ABB Drives/Tools team

DriveSize Presentation

DriveSize is used

to select optimal drive system components

- Line supply unit
- Inverter
- Motor
- Transformer

to calculate

- system harmonics
- efficiencies and power losses
- inverter load currents
- the loads of supply unit

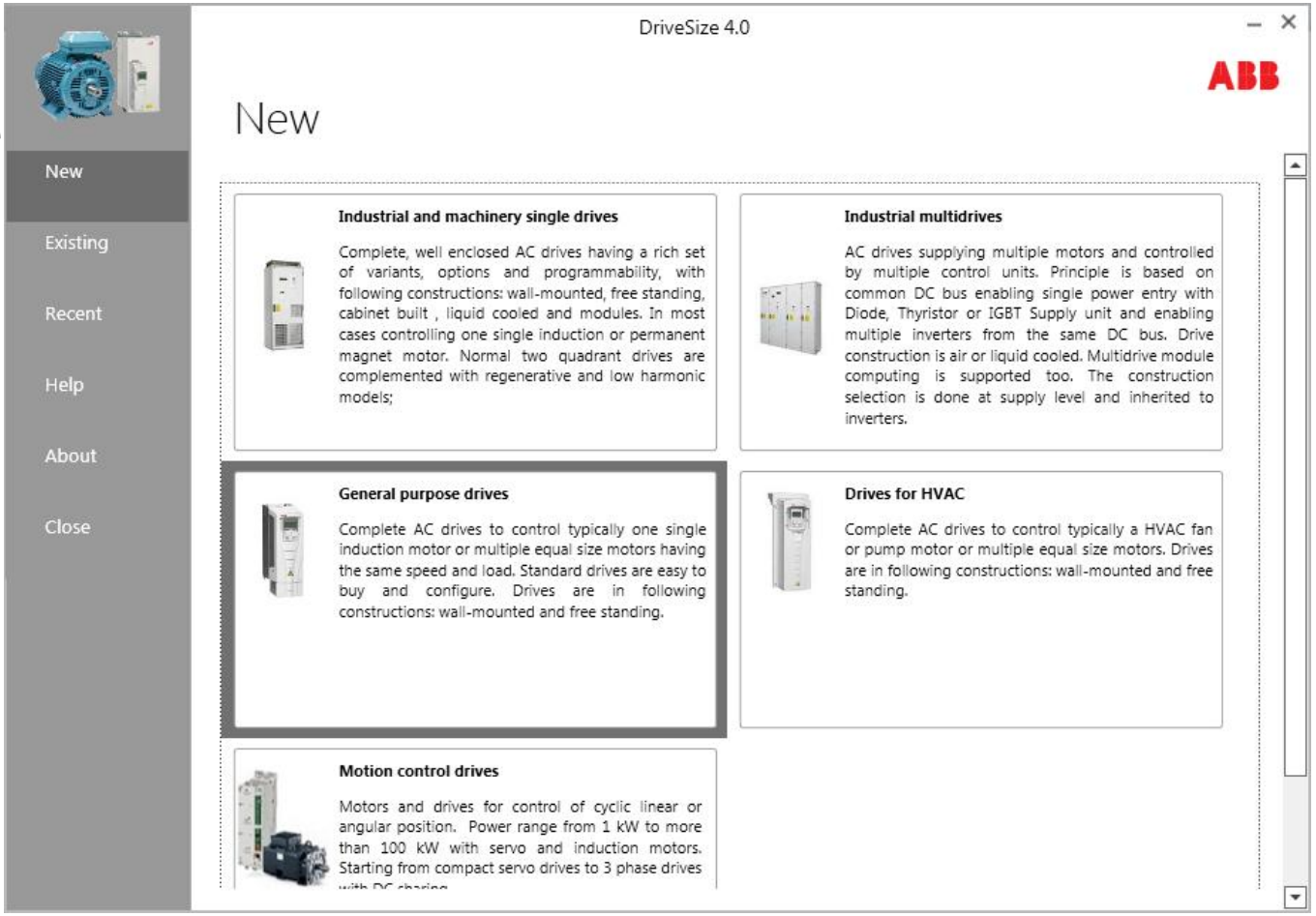
to have results

- in graphical and numerical format
- print and save the results to be used as part of drives offer

available for engineers of end customers too

DriveSize comes with two versions

1. Stand alone

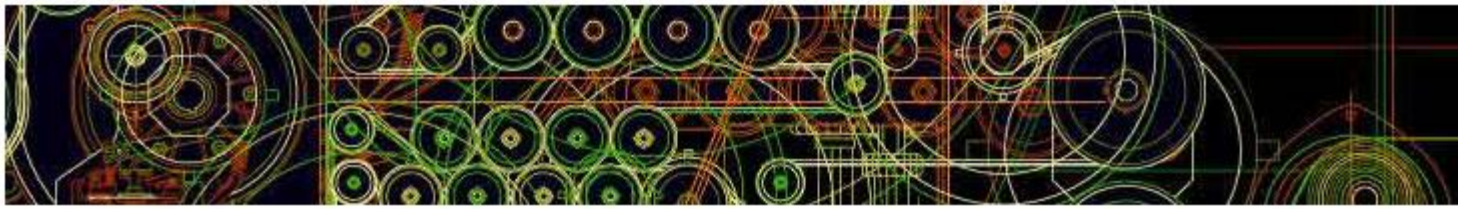


2. Web version with somewhat limited scope:

- - ABB Sophie motors and MCSize out of scope

Web DriveSize with slightly different user interface

Power and productivity for a better world™



Industrial and machinery Single Drives

Complete, well enclosed AC drives having a rich set of variants, options and programmability, with following constructions: wall-mounted, free standing, cabinet built , liquid cooled and modules. In most cases controlling one single induction or permanent magnet motor. Normal two quadrant drives are complemented with regenerative and low harmonic models.

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.

General purpose Drives

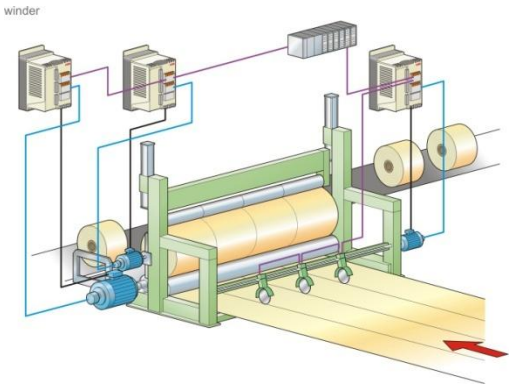
Complete AC drives to control typically one single induction motor or multiple equal size motors having the same speed and load. Standard drives are easy to buy and configure. Drives are in following constructions: wall-mounted and free standing.

HVAC Drives

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.

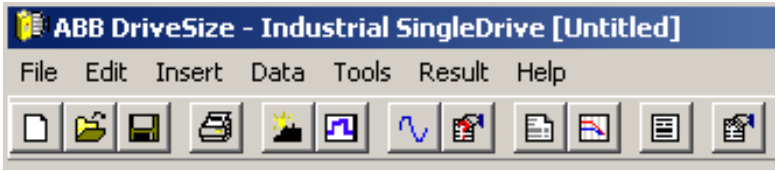
Software components within DriveSize

- **DriveSize** is common starter
- **VsdSize = Variable Speed Drives**
  - Dimensioning and calculation tool for General and Industrial drives
  - Typical inputs are the speed range, load type, base load and overloads for motors more than 22 kW
  - Integrated ABB Sophiè component for customer specific motor dimensioning up to 3.5 MW, computes big induction motors for VSD purposes
- **MCSize (optional)**
  - Sizing tool of motion control drives, ACSM1 product series
  - Several ready-made mechanical applications
- **Earlier also DCSize and MotSize components but not now due technical reasons**



Overview and idea of DriveSize

- Quickly selects drive items with user inputs and default settings
- DriveSize does not contain cost nor price information and cost optimizing is done manually
- Saving and opening an XML based project files.
- Manual selection possible too



