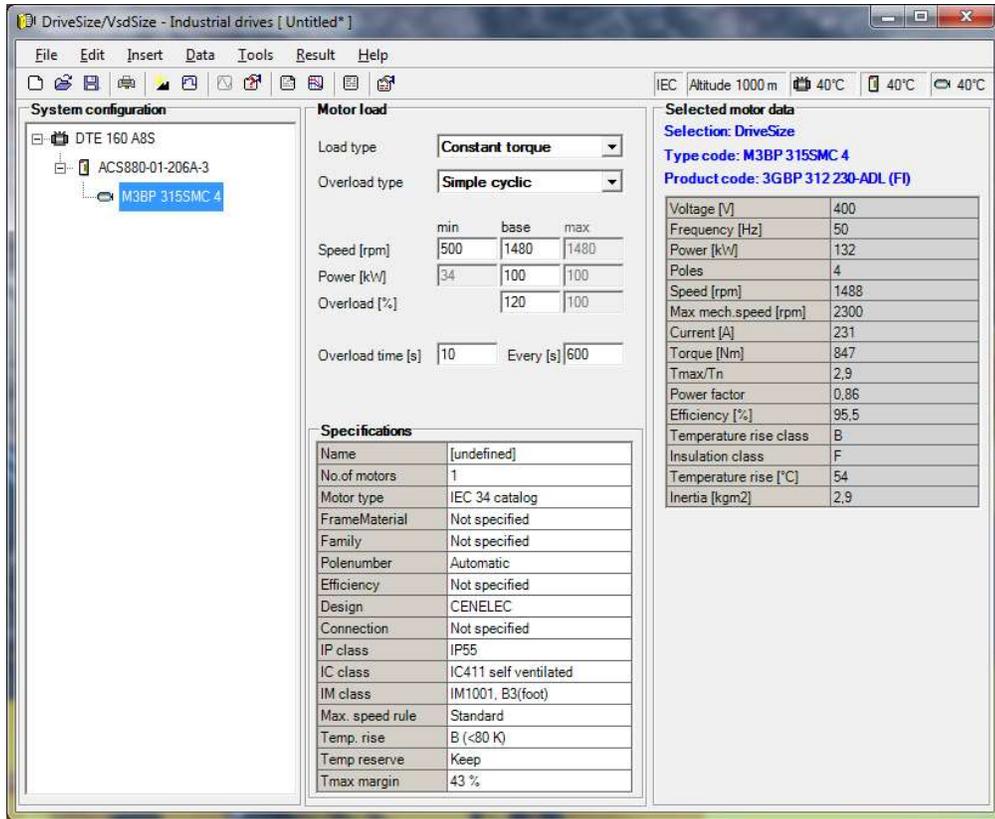


Figure 17: Main DriveSize/VSDSize window

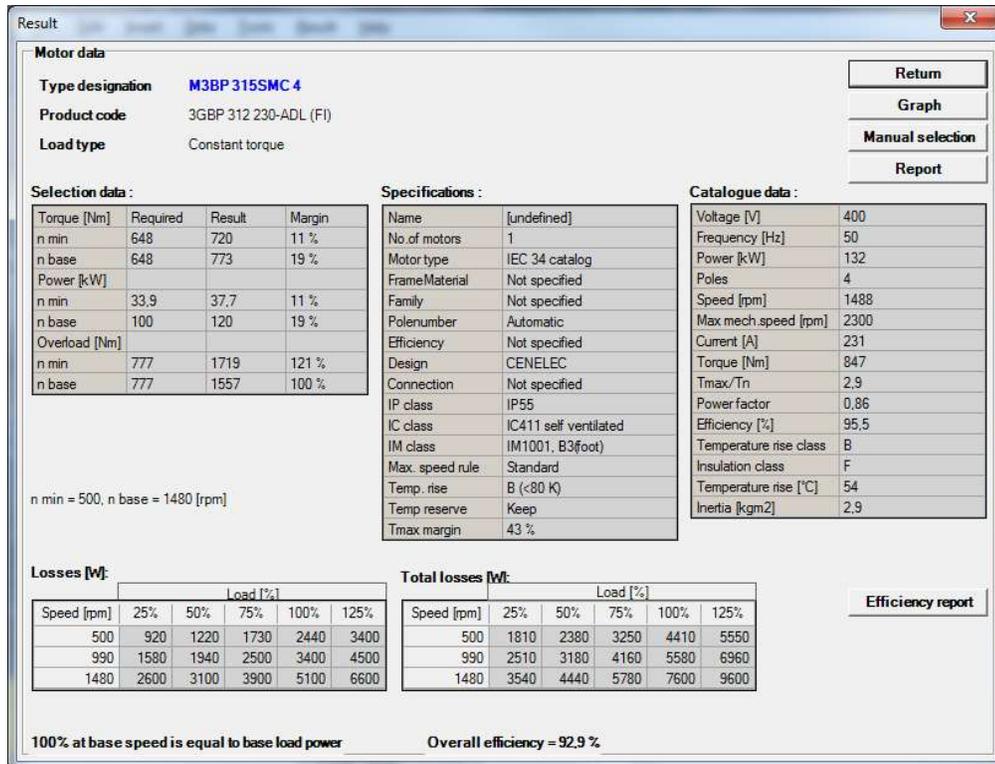


Figure 18: Result view for motors

Table 9: **Selection data for motors**

Torque (Nm) min, base, max	Torque at the user-defined speed: Minimum, base, maximum speed.
Power (kW) min, base, max	Power at the user-defined speed: Minimum, base, maximum speed.
Overload (Nm) min, base, max	Calculated overload torque at the user-defined speed: Minimum, base, maximum speed for the user-defined time.

Table 10: **Selection data for inverters**

Icont (A), Imax (A) or Imax start (A)	Calculated current load for an inverter in two situations: <ul style="list-style-type: none"> • Continuous load and maximum load for the user-defined time • Maximum load at start is shown in case the load type is One time at start overload
Temperature	Temperature margin in percent for the IGBT module. There is also an additional temperature margin for other components like a choke when liquid cooled.

Table 11: **Selection data for diode supply units**

Power (kW) mot cont, mot max, gen cont, gen max	Calculated power load in two situations: <ul style="list-style-type: none"> • Continuous load • Maximum load for the user-defined time
DC-current (A) cont motoring, max motoring, cont generating max generating	Calculated DC bus currents in two situations: <ul style="list-style-type: none"> • Continuous load • Maximum load for the user-defined time
Temperature mot temp, gen temp	Temperature margin in percent. There is also an additional temperature margin for other components like a choke when liquid cooled.

Table 12: **Selection data for IGBT supply units**

Power (kW) mot cont, mot max	Calculated power load in two situations: <ul style="list-style-type: none"> • Continuous load • Maximum load for the user-defined time
AC-current (A) cont motoring, max motoring	Calculated current and power: <ul style="list-style-type: none"> • Continuous load • Maximum load for the user-defined time
Temperature mot temp	Temperature margin in percent for a supply unit. There is also an additional temperature margin for other components like an LCL filter when liquid cooled.

Table 13: **Liquid flow sums of line-up for LC multidrives**

Total flow (l/min)	Calculated total mass flow for this line-up. The liquid flow of line supply unit is shown in the catalogue data table of the LSU result sheet.
--------------------	--

Heat loss (kW)	Calculated loss power for that line-up.
----------------	---

The selection data includes margin values. When the margins are positive, the unit meets the requirements.

Note: When the drive type is ACS800 or ACS880, where a thermal model is used, the margin of continuous current can be negative when the ambient temperature is below 40 °C.

Heat losses and efficiency reports

Since 2004 DriveSize have computed the motor and drive losses in multiple load points. This method is described on ABB Web documents. We favoured the loss numbers instead of efficiencies. These heat losses are shown on **Result screens**. Notice that you can print all efficiency reports at once. This function is available under File menu's Print option (or Ctrl-P).

During 2014 European standard EN 50598-2 adopted the same ideas with the exception that motor losses are computed based on loss measurements with loads 25%, 50%, 75% and 100% full speed. These losses for drive are shown under **Selected drive data**.

DriveSize will maintain older loss computing for those products which does not have EN50598-2 numbers and for motors.

Graph view

The **Graph** view helps you to check how well the unit fits the requirements. The graphs display load and motor torques, load and motor powers and load and inverter currents. Figure 19: Graphs for motor shows the graph for load and motor torques as a function of speed.



Figure 19: Graphs for motor

In the view, a legend explains the curves. Each curve has its own color.

Table 14: **Torque [Nm] curves in the Motor graph**

max. loadability	Motor maximum capability as a function of speed
max. load	User-defined maximum load (overload)
cont. loadability	Motor continuous loadability – thermal limit
cont. load	User-defined continuous load

Table 15: **Current [A] curves in the inverter graph**

max. loadability	Inverter maximum capability
max. load	User- defined maximum
cont. loadability	Inverter continuous loadability
cont. load	User-defined continuous load

Manual selection view

In the **Manual selection** view, you can view and select a smaller or larger unit instead of your current selection (made by the software or by your own previous selection). The selected unit has number 0 and its row is highlighted. Smaller units have a negative mark. Larger units have a positive mark. The table includes some catalogue values and calculated margins to help with the new selection process.

Manual selection									
Catalogue data									
#	Type designation	Apparent power [kVA]	Power [kW]	Icont [A]	Icont margin	Imax [A] (peak)	Imax margin	Selection method	Temp. margin
-2	ACS880-07-0585A-3	405	315	585	4 %	730	0 %	N/A(ow)	0 %
-1	ACS880-07-0650A-3	450	355	650	16 %	730	0 %	N/A(ow)	0 %
0	ACS880-07-0725A-3	502	400	725	29 %	1020	40 %	IGBTtemp	28 %
1	ACS880-07-0820A-3	568	450	820	46 %	1020	40 %	IGBTtemp	47 %
2	ACS880-07-0880A-3	610	500	880	57 %	1100	51 %	IGBTtemp	62 %
3	ACS880-07-1140A-3	790	630	1140	103 %	1482	103 %	diode tempo	114 %
4	ACS880-07-1250A-3	866	710	1250	122 %	1630	124 %	diode tempo	143 %
5	ACS880-07-1480A-3	1025	800	1480	163 %	1930	165 %	IGBTtemp	191 %
6	ACS880-07-1760A-3	1219	1000	1760	213 %	2120	191 %	IGBTtemp	264 %
7	ACS880-07-2210A-3	1531	1200	2210	293 %	2880	295 %	IGBTtemp	361 %
8	ACS880-07-2610A-3	1808	1400	2610	365 %	3140	331 %	IGBTtemp	468 %

Figure 20: Manual selection view for drive shows the alternative selections. The view is available for motors, drives/inverters and supply units.

Table 16: Items in Manual selection view, motor table

Type	Motor's type designation
Code	Motor's product code or generation code (filter option available)
PU	Production unit (filter option available)
Efficiency class	Motor efficiency class
Winding	Standard, restamp or special design.
Power (kW)	Rated power
Poles	Pole number
Speed (rpm)	Nominal speed
In (A)	Nominal current
Tn (Nm)	Nominal torque
Tmax/Tn	Maximum torque / Nominal torque
Tcont margin	Continuous load margin. The smallest margin over the complete speed range.
Tmax margin	Maximum load margin. The smallest margin over the complete speed range.
Im (A)	Calculated continuous load current
Immax (A)	Calculated maximum load current

Table 17: Items in the Manual selection view, inverter table

Type	Inverter's type designation
Apparent power [kVA]	Inverter's apparent power
Power [kW]	Inverter's nominal motor power
Icont [A]	Nominal continuous loadability current
Icont margin	Calculated margin for your continuous load
I _{max} [A] (peak)	Nominal maximum loadability current
I _{max} margin	Calculated margin for maximum load
Selection method	Selection criterion
Temp. margin	Calculated temperature margin

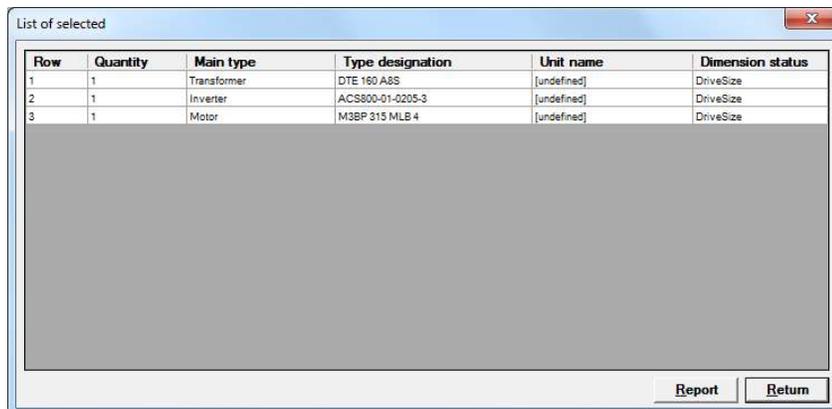
Table 18: Items in the Manual selection view, line supply unit table

Type	Line supply unit's type designation
Apparent power [kVA]	Line supply unit's apparent power
Power margin	Calculated continuous power margin for motoring load.
Current margin	Calculated continuous current margin for motoring load with required power.
Selection method	Selection criterion
Temp. margin	Calculated temperature margin

To select a different unit, click the row. To verify your selection, click **OK**. Your selection is highlighted. Filter options are available in motor table for **Code** and **PU** items. This makes it easier to find certain motor type from long list. Click **Lock** checkbox in **System configuration/Selected motor data** to keep manual selection.

