E-Learning, DC drives

DCS800-R
Rebuild Kit Engineering, part 1
G566e Part 3

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MODERNIZATION_03_R0101

Power and productivity for a better world™

Welcome to the rebuild kit engineering training module for 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.

Help

Objectives

This training module covers:

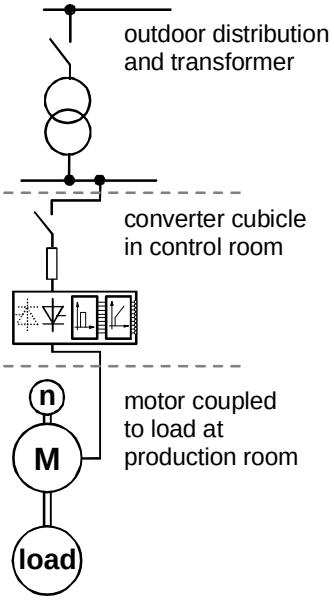
- Engineering required for the DCS800 Rebuild Kit
- Hardware parts of the DCS800 Rebuild Kit
- How to connect the hardware parts

This training module covers:

- Engineering required for the DCS800 rebuild kit,
- Hardware parts of the DCS800 rebuild kit,
- How to connect the hardware parts

Help

Engineering in general
Overview



- A drive system shown by electrical symbols on the left, looks very different when looking at the real components and the mechanics
- Some parts are:
  - Outside a building
  - Inside a clean room
  - Inside a production hall
- For example:
  - Transformer is outside
  - Converter cubicle in the control room
  - Motor and coupled mechanics in the production hall

A drive system, shown by electrical symbols on the left, looks very different when looking at the real components and mechanics.

Some of the parts are outside a building, inside a clean room or inside a production hall. Also the dimensions of the parts are unclear initially and it makes sense to have a look at them to get a feeling about the location and the real dimensions.

A typical configuration can be that the transformer is outside, the converter cubicle in the control room and the motor with coupled mechanics in the production hall.

Help

Engineering in general
Kinds of engineering

- Because of the location of the components necessary for a drive system, every electrical drive independent of
  - The drive type,
  - The application or
  - The product in use,

  needs various types of engineering

- There is always some mechanical work required to have the components within an enclosure or the enclosure within a room
- There is always the electrical wiring, e.g. to the motor
- There is always the control with the I/Os or the serial link doing the interconnection to the PLC

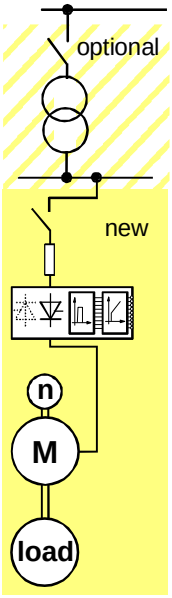
Because of the location of the components necessary for a drive system, every electrical drive independent of the drive type, the application or the product in use, needs various types of engineering.

- There is always some mechanical work required to have the components within an enclosure or the enclosure within a room.
- There is always the electrical wiring, for example the connection to the motor.
- There is always the control with the I/O’s or the serial link doing the interconnection to the PLC.

All those issues should be considered in the engineering process.

Help

Engineering in general



For a project with new components

- Nearly no pre-engineering necessary
- Some design studies for prototypes
- Perhaps some tests to prove performance

For a project with one or a few new parts

- Document the actual configuration
- Document the actual condition
- Measure the actual performance
- Identify and record weak points for improvements

- **Pre-engineering is important!!**

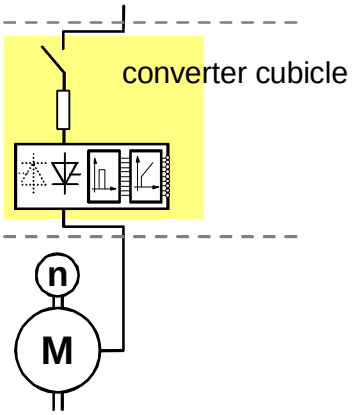
There are two strategies when talking about engineering in general.

- For a project with new components, nearly no pre-engineering is necessary. Some design studies for prototypes make sense to avoid unexpected problems later. Perhaps some tests to prove the performance could be necessary when engineering.
- The engineering strategy for a project with one or a few new parts is completely different. It is essential to document the actual configuration as well as the actual condition. Measuring the performance is also necessary to find out what demands the new system has to meet.
- Identify and record weak points of any improvements which could be required by the customer.

In conclusion, we can say that pre-engineering is very important!

