Welcome to the Principle Cabinet Design training module for the DCS800, ABB DC drives.
If you need help navigating this module, please click the Help button in the top right-hand corner. To view the presenter notes as text, please click the Notes button in the bottom right corner.
After completing this module, you will be able to describe the available ABB documents and tools for cabinet assembly support, including:

- Where to find cabinet assembly related information.
- Tools for cabinet assembly.
- Typical documents that the panel builder should create.
- Knowing how to test a DCS800 enclosure cabinet.
Basically, ABB provides cabinet assembly support documents. The available support documents for cabinet assembly are:

- Manuals, including Hardware manuals and technical catalogues,
- Sample circuit diagrams for cabinets and ready made circuits,
- Dimensional drawings for modules, and
- Cabinet installation drawings.
Typically customers want to have "as-built" documents of the cabinet.
- ABB cannot provide all of these as ABB delivers only the drive module.
- However, we support our system integrators and panel builders by
  - giving examples of the documents to be made by them, and
  - offering drawings in AutoCAD format.

- DCS800 Typical standard circuit diagram converters D1 to D4 (25 - 1000 amps) no options
- DCS800 Typical standard circuit diagram converters D5 (1200 - 2000 amps) no options
- DCS800 Typical standard circuit diagram converters D6 and D7 (2050 - 5200 amps) without circuit breaker no options
- DCS800 Circuit diagram template for typical options
Here are some typical documents required by the end customer.

- Quick Guide documents on CD including all user manuals
- Test certificate of the module from ABB
- Test certificate of the cabinet from the system integrator
- Circuit diagram of the drive module
- "As-built" circuit diagram of the cabinet from the system integrator
- Cabinet layout which includes the location of all components and terminals
- Dimension drawing of the cabinet
The next topic is the testing of a DCS800 enclosure cabinet.
The purpose of this presentation is to provide an introduction to the general principles and methodologies of testing a drive cabinet and to present an overview of certain tests which are always recommended.

This training module is not intended to be a detailed testing guide. The responsibility of providing the detailed testing instructions lies with the designer of the cabinet. The system integrator is always responsible for the design of the cabinet installation and the panel builder is responsible for the installation work.

The modules themselves do not require any testing because they are factory tested - only cabinet installations need testing.
Generally speaking, the minimum requirements for testing a DCS800 cabinet are the following:

- All the needed documents must be at hand and the tools needed for performing the tests must be present,
- A visual and mechanical inspection of the cabinet must be done,
- The cabinet installation must be electrically tested by an insulation test and a function test and
- A testing report must be written.

This training module provides some general principles on the inspections and testing and gives an example of a testing report.
The documents needed to perform a cabinet installation test include:

- The circuit diagrams for the installation, including the required cross-section measurements of all the cables and busbars. These are provided by the designer. The cross-sectional requirements are also dependent on country-specific regulations.
- The parts list (so that the presence of all needed devices can be verified),
- The mechanical drawings,
- The hardware manuals for the modules, the firmware manuals for the required software and the manuals for any options in the installation,
- Common tools, such as a multimeter, an insulation resistance meter and a high-voltage testing device and
- A PC tool, such as DriveWindow, is also recommended but not mandatory.
The purpose of the visual and mechanical inspection is to ensure the quality of the mechanical installation. The drive cabinet should be installed according to its drawings and the hardware manual. The installation has to fulfill the technical requirements of the end-user application and also the environment. For example, the proper electrical or environmental filters must be installed if the protection class of the installation requires it. The installation also has to meet the requirements of local laws and safety regulations.

The cabinet has to be checked for proper installation according to the drawings, for cleanliness and for dusty components or foreign items which must be removed if found. The construction of the cabinet enclosure must be safe for people nearby. Good installation practices necessitate that all live parts, such as supply terminals, are covered for finger protection. If the cabinet is installed in a location where the cooling air is dusty, then income filters are required. If RFI (radio frequency interference) protection is required, it is necessary to check if EMC filters have been installed according to the drawings.

The power supply and motor terminals have to be suitable for the input and output cables. They must be big enough and the proper types of fixing bolts and accessories must be used to ground or fasten the cables. The cables have to have a fixing rail, so that they are not damaged by tension or vibration.
The groundings of the busbars have to be located near the terminals and there must be enough fixing points with bolts and accessories for the grounding cables. The cross-sections of the groundings must be at least half the size of the supply cables. Furthermore, the terminals have to be marked according to local standards or, if none exist, according to those in the hardware manual.

The installation should be checked so that all the components correspond to the ones in the parts list of the delivery and that they are fixed properly. In particular, the conductivity of the fixings that ground a component has to be checked. Paint or other insulating coatings, for instance, have to be removed. All the components also have to be marked with (device) ID labels.