List of selected

List of selected displays the selected units. The list contains: **Type designation**, **Unit name** and **Selection status**, which shows whether you or the software made the final selection.



Row	Quantity	Main type	Type designation	Unit name	Dimension status
1	1	Transformer	DTE 160 A8S	[undefined]	DriveSize
2	1	Inverter	ACS800-01-0205-3	[undefined]	DriveSize
3	1	Motor	M3BP 315 MLB 4	[undefined]	DriveSize

Figure 21: List of selected



Network Check

Contents of this chapter

This chapter describes computing of the supplying network issues.

Harmonics calculation is based on discrete Fourier transformation and tabulation. Please refer to Technical guide book from ABB for the basics.

Network Check view

With **Network Check** you can calculate typical values for:

- the THD, harmonics and power factor for an individual drive
- the THD, harmonics and power factor for a line supply unit
- combined harmonics for several units at transformer level

Both voltage and current harmonics are calculated. DC voltage calculations provide DC link voltage.

DriveSize will always compute the main-wave = first harmonic = base current as well and more importantly compare the harmonics on this main-wave. Some standard papers give harmonics current limits compared to reference currents I_{ref} and as function of short circuit power. The purpose is good. The intention of DriveSize is on the other hand to give user the harmonic levels which are applicable to user's way of loading the particular drives. Please notice that drives produce higher THD% if loading is partial. With full power and consequently with I_{ref} the THD% values are probably smaller.

Tip: Compute the combined harmonics, not harmonics for individual drives. Parallel drives will smoothen and, in some cases, compensate each other. Combine ISU and DSU drives.

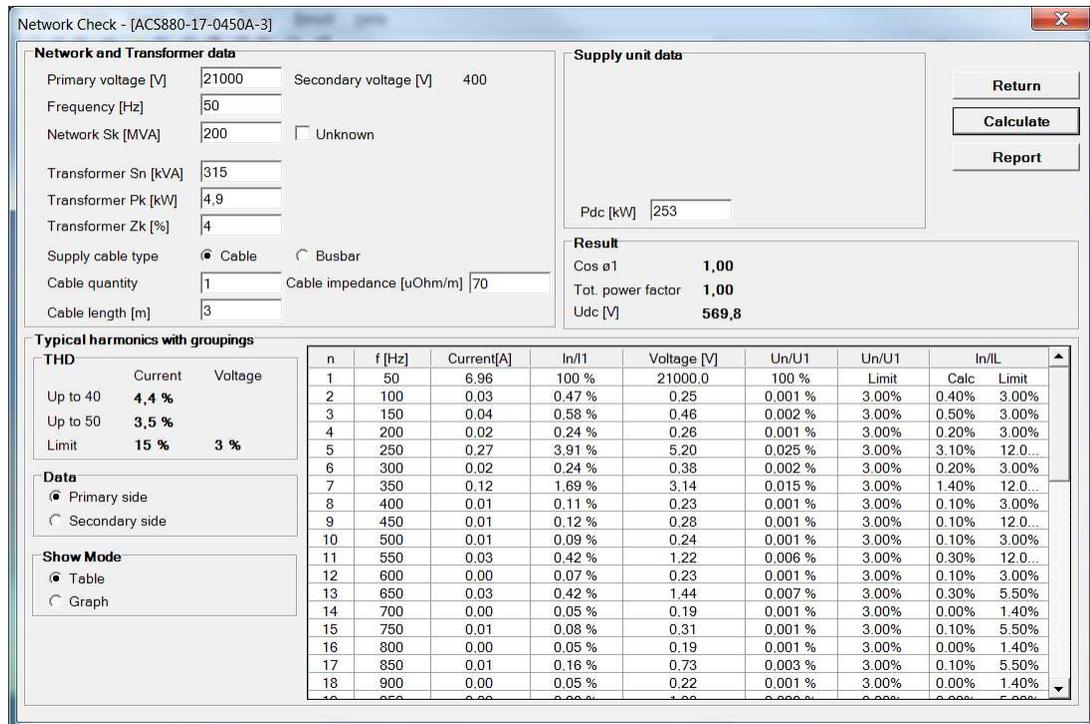


Figure 22: Network Check view.

Interharmonics

DriveSize calculates total harmonics distortion with interharmonics and with grouping. THDs are computed up to 40th harmonic and additionally up to 50th harmonic for primary side. In the first case the divider is I1 and in the second case the nominal current of transformer.

Un/U1 and In/IL limit values are upper limit guidelines for primary. With In/IL values the IL is the transformer nominal current.

54 Network Check

Table 19: Network and Transformer Data items

Primary voltage	Network voltage on the primary side
Secondary voltage	Network voltage on the secondary side
Frequency	Network frequency
Network Sk	Network short-circuit power MVA. Currently the maximum value is 900 MVA
Transformer Sn	Transformer nominal power
Transformer Pk	Transformer load loss power in kW
Transformer Zk	Transformer short-circuit impedance in percent
Cable quantity	Parallel connected cable quantity
Cable length	Length of the cable

Table 20: Supply Unit items

Lac (μH)	AC choke inductance
Ldc (μH)	DC link inductance
Cdc (mF)	DC link capacitance
Pdc (kW)	DC power; the default value is base power plus the losses in the motor and inverter.

Table 21: Result items

cos Φ_1	Fundamental power factor, main wave power factor
Tot power factor	Calculated total power factor with the harmonics included
Udc (V)	Calculated DC voltage

Table 22: Harmonic items

Voltage THD (%)	Voltage total harmonic distortion
Current THD (%)	Current total harmonic distortion
Limit	Harmonics limits specified in IEC519 standard. Limits depend on calculated short circuit ratio.
n	Harmonic order number
f (Hz)	Harmonic frequency
Current (A)	Harmonic current
In/I1	Harmonic proportional current to base current
Voltage (V)	Harmonic voltage
Un/U1	Harmonic proportional voltage to base voltage

To get network check

1. Highlight the transformer or drive and click **Network check** in the toolbar.
2. The Network Check view opens.
3. If necessary, adjust the Pdc and other settings.
4. Click **Calculate**.

Note: The network data you fill in **Network Check** does not have effect on the network data in the main window.

To view the harmonics output as a table or a graph, select the **Table** or **Graph** radio button in **Show Mode**. When you select the graph view, you can choose between the voltage and current harmonics.

7

Printing and saving results

Contents of this chapter

This chapter gives information on the printing functions. The printed results are meant to be used as appendixes for offer, request for offer or just for documentation purposes.

Instead of printing we encourage you to save the results on electronic format. This is one way to avoid consumption of printers and paper.

Printing the results

You can use the printing functions for two purposes:

- exporting the project information to Excel or LibreOffice Calc, which can be used as shopping lists for motors and drives. To do this, select **Preview**.
- printing on paper. To do this, select **Print**.

In the **Print** dialog, define the information you want to move to Excel or Calc.

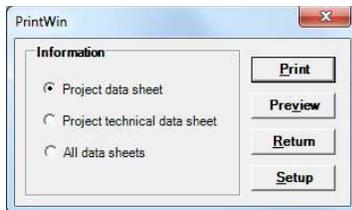


Figure 23: Print dialog

Many DriveSize views have a **Report** button too.

Efficiency and heat loss report

Click the **Efficiency report** button in **Motor data** view to see the efficiencies and losses in a printable form. Note that print **All data sheets** does not contain the Efficiency report sheet. This sheet is available for single drives. Select **All efficiency reports** if you want to print all Efficiency report sheets at once. This function is available under File menu's Print option.

Network check report

Click the **Report** button in the **Network Check** view to see the printable result sheet of the harmonics.



Overview of MCSize

General

The name MCSize refers to motion control and machinery drives and the MCSize software is meant to be a fast technical computing tool for all users who need to select electrical drive system components. Typically, a sizing process starts from the selection of mechanics and motion profiles. Also, gears are an essential part of the system. Because the automatic gear ratio optimization is not currently included in the software, users are expected to use their common knowledge when setting the gear ratios, since it is an important part of cost effective solutions.

The motor selection is based on technical facts only, usually on the torque requirements of the motion and mechanics. MCSize does not contain cost or price information and, thus, cost optimizing must be performed manually. After the calculation of motor choices, the drive is then selected based on motor actual currents. The single drive selections and the sizing of line converter with one or several inverters are supported.

To help new users MCSize inserts reasonable default values to the required input fields. This way the users can command the software to select the motors and drives right away. The software for example gives the default value of 0.2 m for the driver roller of the conveyor, as a value of 0 m would cause the software to give unnecessary error messages about missing data. However, it is easy to override the default values and save new values for future use.

In addition, MCSize provides plenty of intermediate results for users. This helps the user to:

1. double-check results
 2. easily find good and cost-effective solutions
-

- use some of the computed data when the drive or motor is started and commissioned with mechanics.

Functions

With MCSize you can:

- Compute Torque requirements for various mechanical arrangements
- Compare gearing alternatives
- Select the correct size of a drive and the correct motor combination
- Select a suitable line converter for the regenerative drive system
- Select the proper braking chopper and resistor
- Compute multiple axis systems
- Export the produced results from MCSize to the .xls format.
-

Opening MCSize project

In the DriveSize **New** project view, double click the **Motion control drives** icon. On the tabs **Existing** and **Recent** you can open projects saved earlier.

First Drive Type dialog opens for a start. Select the type of drive you want to start with. There is a possibility to add single drives and regenerative drives to the same project. It is possible to convert single drive to line converter supplied unit later.

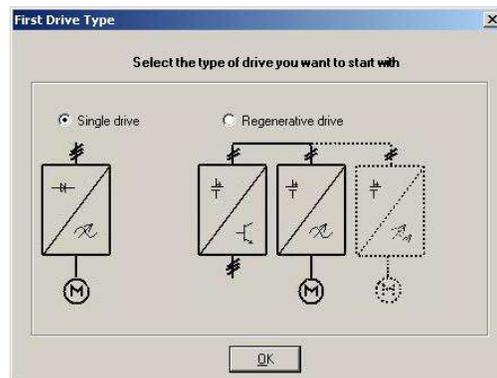


Figure 24 First Drive Type dialog box

The motion control project files have a unique file extension (.mdd).

9

Sizing of motion control drives

Sizing procedure overview

System configuration tree

The **System configuration** tree displays an overview of the frequency converter system of all axis. It shows the type designations or names of units in the tree format (see Figure 25). The order of units follows the power flow.

MCSize includes different displays for the transformer, supply, drive, motor, gearings, and motion profile and mechanics data. When you click on an item in the **System configuration** tree, the display will change accordingly.

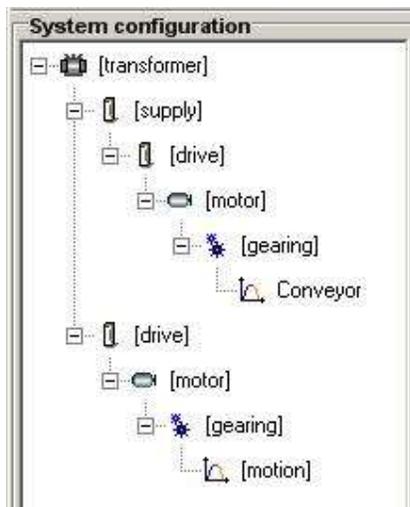


Figure 25 System configuration tree

The **System configuration** tree includes the following icons:

-  Transformer
-  Supply (when regenerative drive)
-  Drive
-  Motor
-  Gearing
-  Motion profile and mechanics

Order of selections

Dimensioning selections can be performed for example in the following logical order:

1. Select a voltage [V] and Frequency [Hz] of the system.
2. Select the type of application.
3. Enter motion profile data.
4. Specify data for mechanics.
5. Select gearings and enter parameters.
6. Select motor specifications and **motor**.
7. Select drive specifications and **drive**.
8. Optionally select supply unit and transformers

To add a second axis, select **Insert > Drive + Motor +Mechanics** or **Insert > Supply + Drive + Motor +Mechanics** from the menu bar and repeat the selections from 3 to 7.

However, MCSize allows you to select and modify units at any level, and you can perform the dimensioning selections in any order. For example, you can easily change the supply voltage and frequency at any stage.

Transformer level

The default network voltage is 400V, 50Hz. To modify these open the transformer display by selecting the **Transformer** icon from the **System configuration** tree. Select the **Secondary voltage [V]** setting from the drop-down list and **Frequency [Hz]** setting. These are linked and will affect what drive series are available at drive level.