User selection

#	Type designation	PU	Power [kW]	Poles	Speed [rpm]	In [A]	Tn [Nr
-5	M3BP 315 SMC 6	FI	110	6	991	202	1
-4	M3BP 315 MLA 8	FI	110	8	740	203	1
-3	M3BP 355 SMA 10	FI	110	10	595	220	1
-2	M3BP 355 SMB 12	FI	110	12	495	238	2
-1	M3BP 315 SMB 2	FI	132	2	2982	228	
0	M3BP 315 SMB 4	FI	132	4	1487	232	
1	M3BP 315 MLA 6	FI	132	6	991	240	1

DriveSize functions -1

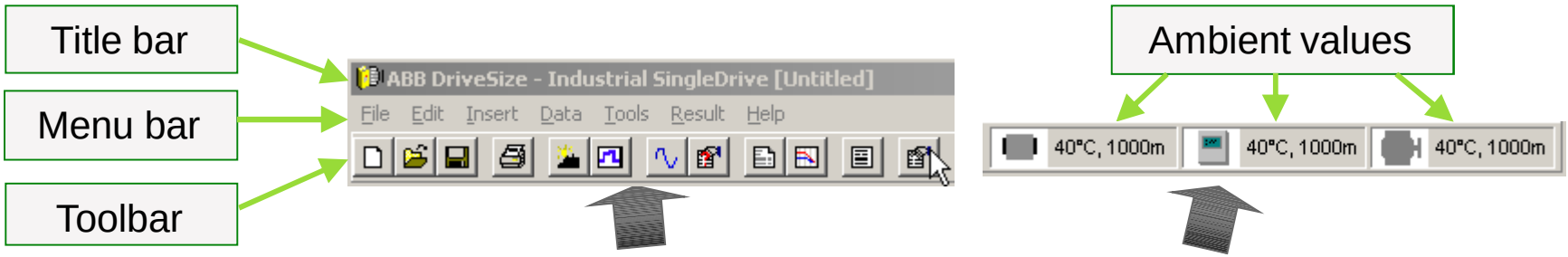
- Motor load types
  - Constant power
  - Constant torque
  - Constant torque & power
  - Quadratic torque
- Overload types
  - One time at start
  - Simple cyclic
  - Multiform cyclic
- Ambient conditions
  - Ambient temperature
  - Altitude

- Motor specifications
- Inverter specifications
- Supply unit specifications
- Selecting manually a component from the user selection list
- Thermal loss and energy efficiency calculations

DriveSize functions -2

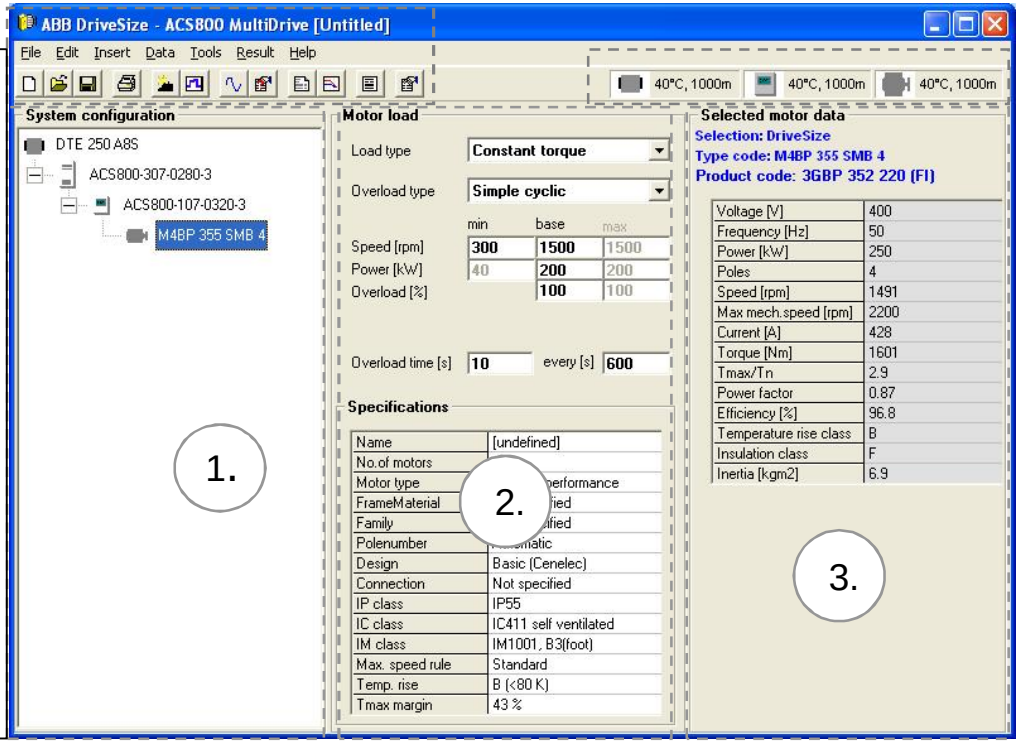
- Drag and drop function
  - You can move an inverter of line supply unit to another location in the system configuration tree.
  - Possibility to highlight several components at one time
- Results in graphical form
- Numerical results
- Generating reports in Excel format for saving or printing
- Total mass flow and dissipated losses for liquid cooled multidrives
- Saving and opening an XML based project files
  - Saved information can be used with other software
- Network harmonics calculation
  - Harmonics for any frequency converter or supply unit
  - Combined harmonics
- Context sensitive HTML help

User interface: Main window



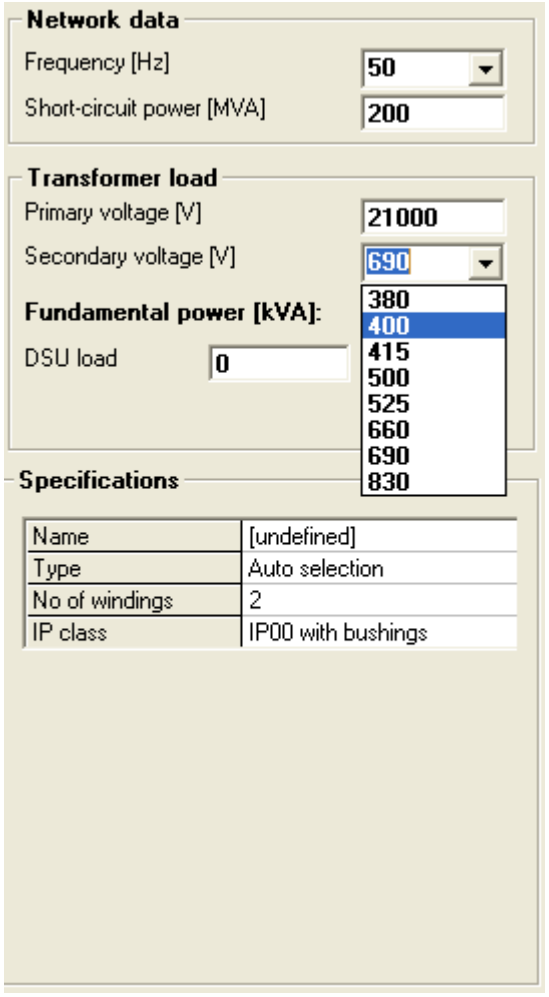
The parts

1. System configuration
   - Drive items in tree structure
   - The input data and results displays will change depending the item you selected
2. Input and specifications
3. Selected data and results
   - Includes the catalogue data of the selected item
   - Indicates whether DriveSize or User selected



