Welcome to the ACS800 fault tracing training module.
If you need help navigating this module, please click the Help button in the top right 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
• explain the functions of ACS800 diagnostics
• find information on how to trace alarms and signals with the fault logger, data logger and datawords.
• explain what kind of support material exists and where to find it, and
• get help for the fault tracing when needed.
Fault tracing is most effective when it is systematic and logical. Proceed step by step and make notes of fault tracing actions. Keep in mind that fault may also be caused by external phenomenon. Knowledge of the application characteristics is essential when analyzing the drives operation.

<table>
<thead>
<tr>
<th>Fault tracing</th>
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<tbody>
<tr>
<td>Systematic fault tracing</td>
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<tr>
<td>- Logical iteration, step by step</td>
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<tr>
<td>- Make notes of fault tracing actions</td>
</tr>
<tr>
<td>- Use application and other drawings</td>
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<tr>
<td>Is the fault in the drive?</td>
</tr>
<tr>
<td>- Application characteristics</td>
</tr>
<tr>
<td>- External devices</td>
</tr>
<tr>
<td>- Supply</td>
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<tr>
<td>- PLC, relays, etc</td>
</tr>
</tbody>
</table>
This flowchart describes the basic principles for fault tracing. For more details of mentioned items follow the highlighted links on the flowchart.

If the drive has no power, first check the supply voltages. If there is a supply voltage present, follow the link to the instructions for a quick check of the main circuit. Based on measurements determine if the fault is in the supplying net, in the drives own supply or in the drives main circuit. In the cases of larger drives or sectional drives there are always individual modules for the supply. Follow the fault tracing instructions in related modules.

If the drive has power, check the indications of the drive. Based on the findings locate the fault. If the fault is located in the drive follow the fault tracing instructions in the manuals.
A quick check for main circuit components can be done by using the multimeter.

Ensure by voltage measurements that there is no voltage on the supply or in the dc –link of the drive. Check all supply phases and also the input fuses.

Locate the input and output terminals and dc-link + and -. Measure the resistance between input U-phase and dc-link +, multimeter reading should show several kΩ.

Carry out the same measurement between dc-link + and output U-phase.

Repeat the measurement to each input and output phase (one by one) against the dc -link + and –.

A short circuit indicates a damaged component in main circuit. Component is on the measured phases + or – branch, where the measurement was connected.

Click the back-button on the top right corner to return to the fault tracing flowchart.
### Supply modules manuals

- **Links to ACS800 supply modules manuals in ABB Library:**
  - ACS800-204 IGBT Supply Modules Hardware Manual
  - ACS800 IGBT Supply Control Program 7.x Firmware Manual
  - ACS800-207 Cabinet-installed IGBT Supply Unit Hardware Manual
  - User's Manual: ACS800-407 and ACS800-807 Cabinet-installed Thyristor Supply Units (TSU) (630 to 5991 kW)
  - ACS800-307 and ACS800-507 Cabinet-installed Diode Supply Unit User's manual
  - Diode Supply Modules ACS800-304 and ACS800-704 User's manual
  - ACA 635 IGBT Supply Sections 260 to 4726 kVA, ACS 800-17 Line-Side Converter 120 to 1385 kVA User's manual

- **DSU on-site tester**
  - ACS800 IHMM
  - 02 Manuals & Guides
  - General Manuals
  - ACS800-304 and ACS800-704 Modules On-Site Tester, User's Guide

Documents can also be found in the ACS800 In-House Maintenance manual.

For the latest revision check the ABB Library with a document number search or see the ACS800 In-House Maintenance manual.

The diode supply units on-site testers user’s manual is available only in the ACS800 In-House Maintenance manual.

Click the back-button on the top right corner to return to the fault tracing flowchart.
## Drive hardware manuals

Links to ACS800 hardware manuals in ABB Library:

- ACS800-01/U1 Hardware Manual
- ACS800-02/U2 Hardware Manual
- ACS800-04/04M/U4 Hardware Manual
- ACS800-04 Drive Modules Hardware Manual (0.55 to 132 kW)
- ACS800-11/U11 Drives Hardware Manual (5.5 to 110 kW)
- ACS800-07 (45 to 560 kW) Hardware Manual
- ACS800-07 (500 to 2800 kW) Hardware Manual
- ACS800-17 Drives (55 to 2500 kW / 75 to 2800 HP), Hardware Manual
- ACS800-31/U31 Hardware Manual
- ACS800-37 Drives (55 to 2700 kW / 75 to 3000 HP), Hardware manual
- ACS800-104 Inverter Modules, Hardware Manual
- ACS800-107 (1.5 to 5340 kW) Cabinet-built Inverter Units Hardware Manual
- ACS800-807 Brake Units Hardware Manual
- ACS800-87 Wind Turbine Drives for Asynchronous Slip Ring Generators Hardware Manual
- ACS800-07LC Drives Hardware Manual

Documents can also be found in the ACS800 In-House Maintenance manual.