The screenshot shows a software interface for configuring transformer load data. It includes dropdown menus for secondary voltage (400V) and frequency (50Hz), and text input fields for load power (0 kVA) and calculated load power (0 kVA). A specification table at the bottom shows the name as '[transformer]' and the type as 'Dry'.

Figure 26 Transformer load data definition

MCSIZE also displays the **Calculated load power [kVA]** when drive and motor loads are on place. You may override it by typing a value for **Load power [kVA]**.

You may insert data in the Specification field of the Transformer load display:

Specification	Options
Name	Any text or number string. This will also show up in reports and, depending on the Tools/Options settings, on screen.
Type	Dry, Oil

Table 23 Transformer load specifications

Supply level data

Supply level is available if regenerative drive was selected in the beginning. The load data is normally derived from underlying drives etc. To view supply load data, open the Supply load display by clicking the **Supply icon** in the **System configuration tree**.

Two **Profile type** options are available: **Manual** and **Derived**. **Derived** load means that load is calculated based on mechanics connected to that regenerative supply unit. The loads that have identical cycle time are collected to own groups. It is also possible to define phase shift between loads with same cycle time (see Figure 27).

Supply Load
Profile type: Derived

Cycle group	Phase shift [s]	Pdcmax [kW]	Pdcmin [kW]
5 [s]			
[drive]	0	6.76	-4.568
[drive]	0	7.777	-5.922
	Total	14.537	-10.491
7 [s]			
[drive]	0	3.752	-2.374
	Total	3.752	-2.374

Specifications

Name	[supply unit]
Supply amount	1
Type	Air cooled
Line filter	Included
IP class	Not specified
Switching frequency	3 kHz

Figure 27 Supply data definition

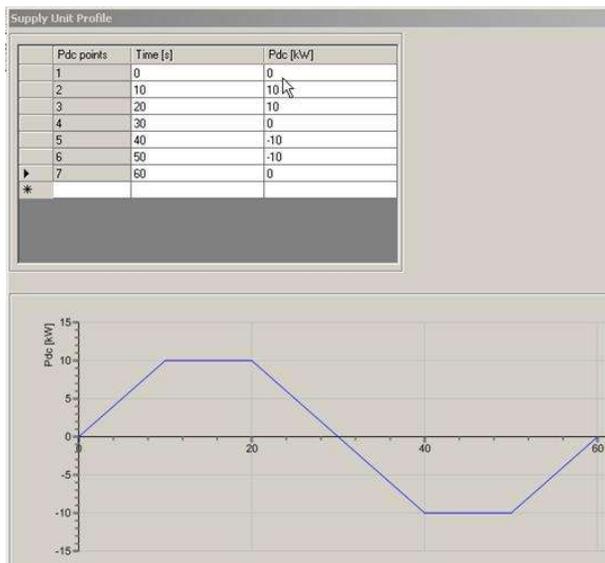


Figure 28 Manual supply data definition

Select manual profile option to enter load manually. These inputs override the load calculated on mechanical load. When manual profile is selected then **Supply Unit Profile** view opens. Manual data can consist on up to 50 load points.

Modifying supply specifications

You can set the following specifications for the regenerative supply: Line converter amount, type, line filter, IP class and switching frequency. To modify drive specifications, click on the desired item. Select new values from the drop-down lists or type the new value to the field.

Specification	Options
Name	Any text or number string. This will also show up in reports and, depending on the Tools/Options settings, on screen.
Supply amount	Number of similar drives with range 1 – 100 for one branch in the System configuration tree
Type	Air cooled, Cold plate
Line filter	Included
IP class	Not specified IP20 – This selection means that the user is specifically limiting the choices to the IP20 protection class.
Switching frequency	3, 4, 5, 8 or 16 kHz

Table 24 Supply unit load specifications

Drive input data

Normally the drive load is derived from underlying motor and its loads. To view drive load data, open the **Drive load** display (see Figure 29) by clicking the **Drive icon** in the **System configuration** tree. White fields are editable and grey fields are calculated based on profile, mechanics, gears, and motor. The calculated values include primarily dimensioning criteria. The inverter is loaded with the calculated motor currents, frequency and power factor.

You can change the motor currents but note that the other motor data and the given speed profile will still be used. In Table 25 you can see the explanations of abbreviations that are used on the display.

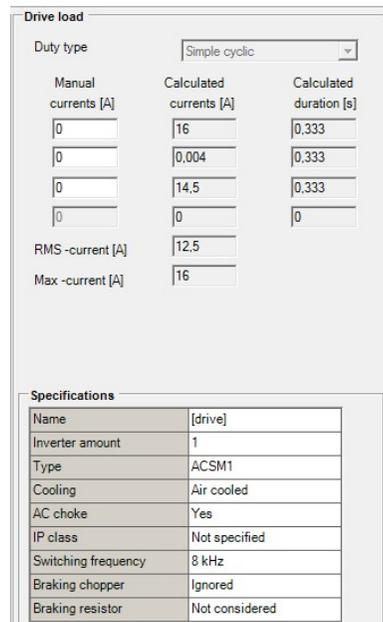
Abbreviation	Meaning
RMS-current	Root mean squared value for the whole duty cycle currents
Max-current	The calculated peak value that occurs during the duty cycle

Table 25 Explanation of abbreviations in Drive load display settings

More complicated inverter profile

The text **custom** is shown in Drive load display's current and duration fields when the Duty type of motion profile is Multiform cyclic. Open **Inverter profile** to see the segmental currents. You can also enter the new current for each segment. All the other motor data and the given speed profile will still be used.

Click the  icon or select Data > Motion profile from the menu to open Inverter profile.



Manual currents [A]	Calculated currents [A]	Calculated duration [s]
0	16	0.333
0	0.004	0.333
0	14.5	0.333
0	0	0

RMS -current [A] 12.5
Max -current [A] 16

Specifications	
Name	[drive]
Inverter amount	1
Type	ACSM1
Cooling	Air cooled
AC choke	Yes
IP class	Not specified
Switching frequency	8 kHz
Braking chopper	Ignored
Braking resistor	Not considered

Figure 29 Drive load input data

Modifying drive specifications

You can set the following specifications: the inverter amount, type, cooling, IP class, switching frequency, braking chopper and resistor. The available types depend on voltage, which was set on transformer level. Higher level selections effect lower level items.

To modify drive specifications, click on the desired item. Select new values from the drop-down lists or type the new value to the field.

Specification	Options
Name	Any text or number string. This will also show up in reports and, depending on the Tools/Options settings, on screen.
Inverter amount	Number of similar drives with range 1 – 100 for one branch in the System configuration tree
Type	ACSM1, MicroFlex, MicroFlex e100, MicroFlex e150, MotiFlex e100, MotiFlex e180 Depending on selected voltage.
Cooling	Air cooled, Cold plate
AC choke	Yes or No
Overload Mode	For MicroFlex and MotiFlex a significant parameter 300% 3s, 200% 3s, 150% 60s, 110% 60s and Not specified.
IP class	Not specified IP20 – This selection means that the user is specifically limiting the choices to the IP20 protection class.
Switching frequency	4, 8, 16 kHz. Higher switching frequency will reduce the audible noise and give better motor performance but will adversely cause losses in the drive and the max current providing capability.
Braking chopper	Ignored – This selection means that even though the internal chopper is used, the losses of it are anyway ignored when a drive selection is performed. Internal – This selection means that the losses of internal chopper are added to drive losses and the limitations of the internal chopper are considered when selecting a drive.
Braking resistor	Not considered – The braking resistor is not selected this time. Selected – The braking resistor is selected based on the motion duty braking power requirements.

Table 26 Drive load specifications

Motor input data

Open the **Motor load** display (see Figure 30) by clicking the **Motor** icon in the **System configuration** tree. The calculated values are shown in grey fields.

Motor load			
Load type		Conveyor Simple cyclic	
	Input	Calculated	
RMS torque [Nm]	0	14,4	
RMS speed [rpm]	0	2349	
RMS power [kW]		3,54	
	Input		Calculated
	Torque [Nm]	Speed [rpm]	Torque [Nm]
	Speed [rpm]	Torque [Nm]	Speed [rpm]
Q1	0	0	18,5
Q2	0	0	-16,7
			3151
			3151
Max power [kW]		6,11	
Reflected inertia [kgm ²]		0,018	
Specifications			
Name	[motor]		
Motor type	ServoMotor		
Motors per inverter	1		
Family	Not specified		
Polenumber	Not specified		
Feedback type	Not specified		
Max inertia ratio	Not specified		
Temp rise class	Not specified		
IC class	IC 416		
Size	Not specified		
Auxiliary brake	-		

Figure 30 Motor load input data

The calculated values are based on profile, mechanics and gears. The calculated values (RMS-values) are the primarily dimensioning criteria. The calculated torque is a peak torque at motor shaft and in the final results the motor inertia is also considered. The calculated speed is the speed at the max dynamical power or the speed when the calculated peak torque really exists. Only the quadrants that really exist in the application are shown in the motor input load view.

Quadrant	Description
Q1	Positive torque, positive speed
Q2	Negative torque, positive speed
Q3	Negative torque, negative speed
Q4	Positive torque, negative speed

Table 27 The definition of quadrants

Modifying motor load specifications

You can see the input fields for motor load specifications in Table 28. Note that some of the input fields are dependent on the selection made in the Motor type field.

Specification	Options
Name	Any text or string
Motor type	ServoMotor – Permanent magnet servo motors in database, InductionMotor – ABB's catalog induction motor, ExistingServoMotor – Enter motor characteristics case-by-case, ExistingInductionMotor – Enter induction motor characteristics. UserDefinedServoMotors
Motors per inverter	Normally 1 but can be in the range 1 – 100 similar induction motors per a drive unit. The load is given for one motor. One inverter feeds several motors connected in parallel.
Family	According to the Motor type selection, the motor family choices are shown. If you have no preferences, use "Not specified".
Polenumber	Not specified, 2, 4, 6, 8, 10, 12
Feedback type	Not specified, Encoder, Resolver – With servomotors an encoder motor might give less output than a resolver motor because resolver motors withstands higher temperatures.
Max inertia ratio	Not specified, 2, 3, 4, 7, 10, 100. Read the text below this table.
Temp rise class	Not specified, B [< 80K], F [<105K]. Not specified means that MCSize will use the class given in motor catalogs.
IC Class	Not specified, IC-0041, IC411, IC416. IC-0041 = enclosed motor without cooling fan. IC411 = cooling fan on motor shaft; means lower loadability at partial speeds. IC416 = separate cooling fan. Choose this option for constant torque cases where the min speed is very low. For large motors there are other choices available.
Size	If specified, limits the selection to the particular shaft height of induction motor or the size code of servomotor.
Auxiliary brake	No brake, Holding Affects to the inertia of motor
Max speed rule	Standard, Metal fan Available only for Induction Motors
Motor Tmax margin	43%, 20% Available only for Induction Motors

Table 28 Motor load specifications

In inertia calculations, the inertia ratio corresponds to the reflected inertia divided by the motor inertia. You can set the maximum acceptable value for this ratio. The ratio will be

the motor selection criterion. The ideal ratio for reflected inertia to motor inertia is 1:1, a ratio that yields the best positioning and accuracy. The reflected inertia should not exceed the motor inertia more than tenfold, if it is important to maintain the control performance. Inertia ratio is shown in the manual selection view of motor.

Motor selection criteria are also based on system voltage which is given as the **Supply voltage**, **Frequency** and **Switching frequency** of the drive.

Catalog induction motors will have the same nominal frequency as the supply, and a nominal voltage like the system voltage. The switching frequency of a drive does not affect the thermal behavior of an induction motor within MSize. The output voltage of a drive at a field weakening area is less than the system voltage, and this is considered when the maximum short-term torque curve is drawn. You will notice this from the fact that the turning point of the curve is not exactly at the level of nominal frequency but below it.

On the other hand, the permanent magnet servomotors have non-standard nominal voltages and they are always lower than the system voltage. When overloaded at higher speeds, the motor voltage will be higher than the nominal voltage but anyhow lower than the system voltage. Some reserve voltage must be available for the good performance of drives. The nominal values of servomotors are given with a switching frequency included in the database. If the setting of drive switching frequency is lower, the nominal values of servomotors must be scaled down a bit. If the drive switching frequency is higher than the motor's switching frequency, the motor's nominal values are kept in the original values. The best thermal characteristics for a motor are achieved with the highest drive switching frequency.

The system voltage also affects the servomotor maximum speed and available short-term torque at high speeds. You will notice this by changing the system voltage, for example, from 380V to 400V or 415V, and by monitoring the short-term torque of the same motor.

If you select ExistingServoMotor or ExistingInductionMotor in the Motor type field, the Existing motor window opens. You can see the input fields for existing motor specifications for ExistingServoMotor in Table 29. You can see the definition of loadability curve in Figure 31. Ensure that the motor data are valid for the same switching frequency that you are going to select from the drive specifications.