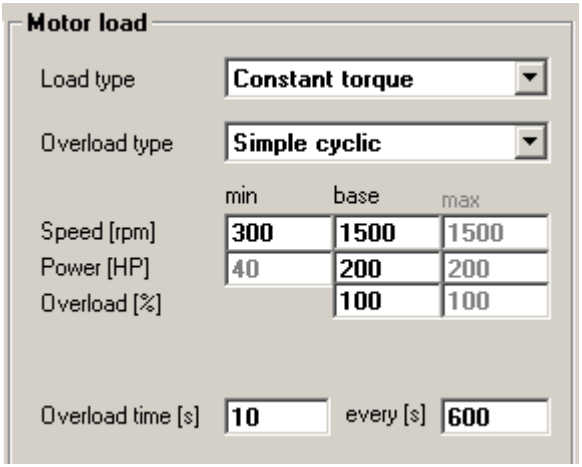
Enter network frequency and voltages

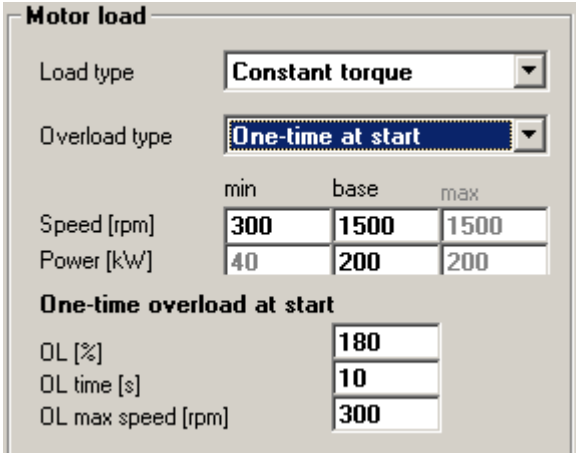
- Network frequency will select also std motor rated frequency and available secondary voltage list
- Select the secondary voltage = system voltage
- Anyway these two values can be changed later without loosing the motor load data
- The short circuit power and primary voltage are important for transformer and network check



Motor load, definitions of terms

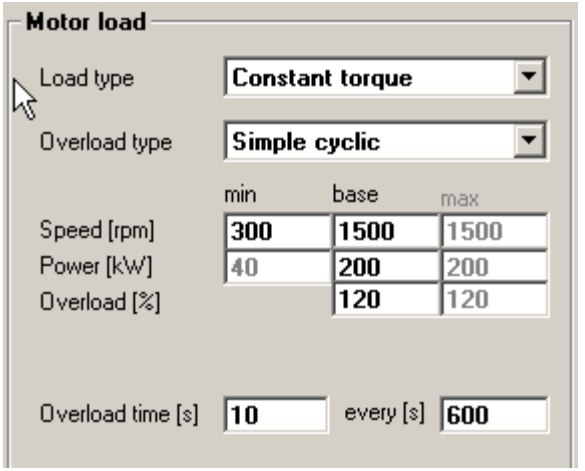
- **Base power**
  - Mechanical power of motor shaft
  - Negative value is possible and it means electric braking
- **Base speed**
  - Mechanical speed of motor where the base power is required
  - It is also the maximum speed of constant torque
  - Use exact value
- **Overload**
  - Use required load %s
  - Negative value is possible too
- **Min speed**
  - Speed which is used without interruptions for a long time like 30 minutes
- **Max speed**
  - Maximum speed that has to reached

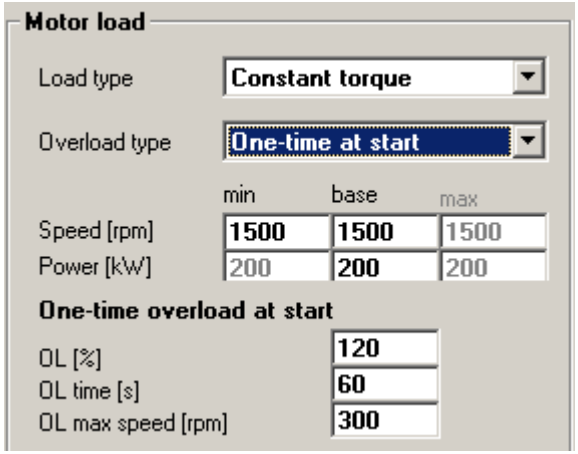




Overload types

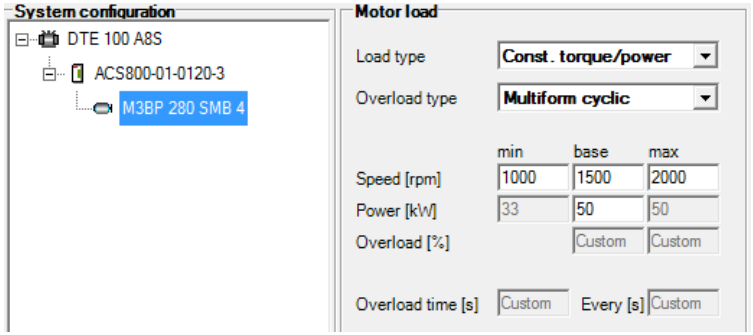
- **Simple cyclic**
- The dynamic torques are included as short term overloads
- Consists of a base load and overload(s) levels within cycle
  - The sign of overload can be also negative and it means opposite sign of overload compared with base load
- Adjust **Overload time** to reflect the reality
  - default settings 10 s every 10 min
- Identical speed range for base load and overload
  - Under base speed the OL is torque and over base speed it is power
- **One-time at start**
- Allows to specify one overload at start
- Drive unit is allowed to cool down before re-starting
- Give speed range of overload from zero to *OL max speed*
- OL in percentage of *base Power and Torque*
- Duration of starting *OL time [s]* from zero to *OL max speed*

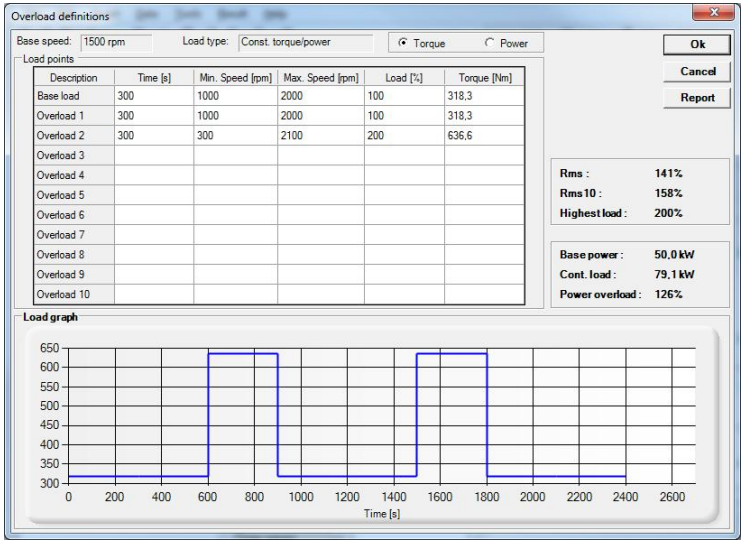




Multiform cyclic overload

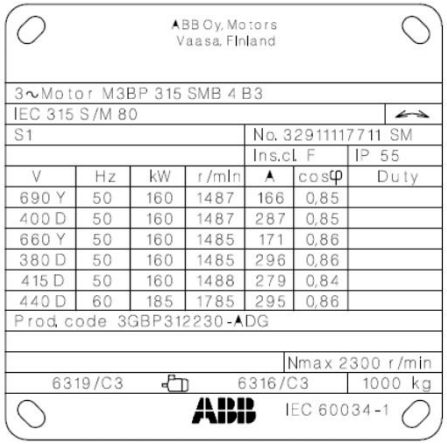
- Overload definitions option under the Data menu
  - **Overload definition** view is shown when motor is highlighted
  - **Overload currents** view is visible when inverter is highlighted
- More sophisticated load definitions
  - Base load with 1…10 overloads
- Define the duty load by intervals
  - Enter the duty cycle in the Load points table
  - in percentage on top of base power
  - min and max speeds
  - with power or torque values
- Load graph shows the defined duty cycle