For the latest revision check the ABB Library with a document number search or see the ACS800 In-House Maintenance manual.

Click the back-button on the top right corner to return to the fault tracing flowchart.
Documents can also be found in the ACS800 In-House Maintenance manual.

For the latest revision check the ABB Library with a document number search or see the ACS800 In-House Maintenance manual.

Click the next page arrow to see the list of the links to the application specific ACS800 firmware manuals.

Click the back-button on the top right corner to return to the fault tracing flowchart.
Documents can also be found in the ACS800 In-House Maintenance manual.

For the latest revision check the ABB Library with a document number search or see the ACS800 In-House Maintenance manual.

Click the previous page arrow to return to the list of the links to the basic ACS800 firmware manuals.

Click the back-button on the top right corner to return to the fault tracing flowchart.
In case the fault seems to be in communication to upper level systems, check the control and reference signals from drives signals and status words. Use the control panel or DriveWindow 2.

Disconnect the motor cable from the drives output and run the drive in scalar mode to see if the fault is caused by the load, motor or the cabling.

Running the drive in scalar mode is also useful when analyzing the condition of the pulse encoder. Disable the speed measurement feedback to the control software. From drive signals you can follow the operation of the pulse encoder and by using an oscilloscope check the pulses.

There may also be other sensors connected to the drive.

Click the back-button on the top right corner to return to the fault tracing flowchart.
ACS800 diagnostics

- Software and hardware functions
  - Signals
    - Alarms and signals
      - Fault indications
      - Actual values
      - Status words
    - Fault logger
    - Data loggers
    - APBU logger
  - Indicators
    - Boards
    - Displays
    - Other indicators

ACS800 drives diagnostics have several software and hardware functions to assist fault tracing operations.

Software based diagnostics contain alarms and signals. For fault tracing use, the drive has a fault and data logger and in larger drives with parallel running modules there is also an APBU data logger available.

Drives also contain many hardware indicators such as LEDs on the boards, displays and other hardware indicators on the relays etc.
ACS800 drives have warning and fault LEDs on the listed locations. In this learning module only the common boards and configurations are mentioned. Option modules have their own indicators which are explained in each modules manuals. See the ACS800 In-House Maintenance manual for further information on option modules.

After a fault detection the fault indication LED normally stays lit.
If the drive is operated with the control panel detached, the red LED in the panel mounting platform indicates the fault condition.
The drive monitoring display NLMD, used in the ACS800 multidrive has three status LEDs.

The display also has LEDs to indicate the selected drive signals, actual speed for instance.
The RMIO board has two status LEDs for auxiliary power and faults.
The AINT board has four status LEDs.

- V204 (green)
  - aux. power ok
- V309 (red)
  - driving permission bits are set
- V310 (green)
  - prevention of unexpected start active
- V311 (green)
  - voltage to gate drivers ok
The GINT board has one status LED showing active supply.
The LED will blink during an input power break to minimize back-up battery current consumption.

The battery discharge time is between 30 and 60 minutes.
Especially in cases of bigger or system drives there are many other indicators available for fault tracing.
ACS products use a two-level protection system:

A warning is indicated at the lower level, for less serious malfunctions. The warning does not have a direct effect on unit operation. Warning messages are generated by the drive or by the control panel.

A fault is indicated at the higher level, for more serious malfunctions. The fault indication always terminates motor operation. Fault messages are generated by the drive.
When a fault is detected, it is stored in the fault history.

The latest faults and warnings are stored together with the time stamp at which the event was detected. The fault logger collects 64 of the latest faults and when the drive power is switched off, 16 of the latest faults are stored.

<table>
<thead>
<tr>
<th>Fault History</th>
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<tbody>
<tr>
<td>- Faults and warnings are stored with the time stamp</td>
</tr>
<tr>
<td>- Fault logger collects 64 latest faults</td>
</tr>
<tr>
<td>- 16 of the latest faults are stored in power off</td>
</tr>
</tbody>
</table>
The fault logger contents can be read by using the control panel or the DriveWindow 2 pc tool. For the fault logger operations in DriveWindow see the attached link.

Alarm and fault codes explanations and possible causes for them are listed in the firmware manuals, which can be found in the ABB Library or ACS800 In-House Maintenance manual in Lotus Notes.

There will be more details of alarm and fault codes in the drive type specific learning modules.
Viewing and resetting the fault history is done in the fault history display. Note that the fault history cannot be reset if there are active faults or warnings.
Preprogrammed protection features cannot be altered by the user.
Some functions which don’t cause direct problems for the ACS800, can be programmed from the parameter Group 30.
Some faults can be reset automatically without pressing the reset button. This function can be activated from the parameter Group 31.
Here are some examples of preprogrammed protection features.
Programmable fault functions can be defined in parameter group 30. For each function there are three possibilities for the action: no action, warning detection or tripping on a fault.