70 Sizing of motion control drives

Specification	Options
Type designation	Any text or string
Voltage [V]	400
Frequency [Hz]	50
Power [kW]	0.62
Poles	2, 4, 6, 8, 10, 12, 14, 16, 18, 20
Speed [rpm]	1500
Efficiency [%]	90
IC class	IC410
Temp. rise class	B[<80K], F[<105K]
Mcs	3,9
Mn	3,9
Mp0	14
Mp1	14
Mp2	14
n1	1500
n2	1500
n3	6000
Kt	3.04
Inertia [Kgm^2]	0.001
Luv [H]	0.004
Ruv [ohm]	2
Back EMF [V]	190

Table 29 Existing motors specifications for Existing Servo Motor.

Where K_t is torque constant [Nm/A], L_{uv} is line-to-line armature inductance [H] and R_{uv} is line-to-line armature resistance [ohm].

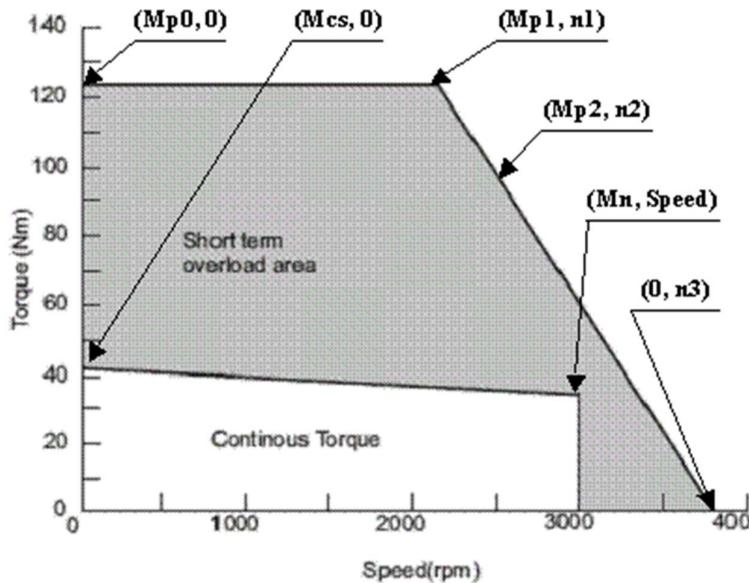


Figure 31 The definition of loadability curve

You can see the input fields for existing motor specifications for Existing Induction Motor in Table 30.

Specification	Options
Type designation	Any text or string
Voltage [V]	400
Frequency [Hz]	50
Power [kW]	1
Poles	2, 4, 6, 8, 10, 12, 14, 16, 18, 20
Speed [rpm]	1000
Efficiency [%]	90
Power factor	0.8
Tmax/Tn	3
Temp. rise class	B[<80K], F[<105K]
Inertia [Kgm ²]	0.001
IC class	IC411, IC416

Table 30 Existing motors specifications for Existing Induction Motor.

Importing own motor list

You can perform dimensioning with motors from your own motor list. Options are Import user motors and Import user induction motors. For User motors, refer to the DriveSize manual.

Gearing input data

To enter gearings data, open the **Gearing** display (see Figure 32) by clicking the **Gearing** icon in the **System configuration** tree. You can set a maximum of three gears. Each has its own view and data input field.

This software does not include an automatic gear ratio optimization. Set the gear ratio so that the maximum speed is as close to the maximum speed of motor as possible.

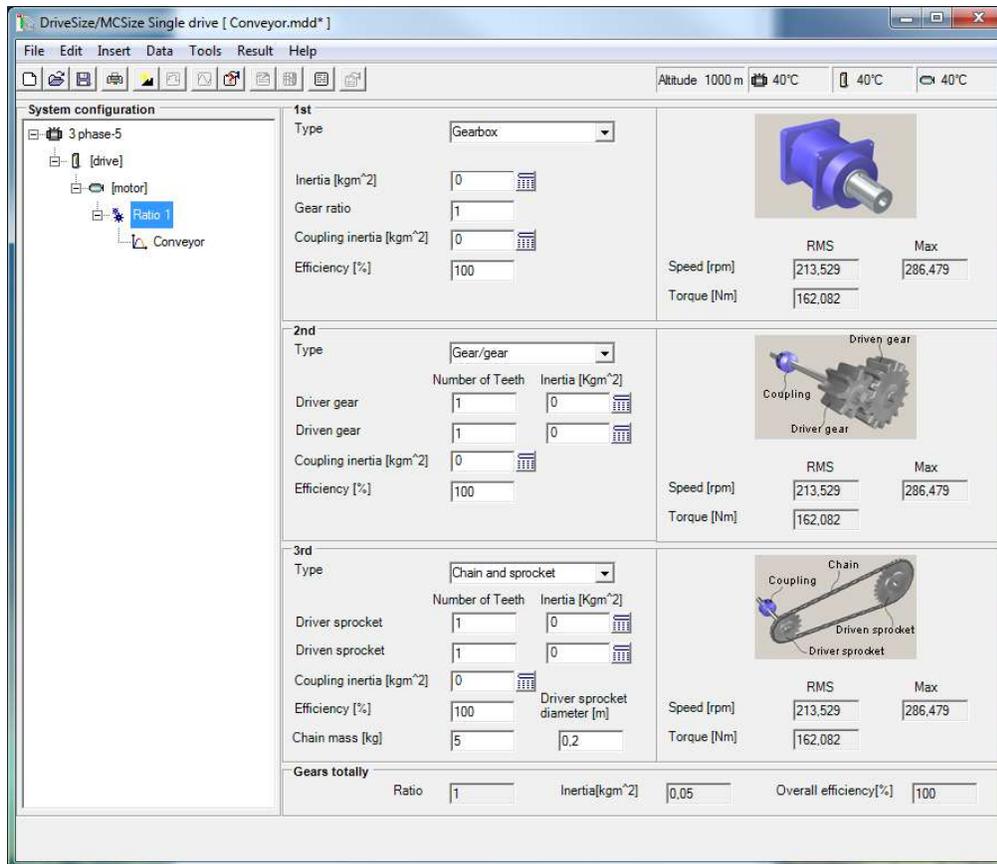


Figure 32 Gearings input data display

The visible gearing settings are determined according to the selected gearing type. Select the desired gearing type from the **Type** drop down list. The order of gearings from the motor to the load is: Motor - 1st - 2nd - 3rd - Load.

The available gearing type options are:

- None
- Gear/gear
- Gearbox
- Chain and sprocket
- Belt and pulley
- Gearhead

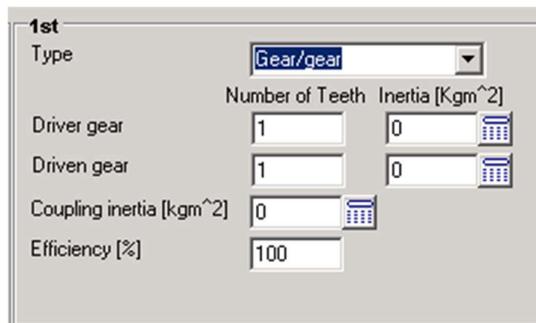


Figure 33 Gearing data input field

Belt and pulley

In belt and pulley gearings the power is transmitted from one pulley to another via a belt (see Figure 34). The ratio of gearing depends on the diameters of the pulleys.

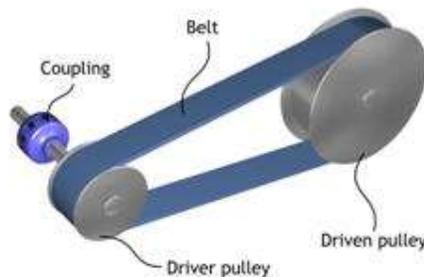


Figure 34 Belt and pulley

You can enter the driver pulley inertia, driven pulley inertia and coupling inertia directly, or you can use the inertia and mass calculator (see chapter 5.1.3. Inertia and mass calculator).

Setting	Explanation
Driver pulley, Diameter [m]	Enter the exact actual diameter of the driver pulley for the correct calculation of reflected inertia.
Driver pulley, Inertia [kgm ²]	Enter the exact actual diameter of the driver pulley for the correct calculation of reflected inertia.
Driver pulley, Inertia [kgm ²]	Enter the value of the driver pulley inertia or use the inertia and mass calculator.
Driven pulley, Diameter [m]	Enter the driven pulley diameter. The speed of driven pulley rotation depends on the belt velocity and the diameter of the pulley. Therefore, the exact value of the driven pulley diameter is required for the correct calculation of the reflected inertia value.
Driven pulley, Inertia [kgm ²]	Enter the value of the driven pulley inertia or use the inertia and mass calculator.
Belt mass [kg]	Enter the belt mass. It influences the value of total inertia.
Coupling inertia [kgm ²]	Enter the inertia of coupling at the motor side of the gearing or use the inertia and mass calculator. This value should also include all additional coupling inertia that is not included in the driver pulley inertia value, for example, the additional inertia caused by the shaft.
Efficiency [%]	With the efficiency setting you can consider the losses of torque. In MCSize the losses are assumed to happen between the belt and driven pulley.

Table 31 Belt and pulley gearing settings

Chain and sprocket

In chain and sprocket gearings the ratio of gearing is inversely proportional to the speeds of the sprockets, that is, to the number of teeth on the sprockets (see Figure 35).

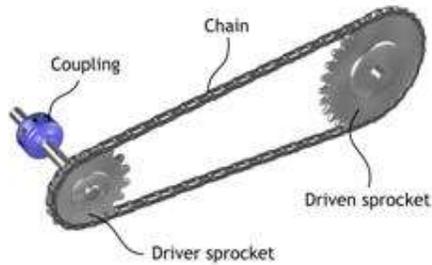


Figure 35 Chain and sprocket

You can enter the driver sprocket, driven sprocket inertia and coupling inertia directly, or you can use the inertia and mass calculator (see chapter 5.1.3. Inertia and mass calculator).

Setting	Explanation
Driver sprocket, Number of teeth	Enter the number of teeth on the Driver sprocket. This value along with the Driven sprocket, Number of teeth value generates the gear ratio. The ratio is smaller when reducing the value. MCSize accepts also the value 1.
Driver sprocket, Inertia [kgm ²]	Enter the driver sprocket inertia value or use the inertia and mass calculator to define the inertia value.
Driven sprocket, Number of teeth	The number of teeth on the Driven Sprocket. This value along with the Driver sprocket, Number of teeth value generates the gear ratio.
Driven sprocket, Inertia [kgm ²]	Enter the driven sprocket inertia value or use the inertia and mass calculator to define the inertia value. If you want to use the inertia and mass calculator, you must know the gear diameter.
Coupling inertia [kgm ²]	Enter here the inertia of coupling at the motor side of that gearing. This value should also include all additional coupling inertia that is not included in the driver pulley inertia value, for example, the additional inertia caused by the shaft.
Efficiency [%]	With the efficiency setting you can consider the losses of torque. In MCSize the losses are assumed to happen between the chain and driven sprocket.
Chain mass [Kg]	Enter chain mass information. It affects the value of total inertia.
Driver sprocket diameter [m]	Enter the true diameter of the driver sprocket to define the chain's effect on the reflected inertia value.

Table 32 Chain and sprocket gearing

Gear/gear

The gear ratio of gear construction is inversely proportional to the gear speeds, that is, to the number of teeth on the gears (see Figure 36). The correct gear ratio is required in the calculation of reflected inertia. You can enter the driver and driven inertia directly or use the inertia and mass calculator.

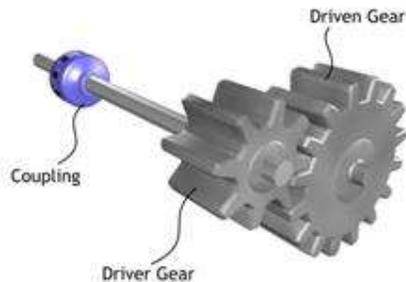


Figure 36 Gear/gear

Setting	Explanation
Driver gear, Number of teeth	Enter here the number of teeth on the Driver gear. This value along with the Driven gear, Number of teeth value generates the transformation ratio. MCSize accepts also the value 1.
Driver gear, Inertia [kgm ²]	Enter the driver gear inertia value or use the inertia and mass calculator to define the inertia value. If you want to use the inertia and mass calculator to define the inertia value, you must also know the driver gear diameter.
Driven gear, Number of teeth	The number of teeth on the Driven gear. This value along with the Driver gear, Number of teeth value generates the transformation ratio.
Driven gear, Inertia [kgm ²]	Enter the driven gear inertia value or use the inertia and mass calculator to define the inertia value. If you want to use the inertia and mass calculator to define the inertia value, you must also know the gear diameter.
Coupling inertia [kgm ²]	Enter the inertia of coupling on the power input side of the gearing or use the inertia and mass calculator to define the inertia value. This value should also include all additional coupling inertia that is not included in the driver pulley inertia value, for example, the additional inertia caused by the shaft.
Efficiency [%]	Enter the efficiency. With the efficiency setting you can consider the loss of torque. In MCSize the losses are assumed to happen in the teeth of gears.