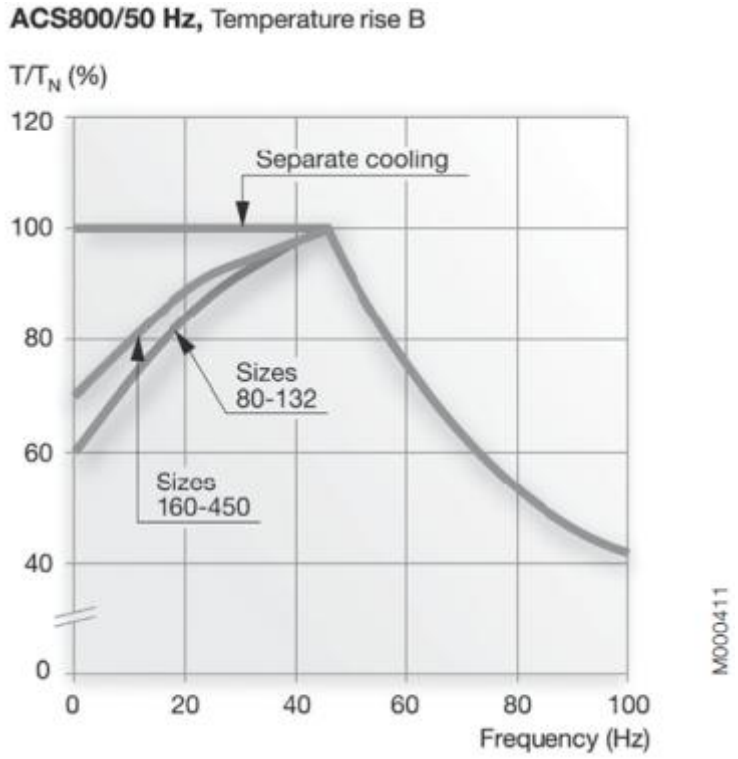
Catalog and standard motors

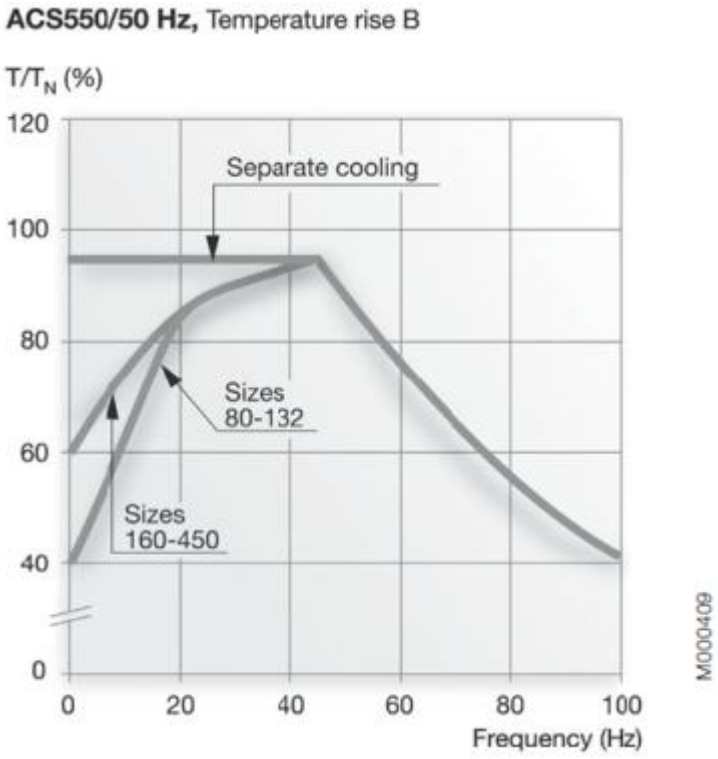
- 3-phase 1-speed motors from database
  - Process and general performance motors
  - Cast iron and Al-motors
  - Motor voltages from database – no re-stamping in VsdSize
  - Max speeds limits: standard, metal fan, separate cooling
- Hazardous area motors (Ex)
  - Dust ignition protection, Flameproof and Non-sparking
  - Temperature rise option B(<80K) available only
  - With direct torque controlled drive (DTC) only
  - Limited overloading with fixed duty
- Marine motors
  - Modification to standard product
  - Temperature rises <90K



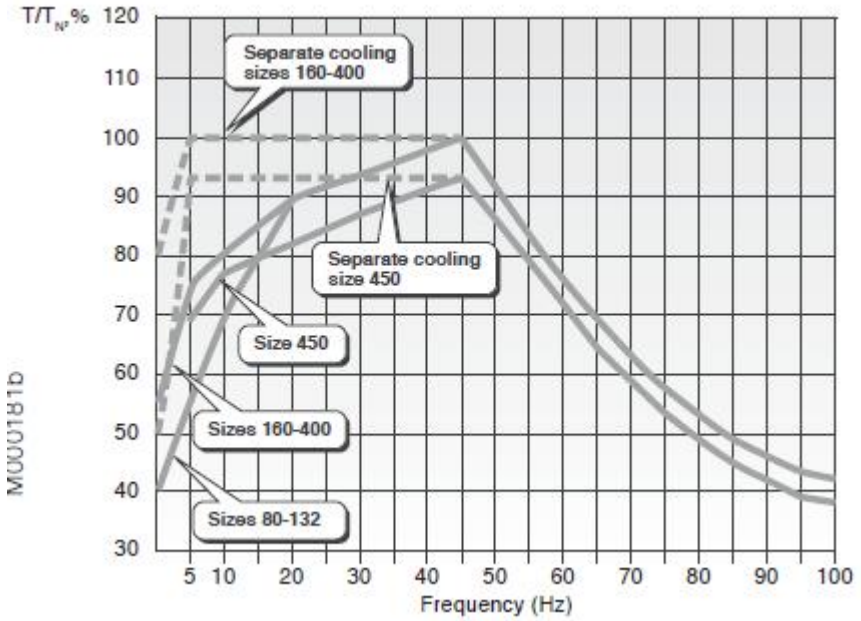
The ability of motor to handle load

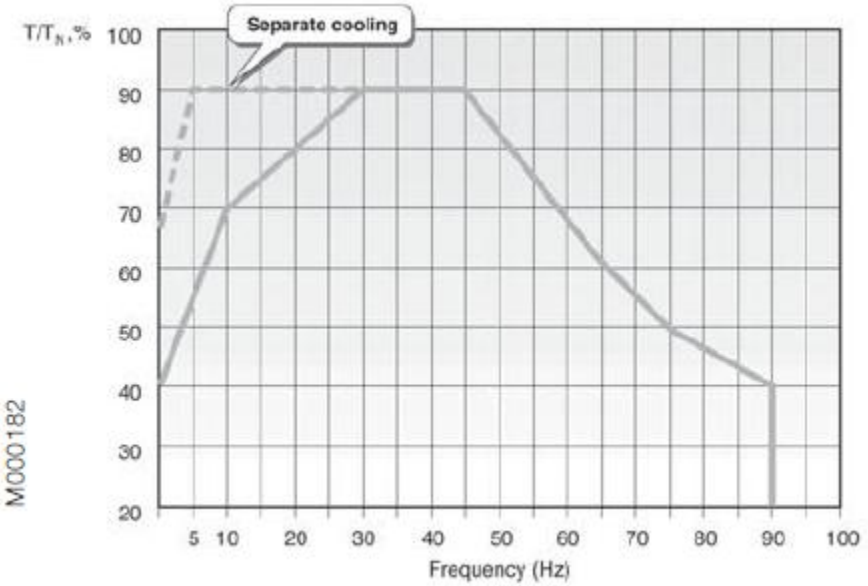
IEC shaft height effects and DTC/non DTC are different





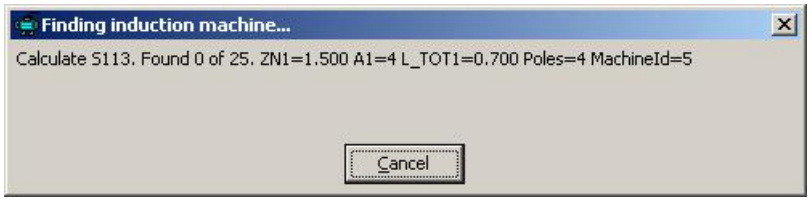
DriveSize and motor loadability ATEX
DTC only