Help

Items to be engineered
Mechanical



With a DCS module or cubicle

- Parts need to be mounted
- Cubicle needs to be transported
- Foundation needs to be done
- Cubicle placed and fixed
- … and so on …

With a DCS800-R0x

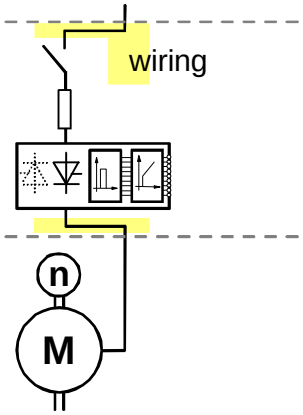
- Nothing of the work above
- Find a place within existing cubicle to mount a few boards

Typically, the first item to be engineered are the mechanics. Only if the mechanics are clearly defined, electrical points be considered.

- All DCS module or cubicle parts need to be mounted. Also the cubicles need to be transported, that may sound quite simple, but can be a problem if there is no direct access to the electrical room or the door inside the electrical room is too small for the cubicle. Cubicles need to be placed and fixed on a foundation, therefore some pre-work is mandatory. This list can be expanded and should show that a lot of small things have to be considered in advance.
- With a DCS800-R kit – the rebuild kit – none of the work above must be done. Find a place within the existing cubicle to mount a few boards. And that is all. The main engineering work for the rebuild kit is at another point!

Help

Items to be engineered
Electrical



With a DCS module or cubicle

- Connection of all the power cables from the low voltage distribution to the cubicle and from the cubicle to the motor
- Wiring and functions need to be tested
- Wiring for voltage and current measurements is ready and tested
- Wiring to thyristors is also existing and factory tested

With a DCS800-R0x

- Power cable connections are existing
- Connection of new boards to power stack

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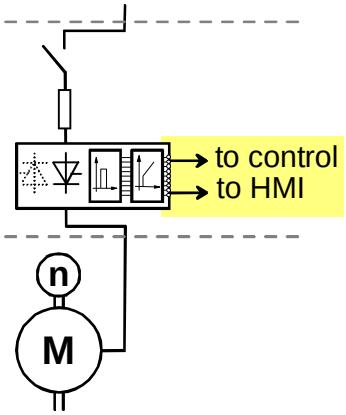
Electrical items need to be engineered as well.

- With a DCS module or cubicle, the connection of all power cables from the low voltage distribution to the cubicle and from the cubicle to the motor must be wired. This wiring needs to be tested to get the expected behaviour and a safe system. But the wiring needed for voltage and current measurement is ready and factory tested. Also the wiring to the thyristors is present and working.
- With a DCS800-R rebuild kit, all power cable connections are typically present and there is often no need for a change, except in strange configurations, if the entire system has to be modernized or any historical circuits will be used, which cannot be reused for the new configuration. But the connection of the new boards to the power stack is always necessary.

Help

Items to be engineered
Control



With a DCS module or cubicle

- Definition of the interface to the control system and vice versa
- Definition of the functions preferable within the converter or within the control system
- Wiring of the signals

With a DCS800-R0x

- The same as above

Another important issue for engineering is the control section. Some drives are controlled by hard wire signals and other ones can have a fieldbus connection.

- With a DCS module or cubicle, the definition of the interface to the control system and vice versa is necessary. If an old PLC has to be reused, it must be checked that the required type is available for the new drive. Also the definition of the preferred functions within the converter or within the control system must also be checked for availability. If the protocol for the fieldbus and the hard wire signals respectively is clearly defined, everything must be wired according to the needs.
- With a DCS800-R rebuild kit, exactly the same procedure is necessary as described above.

Help

Pre-engineering (1)

The engineering of a rebuild kit type DCS800-R0x must be started during the process selecting this solution for the revamp

- Is free space available for the electronic housing?
  - Incl. field exciter
- Is there usable space around the old power stack?
  - Required for firing boards
- Get single line drawings of the present configuration!
- Get detailed drawings showing the present control structure!

Pre-engineering is the step which typically starts the process of selecting the DCS800-R rebuild kit as a solution.

In this step some points should be checked and discussed:

- Is free space available for the electronic housing? If necessary, the field exciter can be chosen as an option inside the electronic housing.
- Is there usable space around the old power stack? This space is required for firing boards.
- Get single line drawings of the present configuration!
- Get detailed drawings showing the present control structure!

Help

Pre-engineering (2)

Before the drive (the line) to be revamped is switched off to start the upgrade work document the present performance