Table 33 Gear/gear gearing settings

Gearbox

The gearbox is an enclosed gearing, that is, a planetary gear for the gearing of higher rotation speed (see Figure 37). The purpose of a gearbox is to achieve output with high torque and low speed. The gearbox is often integrated into the motor.



Figure 37 Gearbox

Setting	Explanation
Inertia [kgm ²]	Enter the inertia of the gearbox or use the inertia and mass calculator to define the inertia value. Typically, gearbox manufacturers specify only one value of inertia. This inertia is valid at the power input of gearbox
Gear Ratio	Enter the gear ratio. This value defines how the speed of the input shaft is transmitted to the output shaft of the gearbox. For example, 3 means that three rotations of the input shaft are required for one complete turn of the output shaft.
Coupling inertia [kgm ²]	Enter the coupling inertia at the power input side of gearing or use the inertia and mass calculator to define the inertia value.
Efficiency [%]	With the efficiency setting you can consider the losses of torque. In MCSize the losses are assuming to happen in the teeth of gears.

Table 34 Gearbox gearing input fields

Gearhead

A selection of planetary gearheads can be found from database. Click **Select** push button to see the list of available gearheads. Gearhead option is possible for the 1st gear only.

There is also a possibility to import an own gearheads data:

Select **File -> Import -> Gearheads** to import new data to the database. Notice that existing gearhead data will be overwritten! **PlanetaryGearheds.xlsx** file is available in your working directory or C:\ProgramFiles\DriveWare\DriveSize\MCSize\system by default. You can change the file name but not the extension. Enter the gearhead data to **PlanetaryGearheds.xlsx file** and import it.

The input field of coupling inertia is available also for planetary gearhead.

Entering motion profile data

To open the **Motion** display, click the **Motion profile and mechanics** icon (see Figure 38). Enter motion profile information to the data input fields. When you enter a new input value, the program calculates a new motion profile. The results are displayed in the **Motion results** display. The layout of the **Motion results** field changes according to the selected mechanics type, whether linear or rotational. You can also select an optional unit for distance. Click **Change type** to open a drop-down list with options for the type of mechanics.

The screenshot shows a dialog box titled "Motion" with the following fields and values:

- Duty type: Simple cyclic
- Profile type: Trapezoidal 1/3,1/3,1/3
- Accel/ Decel type: Linear
- Number of Revolution: 10 (with a "Change type" link)
- Movement time [s]: 5
- Dwell time [s]: 0

Figure 38 Motion input data

Setting	Explanation
Duty type	Select the duty type. The Simple cyclic duty type consists of just one profile that includes the acceleration, continuous speed and deceleration segments. If the Multiform cyclic duty type is selected, you can create more complicated cycles, for example, enter several acceleration and deceleration segments. Enter the data in the separate Motion profiles display (see Figure 39). With several accelerations, it is possible to accelerate or decelerate from one nonzero speed to another nonzero speed. A motion profile can contain a maximum of 50 segments, including acceleration, deceleration, constant speed, dwell and hold segments. Only simple cyclic is available for Winder and Unwinder mechanics.
Profile type	Select the profile type. The available profile type options are the following: Trapezoidal 1/3, 1/3, 1/3 Trapezoidal 1/4, 1/2, 1/4 Triangular 1/2, 1/2 User defined Fractional numbers here refer to the relative times of acceleration, continuous velocity and deceleration. Acceleration time and deceleration time become editable when the profile type is User defined.
Accel/ Decel type	Select the acceleration/deceleration type. You can increase the smoothness of motion with this option. S-curves are used when it is necessary to limit the acceleration change rate (jerk). These curves are also used in dynamic braking. The available s-curve options are the following: Linear

	1/4 s curve 5/8 s curve Full s curve You can achieve the smoothest motion with the Full s-curve setting, but it requires higher peak acceleration and deceleration to produce an equivalent profile. This means that when s-curves are used, more torque is required to accelerate or decelerate the system inertias.
Movement distance [m], Top speed [m/s] Rotational angle [deg] Number of revolutions	Enter the total distance traveled during the cycle. Acceleration/deceleration is calculated based on given distance and movement time. When linear load is selected, the options are Movement distance [m] and Top speed [m/s] . When a rotational movement type is selected, a drop-down list with three options, Rotational angle [deg] , Number of revolutions and Top speed [rev] , appears.
Movement time [s]	Enter the total movement time for one cycle. Includes the acceleration, constant speed and deceleration segments but does not include the dwell time.
Dwell time [s]	Enter the waiting time between sequential cycles.

Table 35 Motion input fields

Entering more complex profile

To enter the more complicated duty type, select Multiform cyclic from the motion input data view (see Figure 38). Select a suitable segment type from the drop-down list for each segment. Enter the data for different segment types in the input fields and the software calculates the rest (see Table 36). MCSize will display an error message in the motion profile view when entered inputs are incomplete for example, if the final speed of the previous segment does not fit with the new segment. A new row appears automatically after you have entered acceptable inputs for the segment. Click the right mouse button to delete or to insert a new segment between two segments. Select the segment you want to delete or a segment after which you want to insert a new segment. The profile is shown also in graphical form. Graph type options Speed vs. time and Displacement vs. time are available for graphics.

There is also a possibility to graphically reshape the profile by mouse. Select Edit from Graph options, use mouse and point out the segment you want to divide into two parts. Click the right mouse button and select Add point, click the left mouse button and a new point will appear. Similarly use Delete line command to remove segments. Select Drag from Graph Options, use mouse and left mouse button to move the red dots.

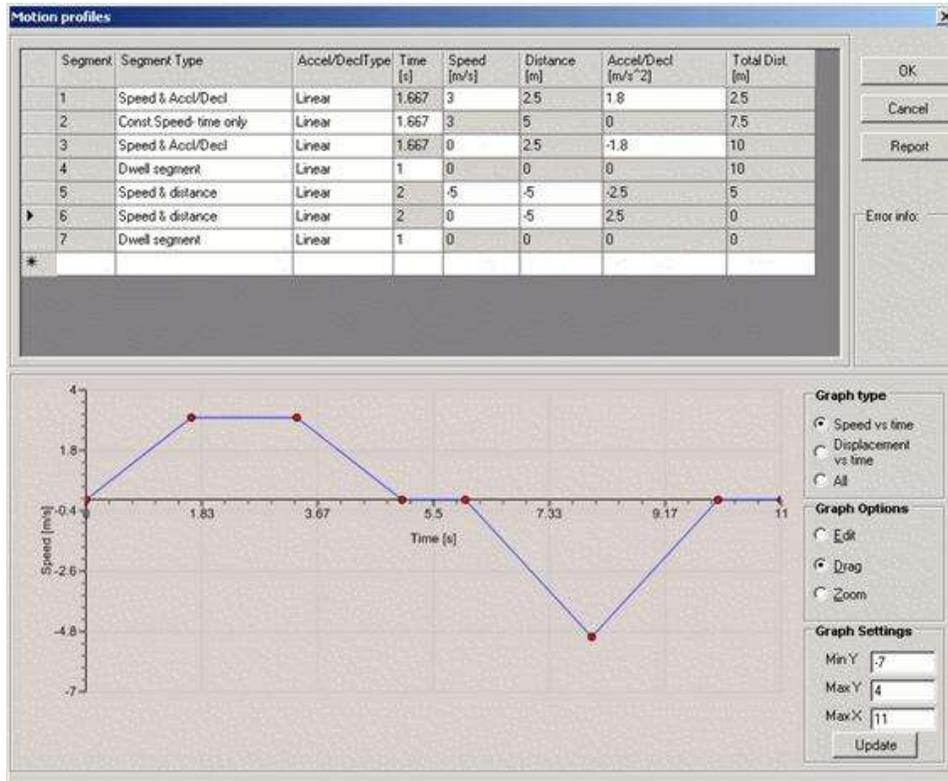


Figure 39 Motion profiles display

Use Graph Settings to change the scale of graph. Enter the new values of axis and click **Update** push button. The zoom function is available when the total cycle time exceeds ten seconds, or the number of segments is ten or more. Select **Enable Zoom**, use mouse and left mouse button to highlight a period you want to zoom in. Click the  push button to zoom out.

Point type	Explanation
Speed & Accl/Decl	For the acceleration or deceleration segment. Enter the final velocity in the end of this segment and the desired value of acceleration. Negative acceleration means deceleration when the speed is positive and vice versa.
Speed & Time	For the acceleration or deceleration segment. Enter the duration or accelerating/decelerating segment and the final speed in the end of this segment. The initial speed and the end speed must have the same sign (both negative or both positive). Reversal is possible via zero speed point only.
Speed & Distance	For the acceleration or deceleration segment. Enter the final velocity at the end of this segment and the desired distance to be travelled during this segment. The distance and the speed must have the same direction (both negative or both positive)
Accl/Decl & Distance	Segment type for acceleration or deceleration segment. Enter the desired acceleration and the distance for the segment. Negative value means deceleration when the speed is positive and vice versa.

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Accl/Decl & Time	Segment type for the acceleration or deceleration segment. Enter the desired acceleration and the duration of acceleration for the segment. Negative acceleration means deceleration when the speed is positive and vice versa.
Dwell segment	This is zero speed and no-load waiting segment between motion segments. The final speed of the previous segment must be zero. Enter the duration of dwell segment
Const. speed – distance only	For the constant speed segment. Enter the distance traveled during this segment. Speed is the final speed of previous segment. The previous segment determines the direction of movement.
Const. speed – time only	For the continuous speed segment. Enter the duration of constant speed segment. Speed is the final speed of the previous segment. The previous segment determines the direction of movement.
Hold segment	This is zero speed hold segment between motion segments. Hold torque is determined by mechanics. Enter the duration of hold segment. The end speed of the previous segment must be zero.

Table 36 Segment types

Setting	Explanation
Segment	Sequence number. You can enter 2...50 segments.
Segment Type	Speed & Accl/Decl, Speed & Time, Speed & Distance, Accl/Decl & Distance, Accl/Decl & Time, Distance & Time, Dwell segment, Const. speed – distance only, Const. speed – time only, Hold segment.
Accel/DeclType	Select the acceleration/deceleration type. You can increase the smoothness of motion with this option. S-curves are used when it is necessary to limit the acceleration change rate (jerk). The available s-curve options are the following: Linear 1/4 s curve 5/8 s curve Full s curve You can achieve the smoothest motion with the Full s-curve setting, but it requires higher peak acceleration and deceleration to produce an equivalent profile. This means that when s-curves are used, more torque is required to accelerate or decelerate the system inertias.
Time [s]	The duration of the segment.
Speed [m/s], [rad/s]	The end speed for acceleration or deceleration segment.
Distance [m], [rad]	Angular distance traveled during the duration of the segment.
Accel/Decl [m/s ²], [rad/s ²]	The mean value of acceleration for the segment. A positive sign means acceleration to the positive direction and vice versa. A negative sign means deceleration when the direction of the movement is positive and vice versa.
Total Dist. [m], [rad]	Total distance or angular distance from the start position to the end position.

Table 37 Motion profile inputs for Multiform cyclic load type

Entering mechanics data

You can select the type of the mechanical application from the **Type** drop-down list in the **Mechanics** display (see Figure 40).

The available mechanics types are the following:

- Conveyor, which is also the default
- Cylinder
- Feed roll
- Lead screw
- Rack & pinion
- Rotating table
- User defined
- Winder
- Unwinder

Each item has its own view and input fields. **User defined**, and **Cylinder** are more universal mechanics types for linear and rotational movements respectively.

Mechanics	
Type	Conveyor
Load mass [kg]	10
Belt mass [kg]	5
	Diameters[m] Inertia [kgm ²]
Driver roller	0.2 0
Driven roller	0.2 0
Idler roller	0.2 0
Coupling inertia [kgm ²]	0
Efficiency [%]	95
Incline angle [deg]	0
Coefficient of friction	0.001
Opposing force [N]	0

Figure 40 Mechanics input data

You can use the inertia and mass calculator to calculate the inertia of mechanical parts based on their dimensions, weight and material. To open the inertia and mass calculator, click the calculator button next to an inertia input field.

Conveyor

Industrial conveyors are material handling machinery that are used for moving bulk materials from one place to another at a controlled rate (see Figure 41). A belt conveyor consists of an endless loop belt and a roller system in which idler rollers are often used to support the belt. The belt position can be horizontal, inclined or declined. The direction of movement is mostly forward but reverse is also possible.