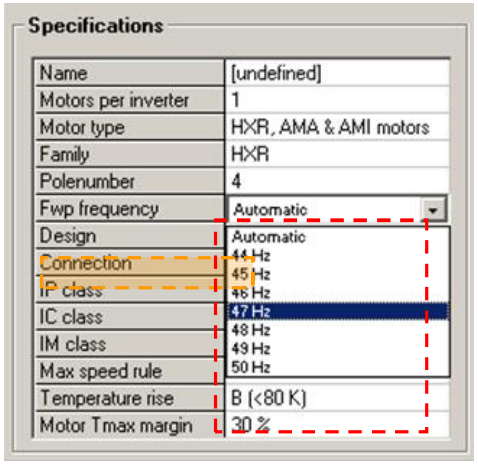




Customer specific motors with industrial drives

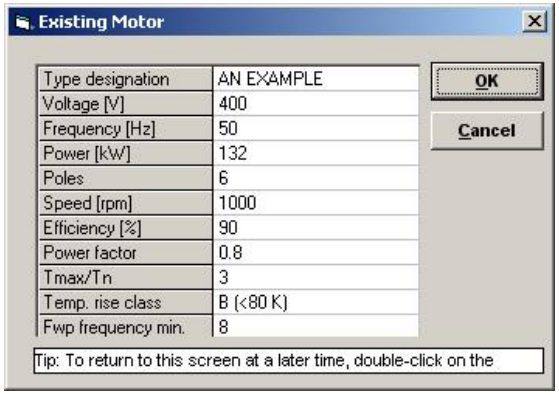
- HXR, AMA & AMI dimensioning with ABB Sophiè component
- Software proposes first HXR and then AMA&AMI automatically if needed
- Automatically selects the number of poles and field weakening point but enables user to specify the number of poles, cooling class, temperature rise etc.
- After auto selection the value of field weakening can be altered between given limits





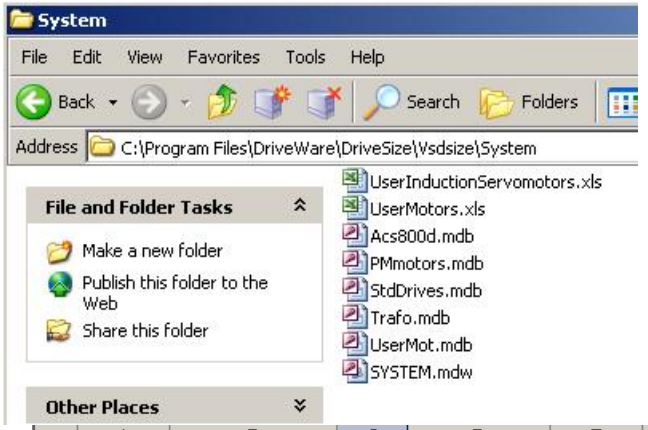
Existing motor

- Existing motor dialog box automatically opens when you select **Existing** motor type from motor specifications
  - Computing a drive for an existing or non-ABB motor
- The software assumes that the existing motor is already installed and driving the load
  - The thermal sizing of an existing motor is not checked
  - The graphs and numerical results are available
  - Maximum torque requirement is checked
  - The max speed limit of the motor is not checked
- Motor catalogue voltage and frequency can be lower than the voltage on supply side of the frequency converter
  - Voltage affect to the field weakening point and current calculations



User defined motors

- Possibility to import an own motor list
- The Excel worksheet *UserMotors.xls* with example data is located in the installation directory by default
  - Enter the motor data into the *Motors* sheet
  - Motor loadability with frequency converter data to the *Own loadability curves* sheet
  - New import overrides the previous
  - Select User motors from File menu and then Import from file
  - Motor type option appears to the drop down list after restarting the software
- Additionally the special worksheet *UserInductionServomotors.xls* for ABB HDP motors
  - User defined HDP can exist in parallel with User Defined



	A	B	C	D	E	F	G
1	Catno	TypeDesignation	Family	RtdConnection	RtdVolt	Frequency	RtdPc
2	Cat1	Type156	Fam1	D	400	50	
3	Cat2	Type200	Fam1	D	400	50	
4	Cat3	Type605	Fam1	D	400	50	
5	Cat4	Type156LS	Fam2	D	400	30	
6	Cat5	Type156HS	Fam3	D	400	100	
7							
8							

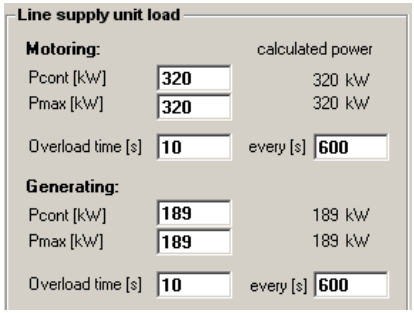
	A	B	C	D	E
1	CurveName	Cooling	TempRiseClass	RelativeFreq	DerValue
2	user1	IC411	B	0	0
3	user1	IC411	B	0.2	0.9
4	user1	IC411	B	0.3	1
5	user1	IC411	B	1	1
6					

Industrial single drives computing

- Wall-mounted and Cabinet-built drives
  - Simulates the drive protections
  - Calculation of losses and semiconductor temperatures
  - Maximum current and power limitation
- Regenerative and low harmonic single drives
  - Additionally thermal model of supply side
  - *Auto selection* turns automatically to regenerative when load is negative
  - Wall-mounted and Cabinet-built product types
- Liquid cooled single drives
  - Temperature of cooling liquid
  - Glycol concentration
- Drives for marine

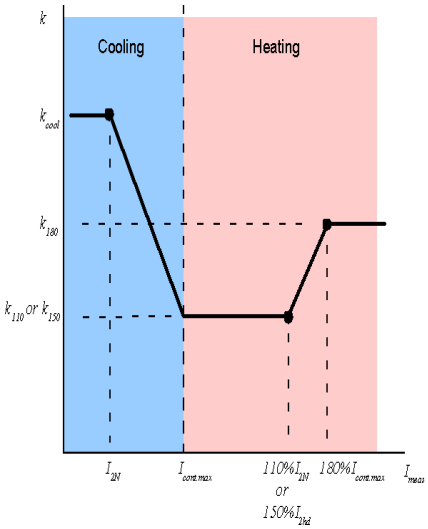
Industrial multidrive

- Inverter computing
  - Calculation of motor currents, INU losses and junction temperatures
  - Maximum current and power limitation
- Supply unit selection
  - Based on DC power drawn by inverters
    - Max and continuous power motoring values
    - Max and continuous power generating values
  - *DriveSize* does not know the mutual timings of different inverters
    - Define power requirements manually to ensure optimal line supply unit
- Liquid cooled units
  - Select cooling method from the specifications of supply unit
  - The specifications of supply unit determine also all the inverters connected to that line-up



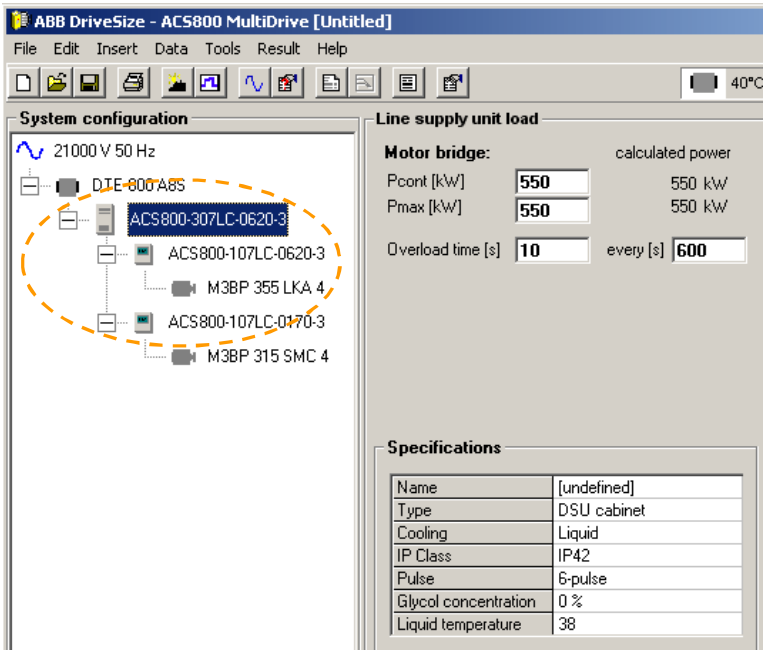
General purpose ACS550 and ACS580 drives