These parameters should be defined according to the application. Instructions can be found in the Firmware Manual.
Here are some examples of programmable protection features.

<table>
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<th>Examples</th>
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<tbody>
<tr>
<td>Examples of programmable protection features</td>
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<tr>
<td>Panel loss</td>
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<tr>
<td>External fault</td>
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<tr>
<td>Motor stall</td>
</tr>
<tr>
<td>Underload</td>
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<tr>
<td>Motor phase loss</td>
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</tbody>
</table>
Automatic fault reset can be programmed in parameter group 31.
Automatic resets are possible only for certain fault types and when the automatic reset function is activated for that fault type.
The automatic reset function is not operational if the drive is in local control.
Here are some examples of programmable autoreset functions.
Datalogger is a useful tool for fault tracing when analyzing the drives operation and state before it tripped on a fault. It can also be set to trace other situations where there may not be any fault indications. Such as the drive stopping by itself due to a wrong command from the upper level control.

Datalogger is a memory buffer located in the drive RMIO board. There can be a maximum of two dataloggers in one drive, depending on the drive control software version.

Datalogger collects selected variables according to the selected triggering settings. The maximum number of channels in one datalogger is four. Each logger contains 1024 samples. The sample interval is adjustable.
The data logger settings and reading the data are done by using the DriveWindow 2 pc tool.

Detailed instructions for using the data logger can be found in the training module for software tools. The DriveWindow 2 manual is available in the ACS800 In-House Maintenance manual and in the ABB Library.
Drive signals

- Can be followed from
  - CDP312 control panel
  - Pc tool (DriveWindow, DriveDebug)

Drive signals are useful when analyzing the current state of the drive. They can be followed from the control panel or by using the pc tool.
Three selectable drive signals can be followed from the control panel in decimal, binary or hexadecimal form. See the ACS800 Firmware manuals for details of control panel operations.
When using DriveWindow drive signals can be followed in both numerical and graphical form.

In numerical form there are several selectable formats for the displayed data.

In graphical form, it is possible to plot six selectable variants. Sample time and scaling can be adjusted to needed values.

When viewing the trend curves you can scroll horizontally and vertically within the buffered data. You can zoom inwards, outwards, and reset zooming. You can examine the trends using a graph cursor.

For more details see the DriveWindow User’s Manual from the attached link or in the ACS800 In-House Maintenance manual.
Listed signals are useful when monitoring the operation of the drive. Speed error describes the deviation between speed reference and the actual speed of the motor. It can be found as individual signal from the system software drives.

The operational state of the drive can be observed from the status words. Use numerical monitoring in binary mode. Explanation of each status words bits can be found from each application softwares firmware manual found in the ABB Library or the ACS800 In-House Maintenance manual.
When setting the scalings it has to be determined what a suitable accuracy for the measured signal would be. Wrong scalings give misleading information of drives operation.

For the vertical scaling determine the measured signals range. Setting of the sample interval should be done so that it is enough to get reliable results.

For instance in the case of a step response test there is no need to plot the entire speed range. The vertical axis should be scaled so that the speed step to the drives speed reference covers almost the whole display.

When analyzing the results one has to know the characteristics of the application. For instance, how the load torque behaves.
The APBU DataLogger is a diagnostic tool used for parallel connected inverter fault tracing. The tool can be used with non-parallel connected inverters as well. The tool consists of the PPCS Branching Unit, APBUDL tool for data exchange and some files to help data analysis. Data analysis can be done by using MS Excel.

The APBU datalogger includes three loggers; First Logger and Last Logger which store the first and last current unbalance, short-circuit or overcurrent faults, respectively, and User Logger, which can be triggered manually during normal running.

The APBUDL tool uploads data from the logger in a CSV (Comma Separated Value) format, so the data can be analyzed by a service engineer.

The measured signals are U and W phase currents, DC voltage, temperature and sum current of each parallel connected inverter unit. The sample time is 25µs and each variable contains 10922 samples.

The status information of the drive modules contains PPCC communication status, switch positions, overcurrent trip information, current unbalance fault information and short circuit (which inverter unit, phase and branch caused trip).

An optical triggering signal output is available for external measurement devices when current unbalance fault, short-circuit or overcurrent trip are detected.

There is also an optical triggering signal input for external triggering.
Product specific firmware and hardware documentation can be found in the Lotus Notes databases and in the ABB Library.

In the drive or module manuals you can find instructions for component measurements and other checkings. They also include explanations of fault and warning messages with possible causes and recommended actions.

The ACS800 In-House Maintenance manual also includes detailed instructions for component replacement, circuit diagrams and service hints for drives.
Drives Technical support services provide accurate, consistent, and responsive information and support to our customers

Check your local ABB representative for more information on support and remote services.
Thank you for your attention. You may now go ahead and move on to the next unit.