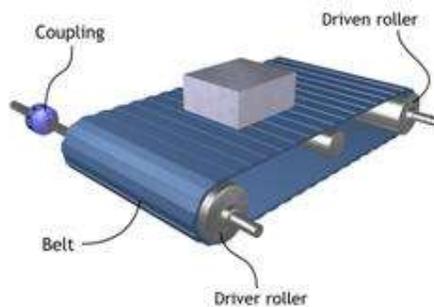


Figure 41 Conveyor mechanics

Setting	Explanation
Load Mass [kg]	Enter the total mass of the load to be conveyed.
Belt Mass [kg]	Enter the belt mass. It affects the value of total inertia and the frictional forces.
Driver roller, Diameter [m]	Enter the exact driver roller diameter for the correct calculation of driven roller inertia, load inertia, belt inertia and idler roller inertia.
Driver roller, Inertia [kgm ²]	Enter the value of driver roller inertia or use the inertia and mass calculator to define the inertia value.
Driven roller, Diameter [m]	Enter the driven roller diameter for the calculation of the effect of the inertia of these rollers on the system inertia.
Driven roller, Inertia [kgm ²]	Enter the driven roller inertia or use the inertia and mass calculator to define the inertia value. The rotation speed of the driven roller depends on the belt velocity and the diameter of the driven roller. For correct inertia value calculations, enter the exact diameter of the driven roller.
Idler roller, Diameter [m]	Enter the idler roller diameter for the calculation of the effect of the inertia of these rollers to the system inertia.
Idler roller, Inertia [kgm ²]	Enter the total inertia for all the idler rollers (typically there are several idler rollers to support the belt) or use the inertia and mass calculator to define the inertia value. Notice that you must enter the exact diameter of the idler rollers for the correct calculation of system inertia. Use zero value when there are no rotating idler rollers in the conveyor.
Coupling Inertia [kgm ²]	Enter the inertia of the coupling between the gears and the conveyor or use the inertia and mass calculator to define the inertia value. This value should also include all additional coupling inertia that is not included in the driver pulley inertia value, for example, the additional inertia caused by the shaft.

Efficiency [%]	Enter the efficiency percentage of the conveyor mechanics. You can consider power losses with efficiency. The efficiency value defines how much more torque is needed due to the losses.
Incline Angle [deg]	Enter the incline angle between the belt and the horizontal plane. Only a positive value of the incline angle is possible. Positive distance means upward motion and negative distance means downward motion.
Coefficient of friction	Enter the coefficient of friction. It considers all the frictional losses of the conveyor system due to the load and belt. It includes the friction between the guides and the belt, the belt and the rollers as well as the bearing friction of the rollers. It is assumed that frictional losses are independent when the angle is inclined.
Opposing force [N]	Enter the sum of forces acting against the belt movement, for example, thrust load trying to push the load off from the belt.

Table 38 Conveyor mechanics settings

Cylinder

In MCSize the cylinder drive is the universal load type for rotational movement (see Figure 42). For example, a load can consist of several cylinders with different diameters that are attached to a common shaft.

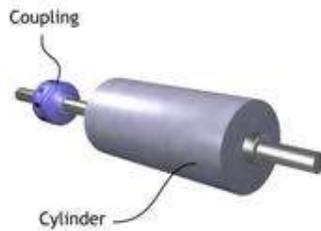


Figure 42 Cylinder drive mechanics

Setting	Explanation
Load inertia [kgm^2]	Enter the total inertia of the cylinder or use the inertia and mass calculator to define the inertia value.
Coupling inertia [kgm^2]	Enter the inertia of the coupling between the gearing and the cylinder drive mechanics or use the inertia and mass calculator to define the inertia value. This value should also include all additional inertia that is not included in the load inertia value, for example, the additional inertia caused by the shaft.
Efficiency [%]	Enter the efficiency percentage (the percentage of the input torque provided to output). The losses of the cylinder drive mechanics are considered in the efficiency.
Conversion diameter [m]	Enter the diameter for thrust force. The thrust load diameter is the doubled distance between the center of the cylinder shaft and the impact point of the opposing force.

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Opposing force [N]	Enter the total sum of opposing forces in this input field. The opposing forces include, for example, the thrust load acting against the movement at a certain radius on the load.
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Table 39 Cylinder mechanics settings

Feedroll

You can see the example of feedroll mechanism in the Figure 43.

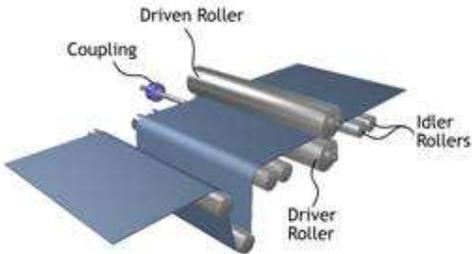


Figure 43 Feedroll mechanics

Setting	Explanation
Load mass [kg]	Enter the total load of the material to be moved.
Number of rolls, Driver roller	Enter the number of driver rolls in the feedroll.
Number of rolls, Pinch	Enter the number of rolls in the pinch.
Inertia, Driver roller	Enter the driver roller inertia or use the inertia and mass calculator to define the inertia value.
Inertia, Pinch	Enter the pinch inertia or use the inertia and mass calculator to define the inertia value. The rotation speed of the pinch feed roll depends on the strip velocity and the diameter of the roller.
Diameter, Driver roller	Enter the exact diameter of the driver roller for correct load inertia and tensional torque calculations.
Diameter, Pinch	Enter the exact diameter of the pinch for correct system inertia calculations.
Coupling inertia [kgm ²]	Enter the inertia of the coupling between the gearing and the feed roll mechanics or use the inertia and mass calculator to define the inertia value. This value should also include all additional coupling inertia that is not included in the driver roller inertia value, for example, the additional inertia caused by the shaft.
Efficiency [%]	Enter losses that should be considered in the torque efficiency. This data defines how much more torque is needed because of the losses.
Strip tension [N]	Enter the tensional force or pull through force that is needed to achieve the desired material tension on the input side of the roller system.
Frictional force [N]	Enter the tensional force that is needed to pinch the strip material in the roller system.

Table 40 Feed roll mechanics settings

Lead screw

A lead screw consists of a screw with a nut moving along it. The rotational motion of the screw turns to the linear motion of the nut. The high torque and low speed of the linear motion can be achieved depending on the value of the screw pitch. The screw position can be horizontal, vertical, inclined or declined. Use counterbalance to eliminate the gravitation component caused by the incline angle, if necessary.

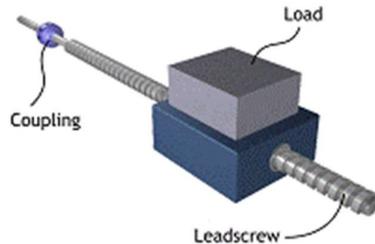


Figure 44 Lead screw mechanics

Setting	Explanation
Load mass [kg]	Enter the total load mass to be transported.
Table mass [kg]	Enter the mass of the table. It influences the value of total inertia and on the frictional forces. All the linearly moving parts (for example, the nut) are considered here.
Counter balance mass [kg]	If counterbalance is used, enter its mass. Note that the acceleration of free fall, or 9.82 m/s ² , is the natural maximum limit for acceleration when counterbalance is used. If no counterbalance is used, enter zero value to this input field.
Lead screw Inertia [kgm ²]	Enter the screw inertia or use the inertia and mass calculator to define the inertia.
Coupling inertia [kgm ²]	Enter the inertia of the coupling between the gearings and the conveyor or use the inertia and mass calculator to define the inertia value. This value should also include all additional coupling inertia that is not included in the screw inertia value, for example, the additional inertia caused by shafts.
Efficiency [%]	Enter the efficiency percentage of lead screw mechanics. The losses of lead screw mechanics, for example, the loss of power due to friction in the bearings, is considered with efficiency. The value indicates how much more torque is needed due to the losses.
Incline angle [deg]	Enter the incline angle between the screw and the horizontal plane. Only a positive value of the incline angle is possible. Positive distance means upward motion and negative distance means downward motion.
Coefficient of friction	Enter the coefficient of friction. It considers the frictional losses between the table and the support or the guide bar. These losses are caused by the total weight of the load and the table. This opposing component is dependent on the cosine of incline angle.
Opposing force [N]	Enter the sum of all opposing forces that affect the movement of the table, for example, the thrust load

	or the preload force. Preload is the opposing force that must be overcome before the load starts to move.
Lead screw pitch [mm]	Enter the linear distance the nut advances for one complete turn of the screw.

Table 41 Lead screw mechanics settings

Rack & pinion

The rack & pinion mechanics consist of pinion and rack gears that transfer the rotational motion of the pinion to the linear movement of the rack (see Figure 45). The rack position can be horizontal, vertical, inclined or declined.

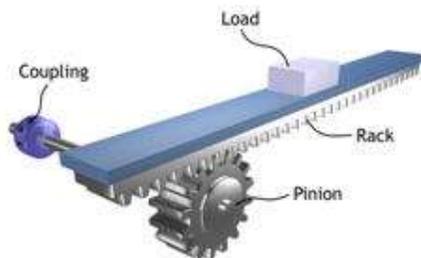


Figure 45 Rack and pinion mechanics

Setting	Explanation
Load mass [kg]	Enter the total load mass to be transferred.
Rack mass [kg]	Enter the mass of the rack including the mass of all parts that move linearly.
Pinion diameter [m]	Enter the exact pitch circle diameter of the pinion for the correct calculation of load inertia, rack inertia, etc.
Pinion inertia [kgm ²]	Enter the inertia of the pinion or use the inertia and mass calculator to define the inertia value.
Coupling Inertia [kgm ²]	Enter the inertia of coupling between gearings and pinion or use the inertia and mass calculator to define the inertia value. This value should also include all additional coupling inertia that is not included in the pinion inertia value, for example, the additional inertia caused by shafts.
Efficiency [%]	Enter the losses of rack & pinion mechanics. For example, the frictional loss of bearings is considered in the efficiency coefficient. The efficient defines how much more torque is needed due to the losses.
Incline angle [deg]	Enter the incline angle. It is the angle between the rack and the horizontal plane. Only a positive value of the incline angle is possible. Positive distance means upward motion and negative distance means downward motion.
Coefficient of friction	Enter the coefficient of friction. It considers the frictional losses between the rack and the support. These losses are caused by the total weight of the load and the rack. This opposing component depends also on the cosine of the incline angle.
Opposing force [N]	Enter the thrust load, that is, the sum of forces that effects against the movement of the rack.

Table 42 Rack and pinion mechanics settings

Rotating table

A horizontally rotating table is controlled through a shaft and a coupling (see Figure 46). The table moves and positions bulk loads.

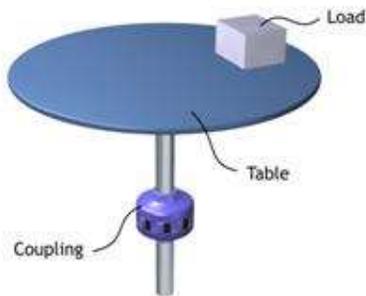


Figure 46 Rotating table mechanics

Setting	Explanation
Load mass [kg]	Enter the total load mass to be moved.
Load - center distance [m]	Enter the distance between the center of the table and the center of the weight. The radius can be defined as the average of the inside radius and outside radius. The inertia of the load depends on its position in relation to the center of the table.
Table inertia [kgm^2]	Enter the inertia of the table and the shaft or use the inertia and mass calculator to define the table and shaft inertia value.
Coupling inertia [kgm^2]	Enter the inertia of the coupling between the gears and the rotary table or use the inertia and mass calculator to define the inertia value. This value should also include all additional coupling inertia that is not included in the table inertia value, for example, the additional inertia caused by shafts.
Efficiency [%]	Enter the efficiency percentage of input power provided to output. The efficiency value considers the losses of the rotating table mechanics.
Opposing force distance [m]	Enter the opposing force distance. It is equivalent to the distance from the center of the table to the impact point of opposing frictional force.
Opposing force [N]	Enter the opposing force. The opposing force can be any additional frictional force that acts on a certain area from the center of the table.

Table 43 Rotating table mechanics settings

User defined

User defined is the universal load type for linear movement in this software. The inertia of linear load is converted to rotational movement with the conversion diameter defined by the user. See the general structure of user defined mechanics in Figure 47.

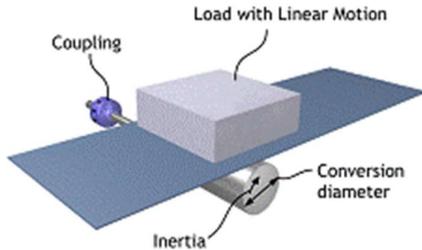


Figure 47 User defined mechanics

Setting	Explanation
Load mass [kg]	Enter the total load mass to be conveyed.
Conversion diameter [m]	Enter the conversion diameter. The diameter defines the distance the load travels for the full revolution of the input shaft. The distance is equal to π multiplied by the conversion diameter.
Coupling inertia [kgm ²]	Enter the inertia of coupling between the gearing and the user defined mechanics or use the inertia and mass calculator to define the inertia value. You can add any load side rotating inertia to this input field.
Efficiency [%]	Enter the losses of user defined mechanics. For example, frictional losses are considered in the efficiency. The system's efficiency is defined as the percentage of the input torque provided to output.
Coefficient of friction	Enter the coefficient of friction. It considers the frictional losses caused by the weight of load.
Opposing force [N]	Enter the sum of any opposing forces that affect the movement of linear load, for example, thrust load.

Table 44 User defined mechanics settings

Winder

A centerwind type of mechanics winds material around a core or a reeling drum (see Figure 48). In this type of winder, the center of coil is driven by motor. In the figure the positive direction of angular speed and tension are shown. The MCSize assumes that winding starts from minimum diameter to maximum without stops. Due to this the Multiform cyclic Duty type is not valid.