- All four load type options are available
- Current integrator based
  - Simulates the current integrator used in real drive
    - Heating: current integrator value increases
    - Cooling: current integrator value decreases
  - Current limitation
  - Power limitation
- Bigger ACS580 computed like ACS880
- Switching frequency
  - Options 1½, 2, 4, 8 and 12 kHz
  - Effect loadability of drive
- Low operating frequencies (<5 Hz)
  - Decreases maximum continuous current
- Swinging ac choke types ACS550



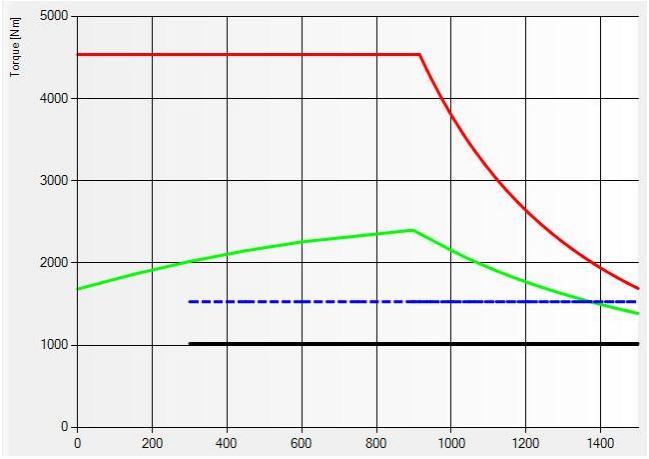
Liquid cooled units (SD and MD)

- Glycol concentration (0%,30% and 50%)
- Liquid temperature (25°C…45°C)
- Thermal model
  - Model for IGBT modules
  - Thermal model for other critical components
- The specifications of supply unit determine also all the inverters connected to that line-up.
  - Cooling method air/liquid
  - Type cabinet/module
- Calculate for line-up the liquid values
  - Total flow (l/min)
  - Heat loss (kW)



Results

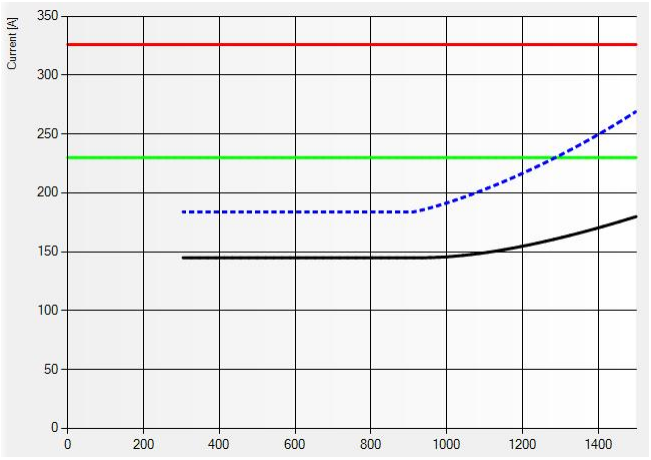
- Results in graphical form
  - Torque and power curves
    - Maximum limit
    - Thermal limit
    - Maximum load requirement
    - Continuous load or base load
  - Inverter currents
    - Maximum current limit
    - Continuous current limit
    - Maximum current demand
    - Calculated continuous current
  - Power losses
- Numerical results
  - Requirements
  - Ratings or results
  - Margins
  - Generated heat and efficiency



Type designation	**M3BP 355 MLB 6**
Product code	3GBP 353 420-ADK (FI)
Load type	Constant torque

Selection data :

Torque [Nm]	Required	Result	Margin
n min	1019	2017	98 %
n base	1019	1386	36 %
Power [kW]			
n min	32	63,4	98 %
n base	160	218	36 %
Overload [Nm]			
n min	1528	4534	197 %
n base	1528	1689	11 %



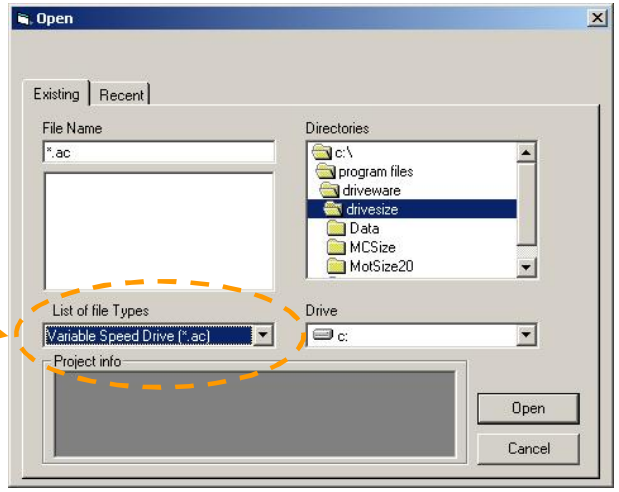
Type designation	**ACS800-02-0260-7**

Selection data :

Limit	Required	Result	Margin
Icont [A]	180	230	28 %
Imax [A]	270	326	21 %
Pmax kW	250	267	7 %
Temperature			7 %

Project files

- **Save, Save as** and **Open** commands under **File menu**
- File extensions are
  - VsdSize file .ac
  - MCSize file .mdd
- Select a relevant extension from *List of file Types* when opening an existing file from DriveSize
- Input data, specifications and the type codes of selected components are saved to the project file
  - Results are not saved - only type codes
  - Different results than earlier are possible if there are database updates or changes in sizing rules between versions of software
- The software uses an **XML** based project files, which can be comsumed by other software (DOCWin, configurators etc)



AC Drives comes with low losses - 1

DriveSize user interface

- Show low losses instead of efficiency. The losses will come down when speed is controlled downwards.
- Motor losses are shown in tabular form.
- Single drive and Multi drive inverter losses same way
- Supply unit losses
- Total losses for Single Drives
- In the reports the efficiencies are also shown

AC Drives comes with low losses - 2
DriveSize with constant torque type of load

- Drive
  - Min
  - Avg
  - Base

Losses [W]:

	Load [%]				
speed [rpm]	25 %	50 %	75 %	100 %	125 %
300	800	990	1280	1630	2040
650	860	1150	1570	2110	2800
1000	880	1360	2050	2900	4000

- Motor and together

n min = 300, n base = 1000 [rpm]

Losses [W]:

	Load [%]				
speed [rpm]	25 %	50 %	75 %	100 %	125 %
300	930	1200	1660	2300	3100
650	1580	1900	2440	3200	4200
1000	2450	2900	3700	4800	6300

Total losses [W]:

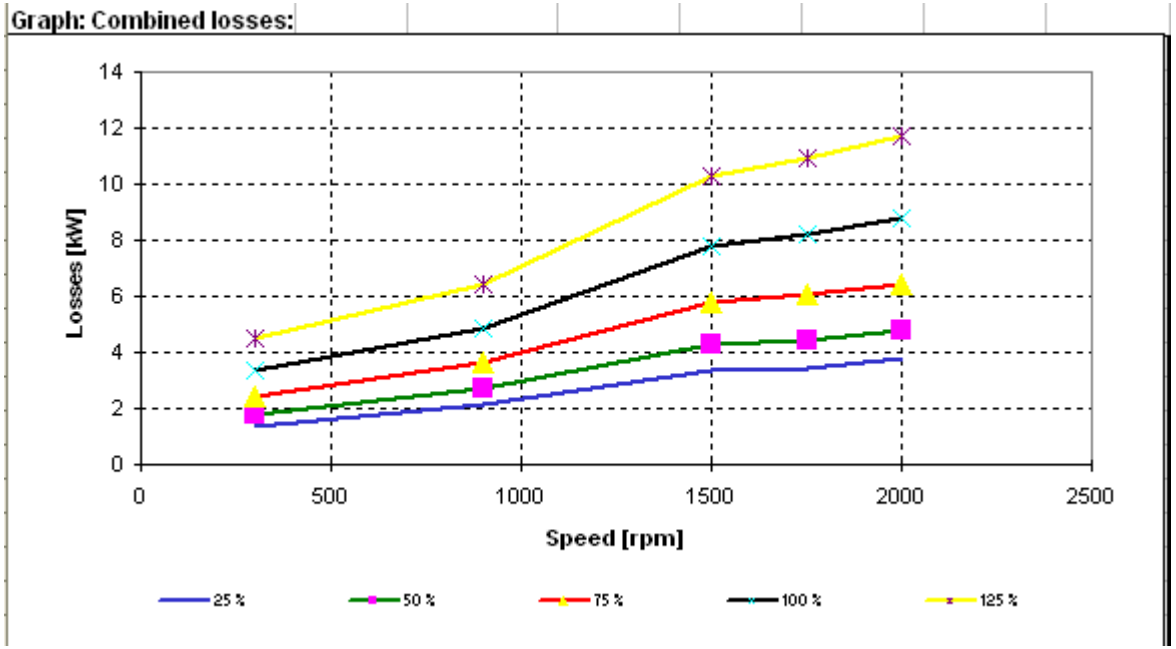
	Load [%]				
speed [rpm]	25 %	50 %	75 %	100 %	125 %
300	1730	2190	2940	3930	5140
650	2440	3050	4010	5310	7000
1000	3330	4260	5750	7700	10300