Check that the wirings and cablings have suitable ending sockets and that their routes are either mechanically fixed or run inside a cable duct. The wires should be installed in such a way that normal operation does not cause them to wear out - for example, opening the cabinet doors or mechanical vibrations from the surrounding environment (like in a ships' engine room). The cross-sectional areas of the wires and cables have to be in accordance with the design drawings. If that area is less than 2.5 mm², tin coating is recommended for the wires and endings (cable plugs). In corrosive environments, coating the wires and cables is mandatory. Also, the color of the wires should be in accordance with local standards or, if none exist, in accordance with the hardware manual.
The busbars have to be supported so that they can withstand high short-circuit currents. Check that the supports are mounted according to the drawings and the hardware manual. When the busbars are not coated, all joint surfaces must be polished in order to ensure good conductivity. Polishing is not necessary if the busbars have anti-corrosion protection (because they do not oxidize).

Correct ventilation is one of the key aspects that must be inspected when testing the installation. The air inlet and outlet vents have to be large enough and in the correct position to provide sufficient airflow inside the cabinet. The hardware manual includes a table of that information. The figures there refer to the effective airflow area. The correct positions for the vents are also presented in the manual for installation of the cabinet.

The fans must be located so that the cooling air is able to pass freely through the cabinet. The air must not be trapped circulating inside the cabinet. The hardware manual contains details on how to prevent this. Also, all drive modules must receive fresh cooling air, that is, they must direct the heated air away from other modules.

Finally, the heated air has to be lead through an air duct outlet so it can not be used again.
The grounding of the cabinet must be done according to the cabinet drawings and hardware manual in order to avoid radio frequency interference (RFI) and to ensure the safety of the cabinet.

All the electrical connections must be done correctly and all screws and bolts must be tightened with the appropriate torque.

The insulation and creepage distances of the main circuit must be checked that they adhere to local standards or, if none exist, to those of the hardware manual. The insulation and creepage distances between the live parts and between them and the frame have to be at least 13 mm.
The third part of testing is the mechanical operation test. Operation of all switches, miniature and moulded case circuit breakers (MCB) and control switches has to be inspected.

The maintainability of all fuses and components needing maintenance must be checked.

- Fuses must be easy and safe to access and change.
- Check correct rating of fuses.
- All components and devices which may need setup are safely accessible.

Check the doors

- Can be opened to a wide enough angle.
- The locking mechanisms work properly.

Doors must not be obstructed so that they can be opened wide enough as defined in the drawings and hardware manual. The operation of all locking mechanisms in doors and equipment must also be checked.
The minimum electrical testing that has to be conducted for the various circuits of an installation are the insulation resistance measurement and the high voltage test. This table is an example of the voltages used to test the resistance and current leakages for different circuits. The resistance should be higher than the acceptable limit and the leakage current should be less than the acceptable limit. The figures here are suggestions only.
This diagram shows, in principle, the connections for measuring the insulation resistances and for carrying out the high voltage tests for various circuits. The circuits shown here are merely examples of those that have to be tested. Your installation may have another kind of circuitry.

First, measure the insulation resistances for all the circuits individually. The test device only needs to be connected to one circuit while all the other circuits are grounded.

Then, conduct a high voltage test for all the circuits individually.

After that, measure the insulation resistances once again to ensure that the resistances have not changed.

**Attention**

Insulation measuring for 24-volt-circuits has to be carried out exclusively for cabling and wiring, all the PCB’s, must be disconnected.

Mini-circuit-breakers have to be closed during the test.
This slide should explain the PE testing procedure.

- In a DC drive cabinet the PE connection has to be tested.
- The PE conduction of all touchable devices has to be tested, e.g., the cabinet door, the converter or auxiliary devices.
- The Protection cover of touchable devices has to be checked.
- The test procedure is shown on the picture. It is necessary to check the proper connection of PE cables. Also, the correct crimping can be checked with this procedure.
- This can be done with a constant current of 10 amps. Then, the PE connection’s maximum voltage drop must be within the limit. Typical values are shown in the table.
The functionality of auxiliary transformers, main contactors, breakers, fans and measurement and control devices has to be tested as well.

The functional test is done while the main power is switched on. Before switching on the power, check that the auxiliary transformers and main circuit connections are carried out according to the drawings, that all miniature circuit breakers (MCB) and switches are disconnected and that the cabinet is grounded.

- Measure the voltages of auxiliary transformers and all circuits.
- Test that the main contactor or circuit breaker (molded case circuit breaker, MCCB) is operational.
- Check that all cooling fans run in the proper direction.
- Test the operation of miniature circuit breakers.
- Check that all circuits, devices and the control panel are functional.
- Check that the settings of the option modules are correct.
- Follow safety instructions from the Firmware Manual.
Write a test report that includes your name, the name and address of your company, the date that the tests were conducted and the inspections that you have performed on the installation.

Deliver the test report to the end-user with the drive.

To download an example test report as a Word document, please click on the Attachments button in the top right-hand corner and click on the link labeled "Test report". You can use that as a template for your own report.
The key points of this module are:

- How to describe the available ABB documents and tools for cabinet assembly support.
- How to test a DCS800 enclosure cabinet.
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