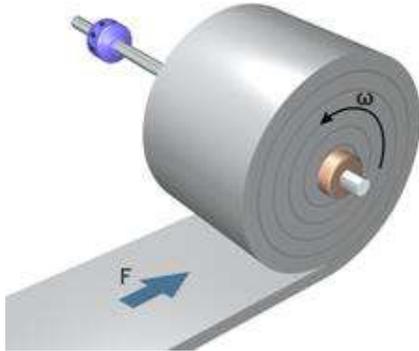


Figure 48 Winder mechanics.

Setting	Explanation
Max diameter [m]	Diameter of the complete coil.
Min diameter [m]	This is the initial value of diameter when rewinding starts. In many cases this is the diameter of core or reeling drum.
Coupling inertia [kgm ²]	Enter the inertia of coupling between the gearing and the winder mechanics or use the inertia and mass calculator to define the inertia value. You can add any load side rotating inertia to this input field.
Core inertia [kgm ²]	Enter the total inertia of core and shaft or use the inertia and mass calculator to define the inertia value. This is the initial value of inertia.
Efficiency [%]	Enter the efficiency percentage of input torque provided to output. The efficiency value considers the losses of the winder mechanics like bearings.
Width [m]	Enter the width of material.
Density [kg/m ³]	Enter material density information. It affects the value of inertia.
Tension [N]	Enter the tensional force that is needed to achieve the desired material tension.
Opposing force [N]	Enter the sum of any opposing forces that affect the movement of reeled material. This force is acting against movement at the surface of the coil.

Table 45 Winder mechanics settings

Unwinder

A centerwind type of mechanics is unwinding material from reel. In this type of winder, the center of coil is driven by motor. When the positive directions are according to the figure the normal running power is negative and will be shown in second quadrant in torque speed diagram. The MSize assumes that winding starts from maximum diameter to minimum without stops. Due to this the Multiform cyclic Duty type is not valid.



Figure 49 Unwinder mechanics.

Setting	Explanation
Max diameter [m]	Diameter of the full coil. This is the initial value of diameter when unwinding.
Min diameter [m]	This is the final value of diameter when unwinding ends. In many cases this is the diameter of core or reeling drum.
Coupling inertia [kgm ²]	Enter the inertia of coupling between the gearing and the winder mechanics or use the inertia and mass calculator to define the inertia value. You can add any load side rotating inertia to this input field.
Core inertia [kgm ²]	Enter the total inertia of core and shaft or use the inertia and mass calculator to define the inertia value.
Efficiency [%]	Enter the efficiency percentage of input torque provided to output. The efficiency value considers the losses of the unwinder mechanics like bearings.
Width [m]	Enter the width of material.
Density [kg/m ³]	Enter material density information. It affects the value of coil inertia.
Tension [N]	Enter the tensional force that is needed to achieve the desired material tension.
Opposing force [N]	Enter the sum of any opposing forces that affect the movement of reeled material. This force is acting against movement at the surface of the coil.

Table 46 Unwinder mechanics settings

Inertia and mass calculator

When entering inertia data, for example, in the **Motor load**, **Gearing** or **Mechanics** displays, you can use the Inertia and mass calculator v1.1© program developed by ControlEng Corporation for the calculation of inertia (see Figure 50).

Click the calculator button () next to the **Inertia [kgm²]** value fields to open the inertia and mass calculator.

To calculate the inertia and mass with the inertia and mass calculator:

1. Select the element shape and, in most cases, enter the dimensions of the mechanical component.
2. Enter the material and density. The mass and the inertia are calculated automatically and displayed in the **Mass** and **Inertia** fields.
3. Add the calculated mass and inertia to the **Calculation Table** field for the calculation of total mass and inertia by clicking the  (positive) or  (negative) button at the bottom of the **Inputs** field. To replace an active row from the **Calculation table** with the information in the **Inputs** field, click the  button.
4. Feed another mass and inertia information and add it to the totals, if necessary.

To remove a row from the **Calculation Table**, activate it and click the  button. To display and modify information in a row in the **Calculation Table** in the **Inputs** field, activate the row and click the  button.

Note that the unit of inertia must be **kg-m²**.

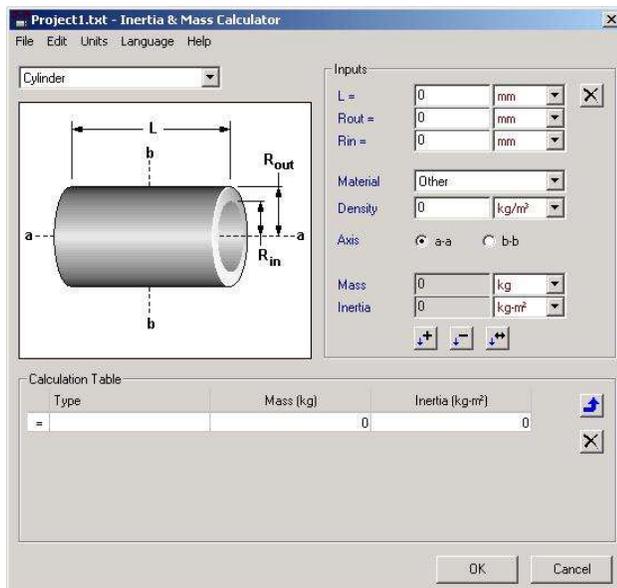


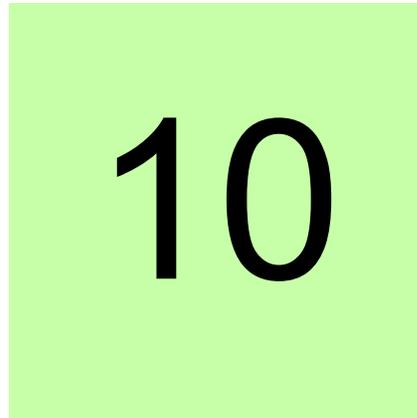
Figure 50 Inertia and mass calculator

Sizing examples

The software includes example project files that include pre-filled input data. With these files you can learn quickly how the software works and how to enter data.

To open a sizing example file:

Select **File > Examples** and pick the desired file from the list.



Motion control results

Motion and mechanics results

To open the **Motion results** display (see Figure 51), click the **Motion** icon in the System configuration tree.

Motion results, mechanical results and combined results are calculated immediately when new data is entered to the Motion and Mechanics input fields.

Motion results

The calculation of motion results is based on the Motion profile input data.

The results are also shown in graphical form. The motion profile graph in the **Motion results** display includes two **Graph type** display options, **Speed vs. time** and **Displacement vs. time**.

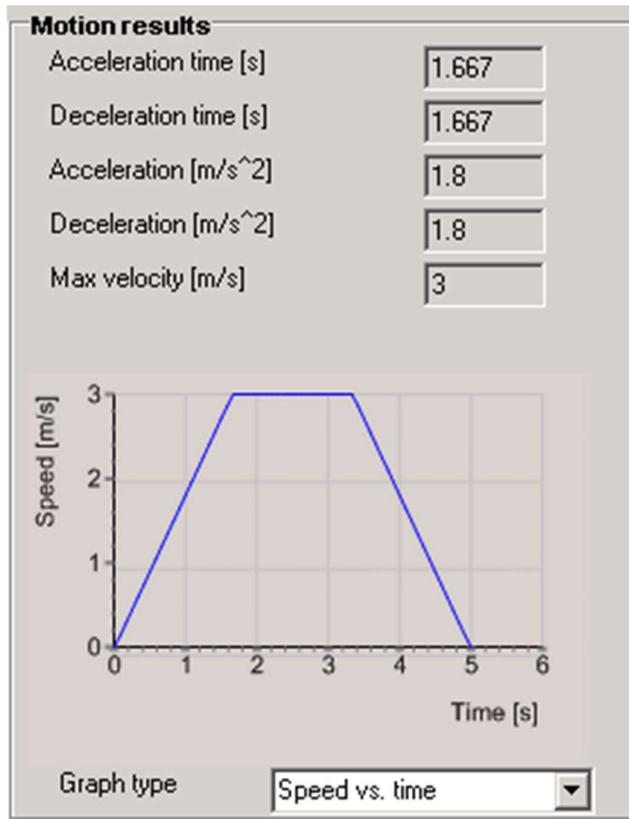


Figure 51 Motion results

You can see the result fields of the Motion results display in Table 47. These values produce the profile that is entered to the input fields of the motion display.

Result	Explanation
Acceleration time [s]	Calculated acceleration time. This field is editable when the Profile type is User Defined.
Deceleration time [s]	Calculated deceleration time. This field is editable when the Profile type is User Defined.
Acceleration [m/s ²], [deg/s ²] or [1/s ²]	Calculated equivalent value of acceleration. Units are selected automatically depending on whether linear or rotational movement is used.
Deceleration [m/s ²], [deg/s ²] or [1/s ²]	Calculated equivalent value of deceleration. Units are selected automatically depending on whether linear or rotational movement is used.
Max velocity [m/s], [deg/s] or [rpm]	Calculated maximum velocity
Velocity at max dyn power [m/s], [rpm] or [deg/s]	When S-curves are applied the movement speed where the maximum power is required is not at maximum speed but lower. Applying s-curves might allow smaller motors than without because the high torque at max speed is avoided.

Table 47 Motion results

Mechanical results

The values displayed in the **Mechanical results** field (see Figure 52) are only intermediate results and they are true at the input shaft of mechanics. Gearings are not considered here.



Figure 52 Mechanical results

Result	Explanation
Oposing torque [Nm]	Intermediate opposing torque for mechanics only. Motor and gearings are not considered.
Equivalent inertia [Kgm ²]	Intermediate inertia at input shaft for mechanics only. Motor and gearings are not considered.

Table 48 Mechanical results

Combined results

The combined results for motor selections are displayed in the **Combined results** field (see Figure 53). These results are true at the input shaft of mechanical application. Gearings are not considered.

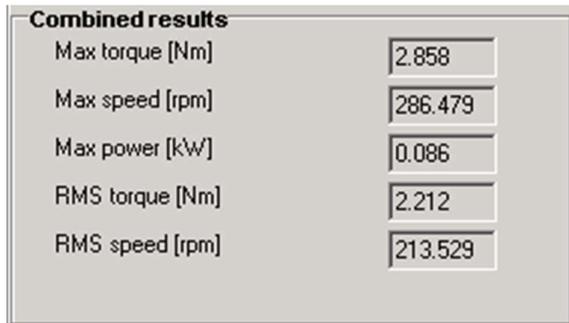


Figure 53 Combined results at the driver shaft

Item	Explanation
Max torque [Nm]	Calculated maximum torque for given profile and mechanics
Max speed [rpm]	Calculated maximum speed for given profile and mechanics
Max power [kW]	Calculated maximum torque for given profile and mechanics
RMS torque [Nm]	Calculated root mean squared torque for given profile and mechanics
RMS speed [rpm]	Calculated root mean squared speed for given profile and mechanics. This is the speed that corresponds with the calculated RMS torque.
Speed at max dyn. power [rpm]	Rotational speed where maximum torque load exists. This appears when s-curves are used. Applying s-curves might allow smaller motors than without because the high torque at max speed is avoided.

Table 49 Combined results display items

Gearing results

To view gearing results, click on the **Gearing** icon in the System configuration tree. You can see the results of gearings in the **Gearing** display, on the right side of the gearing settings (see Figure 54).

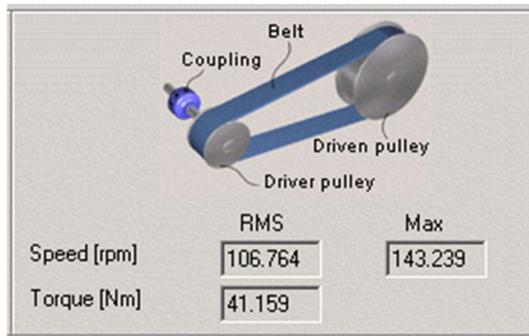


Figure 54 Gearing results

RMS torque and speed are root mean squared results at the input side of gearing. The order of gearings is read from the motor output to the mechanics input, that is, the 1st gearing is connected to the motor shaft, the 2nd shaft is coupled to the output shaft of the 1st gearing, and so on.

At the bottom of the **Gearing** display you can see the total values of all gearings in the **Gears totally** field.

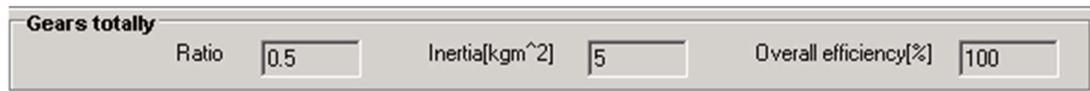


Figure 55 Total values of all gearings

Result	Explanation
Total gear ratio	Combined gear ratio for all gears
Inertia due to gears [kgm ²]	Combined inertia of all gears at motor shaft
Overall efficiency [%]	Combined efficiency for all gears

Table 50 Gears totally result items

Results menu

To show dimensioning results first select the drive component or the supply unit from the tree and then click the  icon or select **Result > Dimensioning result**.