AC Drives comes with low losses - 3
ABB DriveSize – Efficiency and graph (CTP)

- Combined efficiency

Efficiency %					
speed [rpm]	25 %	50 %	75 %	100 %	125 %
300	78.9	85	86	85.6	84.7
900	87.5	91.7	92.5	92.5	92.1
1500	88.1	92.1	92.9	92.8	92.4
1750	89.5	92.9	93.5	93.4	93
2000	89.8	93.3	94	93.8	93.4

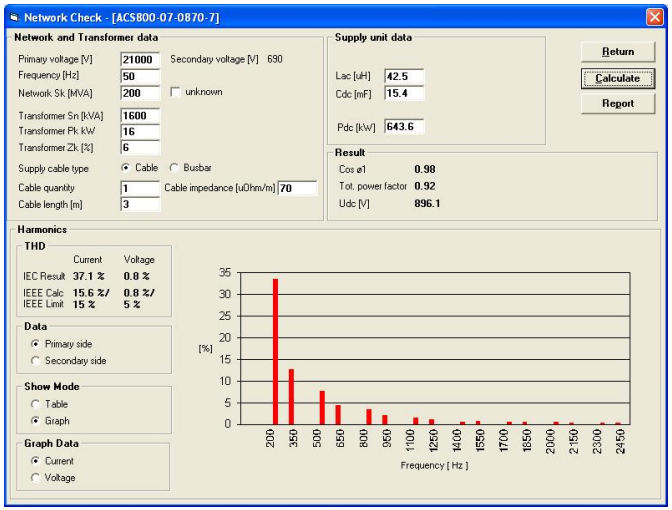
- Graph in report



Network harmonics calculation -1

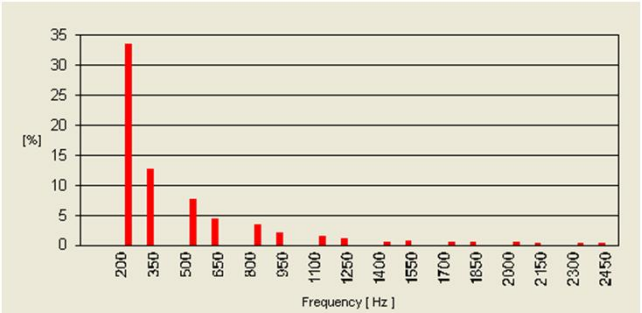
- **Polluting public networks with harmonics should be avoided**
- To calculate harmonics of individual drive or line-up please select the drive/line-up and to calculate combined harmonics at the point of common coupling (PCC) please select the transformer in *System configuration* tree
- **Network check** tool under the **Tool** menu or icon

- IEC results
  - Total harmonic distortions (THD) are according to IEC61800-3
  - Voltage and current harmonics
  - Harmonic components up to the 40th
- Primary or secondary harmonics
- IEEE results are calculated for primary side according to IEEE519 to show how much the drive affects the network at the PCC
  - Harmonics are calculated up to the 50th
  - Limits are based on network short-circuit current ratio



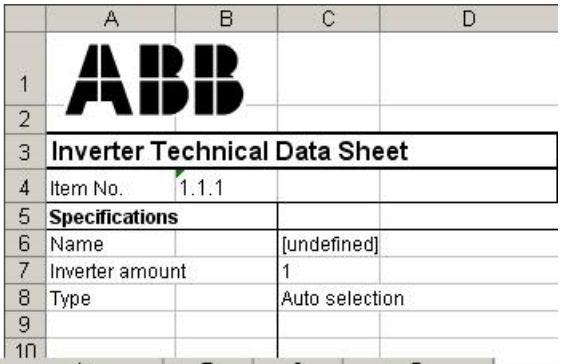
Network harmonics calculation -2

- Transformer data is based on selected transformer
- White fields are editable and new data overrides the originals
  - This network data doesn't affect to *Main dimensioning window* network data
  - The save command doesn't save these changes to the project file either
- The type of choke is automatically taken into account
  - DC choke, AC choke or swinging AC choke
  - LCL filter of ISU
  - Combined harmonics calculation may contain several drives with different types of chokes
- Harmonics of 12-pulse supply unit
  - Select three winding option first from *Transformer Specifications*
- Additionally *Network check* calculates
  - Phase shift between base current and voltage
  - Total power factor of the unit including the effect of harmonics
  - DC voltage level etc.
- Numerical and Graphical results
- *Network check* Excel result sheet to print out the harmonics results

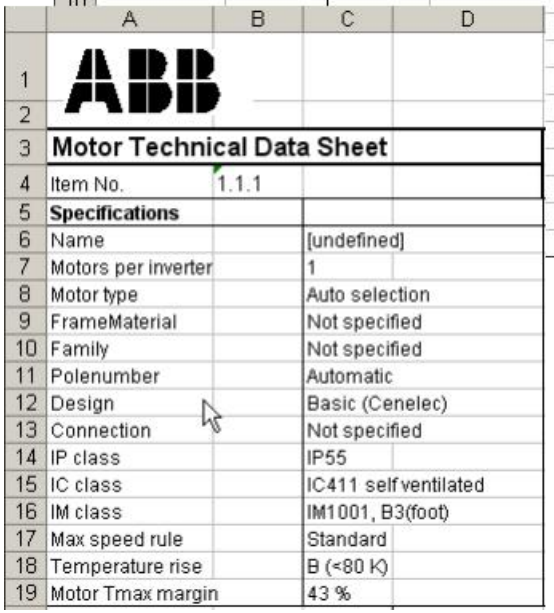


Project documentation

- DriveSize uses Excel for Printing/Reports
  - Motor Technical Data Sheet
  - Inverter/Drive Technical Data Sheet
  - Line Supply Unit Technical Data Sheet
  - Network Check
  - Efficiency Report
  - Project Technical Data Sheet
  - Project Data Sheet
- **Learn to use the reports but remember that native XLS files are easily tampered. So paper format and pdf format are safer.**
- **Print** dialog available under **File menu** with options
  - Project data sheet
  - Project technical data sheet
  - All data sheet
- Many DriveSize screens have a report button.
- Click Report to print the screen data with Excel.