Graphs

To show Graphs, click the  icon or select Result > Graphs. This opens the **Graph** window that displays graphs for the following graph options:

- Load/Motor graph
- Inverter
- Performance and profile graph

For inverters the following options are available:

- Current
- DC power

To show supply unit DC power graph, select supply from system configuration tree and click the **graph** icon.

Multi-graph view

To show several graphs at a time, select the components from the system configuration tree. To highlight several components, use the **Ctrl** key, mouse and left mouse button. Press and hold down the **Ctrl** key when selecting components. Select first the object that you want to see uppermost. Two of the graphs are shown at once and you can change the lower one by scrolling the graphs. You can show the multi-graph view for all graph options.

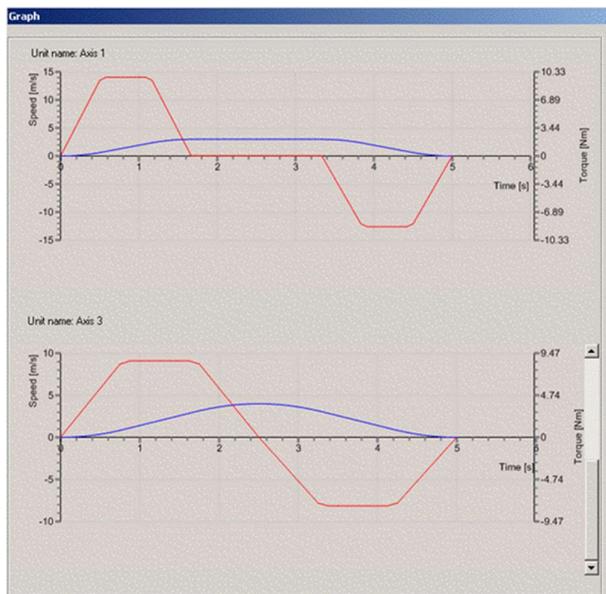


Figure 56 Performance and profile multi-graph view

Reports

To show Reports, select Result > Reports or click the Report button in the result or graph display.

Motor results

The motor **Selection data** is shown in the **Motor data** field of the **Motor Results** display. Calculated margins are between the following values:

- Required RMS torque to the nominal torque of motor
- Required peak torque to the maximum short-term torque of motor

In the motor data display you can see also Inertia ratio, Max air gap torque, RMS torque, Motor copper losses, Specifications and Catalogue data for the selected motor.

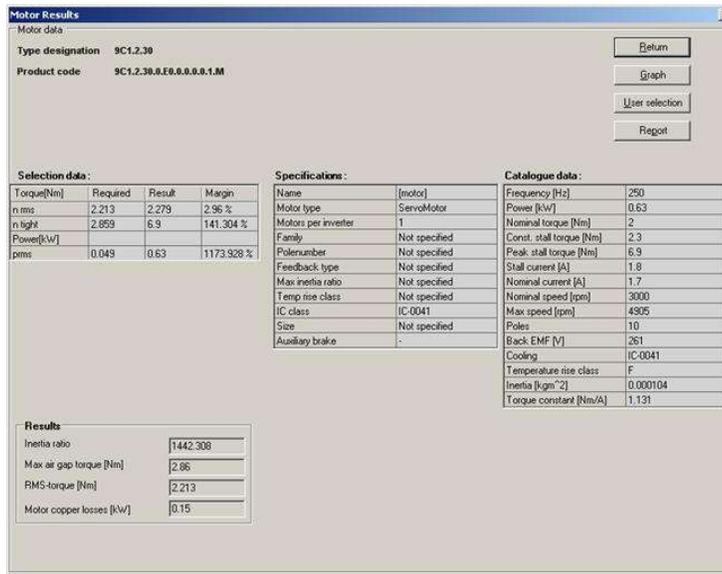


Figure 57 Motor selection data

Motor Graph

You can see the motor results also in graphical form (see Figure 58 and Figure 59). Calculated RMS torque at RMS speed, dynamic torques, and limits are illustrated in a motor graph. The green torque (speed curve) defines the thermal long-term limits of the motor. The red curve defines limits for short term intermittent loads and maximum allowed speeds for these loads. These required results are calculated based on the motor air gap torque. The effect of motor inertia is also taken into consideration.

The selection criteria for a motor are:

- Calculated RMS torque must be inside the range of the **Cont loadability** limit.
- Dynamic peak torque curve must be inside the range of the **Max. loadability** limit.

98 Motion control results



Figure 58 Motor Graph display for ServoMotor

Please notice in this case the dynamic torque curves. They are shown as black arcs and in this close to optimal case they are very close to max torque of motor.

The Motor Graph may have up to four quadrants if the application is braking and running in reverse direction at the same time. The required torque curves are not shown in full length to keep the graph uncluttered. If s-curves are applied the parts of torque curve representing maximum mechanical power are displayed.

Notice that drive's switching frequency has an effect to torque curves.



Figure 59 Motor Graph display for Induction Motor

Drive results

In the **Drive Results** display you can see the results and specification data for **Selection data**, **Specifications**, **Catalogue data** and **Drive losses at RMS speed**.

The selection criteria for a drive are:

- Peak current trajectory must be lower than the max current limit.
- Calculated RMS current must be lower than the nominal current.
- Inverter maximum output power must not be exceeded
- Additionally, the dynamic thermal limit is checked

The screenshot shows a software window titled "Drive Results" with a sub-header "Drive data". The drive designation is "ACSM1-04As-05A6-CHK-02". There are four buttons: "Return", "Graph", "User selection", and "Report".

Selection data:

Criteria	Required	Result	Margin
I _{lim} [A]	3.903	5	26 %
I _{max} [A]	9.161	10.5	15 %
P _{max} [kW]	2.523	4.62	83 %
dyn current limit			9 %

Specifications:

Name	[drive]
Inverter amount	1
Type	Air cooled
AC choke	Yes
IP class	Not specified
Switching frequency	8 kHz
Braking chopper	Ignored
Braking resistor	Not considered

Catalogue data:

Voltage [V]	400
Nominal power [kW]	2.2
Nominal current [A]	5
Continuous current [A]	5
I _{max} [A]	10.5
Included AC choke [μH]	4610
Nominal AC choke [μH]	4610
IP class	IP20
Nominal freq [kHz]	4

Drive losses at RMS speed [kW] 0.14

Figure 60 Drive results display

Drive Graph

You can see the drive results also in graphical form (see Figure 61). Current/speed curves define the limits for continuous (green) and intermittent currents (red). The latter current limit depends on drive heatsink temperature, output frequency and switching frequency. Calculated RMS current, actual current trajectory and limits are shown in the drive graph.

Also, this graph can have two quadrants.

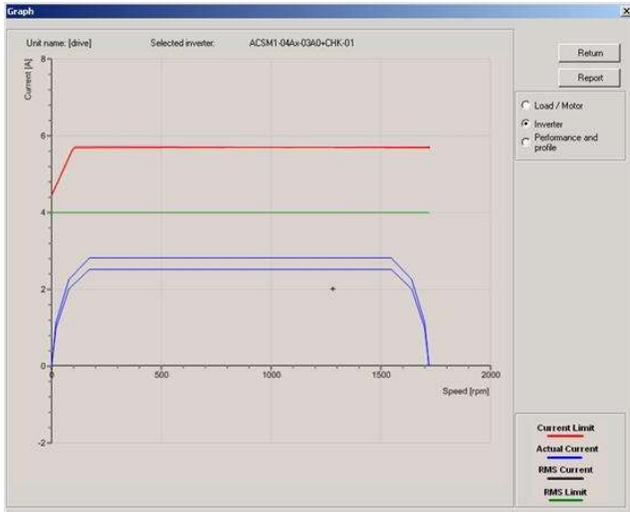


Figure 61 Drive Graph display

Please notice that in this example due to s-curves the acceleration starts smoothly, runs most of the time at 2.4A and will ease up at 1520 rpm. The deceleration will happen with lower current but with the same idea.

Supply unit results

In the **Supply unit data** display you can see the results and specification data for **Selection data** (Figure 62), **Specifications**, **Catalogue data** and **Supply unit losses**.

The selection criteria for a supply unit are:

- Calculated RMS current must be lower than the nominal current.
- Peak current must be lower than temperature dependant max current limit.
- Additionally, the dynamic thermal current and temperature limits are checked.

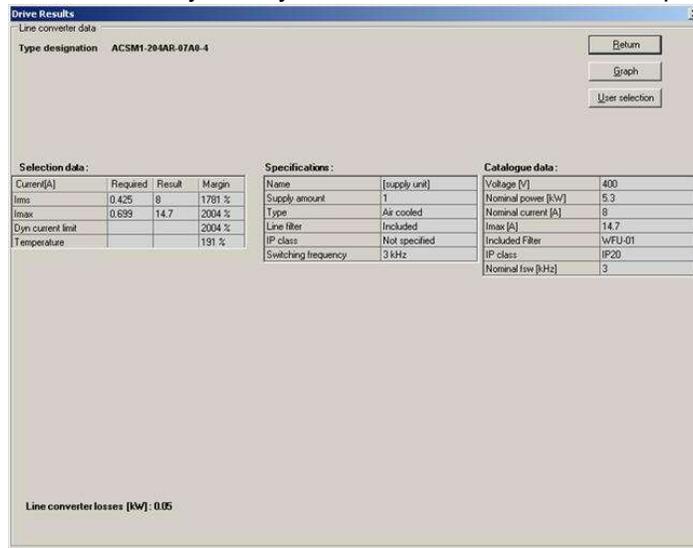


Figure 62 Selection data of supply unit

Supply unit Graph

You can see the supply unit results in graphical form. There the DC-power of supply unit is shown in function of time. The graph illustrates the total DC-power of all inverters connected to that supply unit.

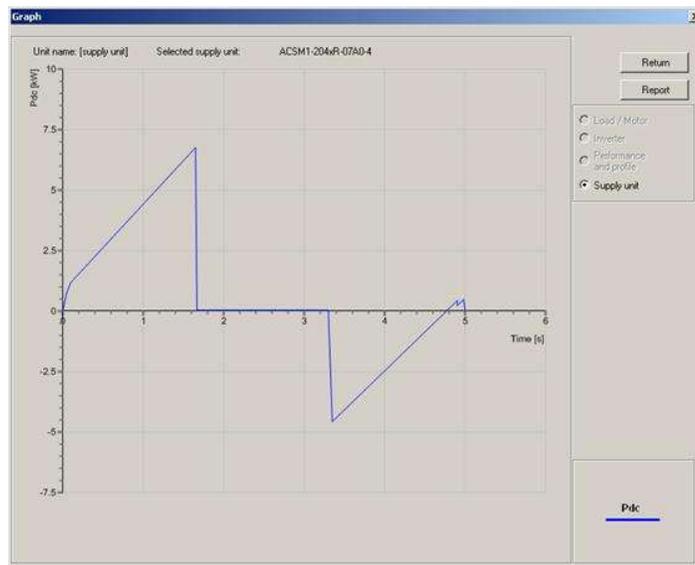


Figure 63 Supply unit graph display

Manual selection

Manual selection functionality is a part of the sizing process and the screen with plenty of computed choices is also a part of the results.

In the **Manual selection** display you can select a smaller or larger unit instead of your current selection (made by the software or by your previous other choice selection). The selected unit has number 0 and its row is highlighted. Smaller units have a negative mark. Larger units have a positive mark. In this table there are some catalogue values and calculated margins to help with the new selection process. In some cases in which the overloads are decisive there are no smaller units in the list.

#	Type designation	Power kW	Icont [A]	Margin	Imax [A] (peak)	Margin	Temperature margin
-1	ACSM1-04Ax-02A5+CH	0.75	2.5	24 %	5.3	88 %	-10 %
0	ACSM1-04Ax-03A0+CH	1.1	3	49 %	6.3	123 %	102 %
1	ACSM1-04Ax-04A0+CH	1.5	4	99 %	8.4	198 %	198 %
2	ACSM1-04Ax-05A0+CH	2.2	5	148 %	10.5	272 %	272 %
3	ACSM1-04Ax-07A0+CH	3	7	247 %	14.7	421 %	421 %
4	ACSM1-04Ax-09A5+CH	4	9.5	372 %	16.6	489 %	489 %
5	ACSM1-04Ax-012A+CH	5.5	12	496 %	21	645 %	645 %
6	ACSM1-04Ax-016A+CH	7.5	16	694 %	28	893 %	893 %
7	ACSM1-04Ax-024A+CH	11	24	1091 %	42	1389 %	1389 %
8	ACSM1-04Ax-031A+CH	15	31	1439 %	54	1815 %	1815 %
9	ACSM1-04Ax-040A+CH	18.5	40	1895 %	70	2382 %	2382 %
10	ACSM1-04Ax-046A+CH	22	46	2183 %	81	2772 %	2772 %

Figure 64 Manual selection display

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