	A	B	C	D
1	ABB			
2				
3	**Inverter Technical Data Sheet**			
4	Item No.	1.1.1		
5	**Specifications**			
6	Name		[undefined]	
7	Inverter amount		1	
8	Type		Auto selection	
9				
10				



	A	B	C	D
1	ABB			
2				
3	**Motor Technical Data Sheet**			
4	Item No.	1.1.1		
5	**Specifications**			
6	Name		[undefined]	
7	Motors per inverter		1	
8	Motor type		Auto selection	
9	FrameMaterial		Not specified	
10	Family		Not specified	
11	Polenumber		Automatic	
12	Design		Basic (Cenelec)	
13	Connection		Not specified	
14	IP class		IP55	
15	IC class		IC411 self ventilated	
16	IM class		IM1001, B3(foot)	
17	Max speed rule		Standard	
18	Temperature rise		B (<80 K)	
19	Motor Tmax margin		43 %	

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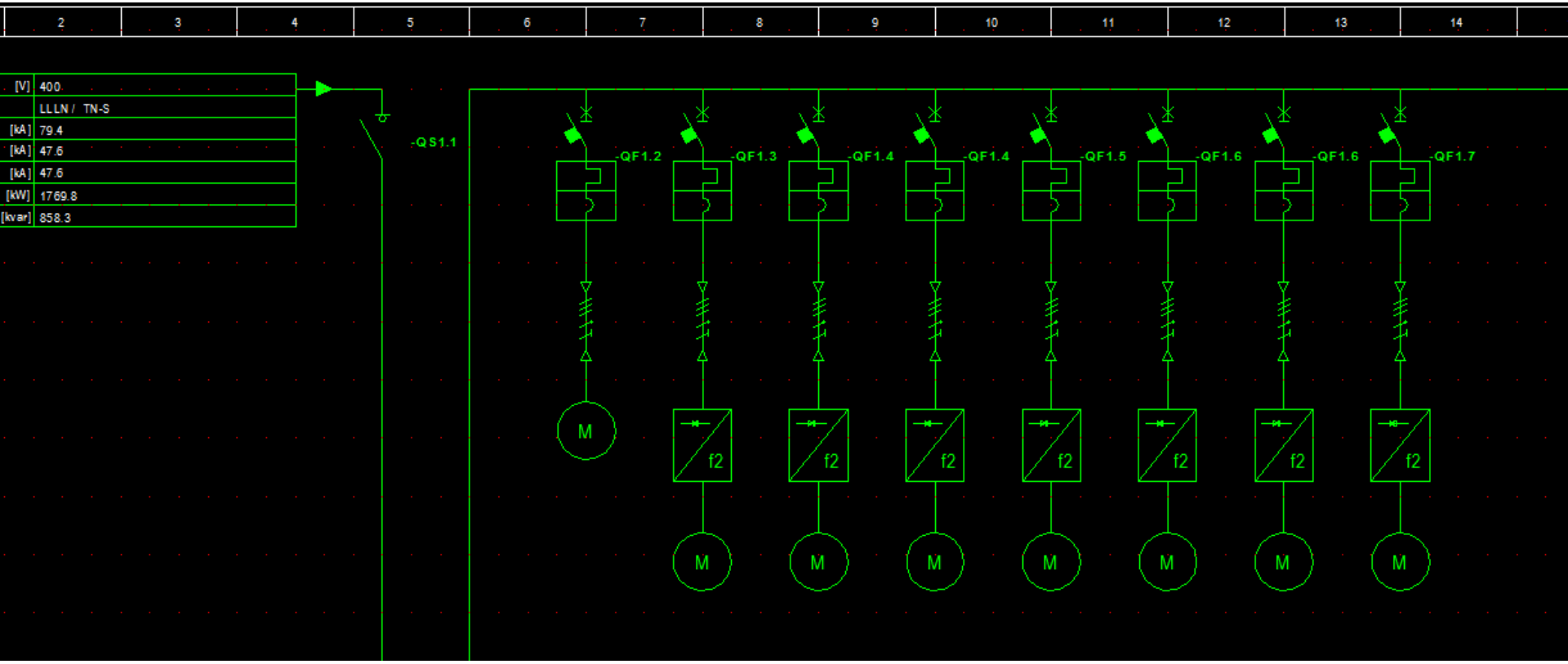
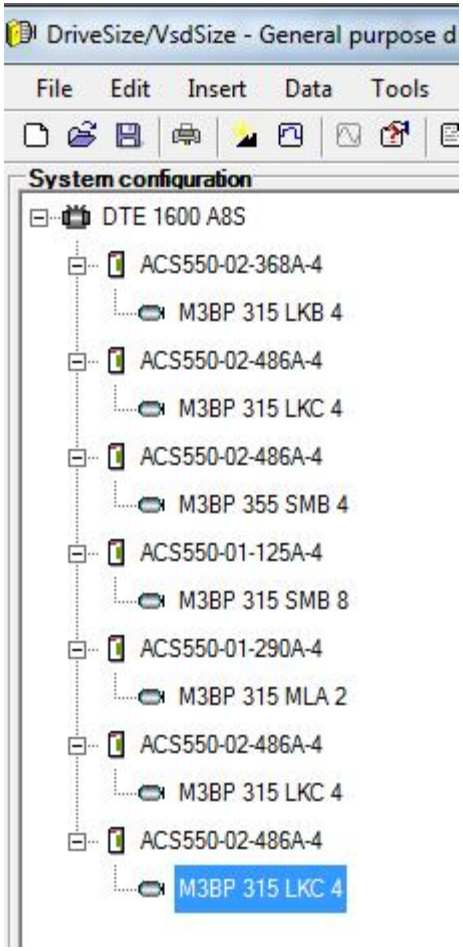


Import motor loads from Excel file into DriveSize

- Have the motor loads listed with format:

	A	B	C	D	E	F	G
	ABB		Tuusula water utility				
	Motor loads for DriveSize						
	Load type	Speed [rpm]	Power [kW]	Overload% [%]	Overload time [s]	Cycle time [s]	Item name
	Pump/fan load	1500	180	110	10	600	Raw water pump
	Pump/fan load	1500	200	110	10	600	Feeder pump
	Pump/fan load	1500	230	110	30	600	Main fan
	Pump/fan load	1500	100	110	10	600	Waistwater pump
	Pump/fan load	1500	140	110	10	600	Booster pump
	Pump/fan load	1500	170	110	10	600	Discharge pump
	Constant torque	1200	100	110	40	600	Screw

- Then import list into DriveSize with File Import Motor loads…



Application specific Excel worksheets
to compute values for DriveSize

Hoist drive of crane - input sheet to compute values for DriveSize

1) Hoist function

Weight of rope and hook	1000	kg
Weight of the load	10000	kg
Mechanical efficiency	0,9	
Hoisting speed	5	m/min
Other inertia on motor shaft	1	kgm^2
Acceleration 0...max.sp (s)	5	s
ED %	50	%
Hoisting height	20	m

2) Motor specification

Motor speed at hoist speed	1470	RPM
Estimated motor inertia	0,16	kgm^2

3) Call DriveSize calculator

Calculate

Calculated values

Constant speed time	235	s
Acceleration	0,017	m/s2

Overload definitions

Base speed: 1470 rpm Load type: Constant torque Torque Power

Ok Cancel Report

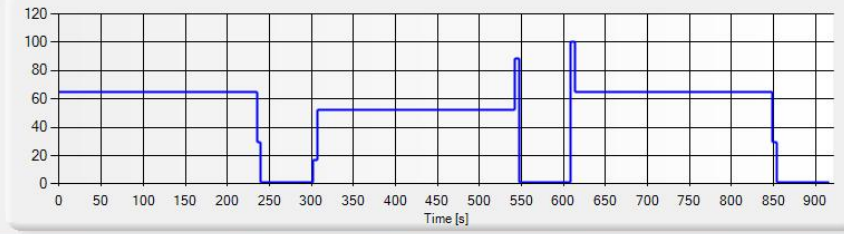
Load points

Description	Time [s]	Min. Speed [rpm]	Max. Speed [rpm]	Load [%]	Torque [Nm]
Base load	235	1	1470	100	65,0
Overload 1	5	250	1470	45	29,2
Overload 2	61,5	1	15	1	0,6
Overload 3	5	1	1470	26	16,9
Overload 4	235	1	1470	81	52,6
Overload 5	5	1	1470	136	88,3
Overload 6	61,5	1	15	1	0,6
Overload 7	5	1	1470	155	100,7
Overload 8					
Overload 9					
Overload 10					

Rms :	82%
Rms10 :	83%
Highest load :	155%

Base power :	10,0 kW
Cont. load :	8,3 kW
Power overload :	187%

Load graph



DriveSize documents

- DriveSize User Manual
- MCSize User Manual
- Readme files
- Context sensitive HTML help

Software and documents are available on internet and after installation also on installation directory.

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