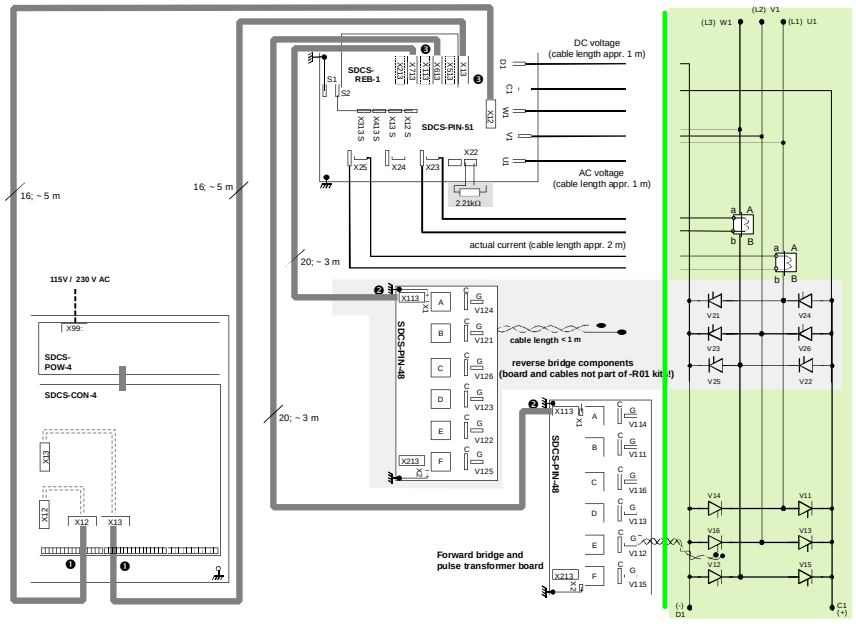
- Tools necessary
  - Oscilloscope or similar clamp,
  - Clamp on current probe or similar,
  - Isolating amplifier, speed sensor, etc.
- To be recorded
  - With the machine at nominal condition take records of actual signals like speed, line-, motor- and field voltage, motor- and field current and application related signals
- Determine all polarities of the power stack and the thyristor numbers
- With thyristors in parallel, verify if all thyristors are o.k.

Before the drive or production line to be revamped is switched-off to start the upgrade work, it is helpful to document the current performance.

- The following tools are necessary: oscilloscope or similar clamp, clamp on current probe, isolating amplifier, speed sensor and so on.
- With the machine at nominal condition, take records of actual signals like speed, line voltage, motor voltage and field voltage. Also motor and field current, as well as application related signals, should be recorded.
- Determine all polarities of the power stack and the thyristor numbers. Attention: the thyristor numbering, which is used nowadays in ABB DC drives, could be different from the old thyristor numbering. That should be checked to avoid any mistakes.
- With thyristors in parallel, verify if all thyristors are ok.

Help

Hardware to be engineered
Connection diagram



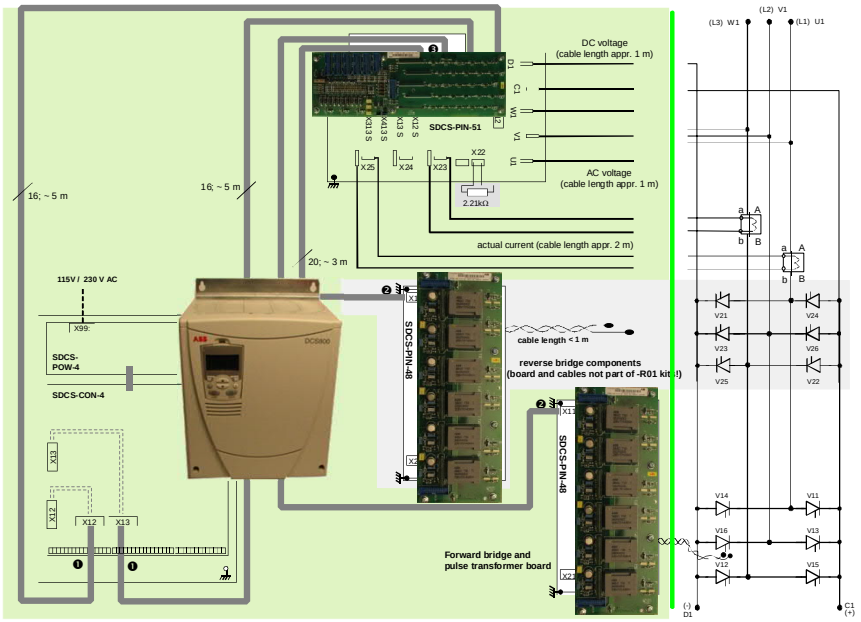
The picture shows the principle connection diagram for the DCS800 rebuild kit. On the right hand side of the green line is the power part, which will be reused. The power part consists of at least a single bridge used for 2-quadrant mode. In historic circuits, it is possible to have thyristors in parallel because in former times the power of the thyristor was limited.

Also a reverse bridge can be possible with the same historic arguments as described before.

On the right hand side of the green line is the control part with new components, which are included in the rebuild kit.

Help

Hardware to be engineered
Required hardware components



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The required hardware components for the rebuild kit are shown in the picture. The main part in the electronic housing, is connected to some other electronic boards. Only the electronic housing, the electronic boards and the cables are contents of the rebuild kit. Thyristors, current transformers and main switches should be reused or modernized, if necessary.

Help

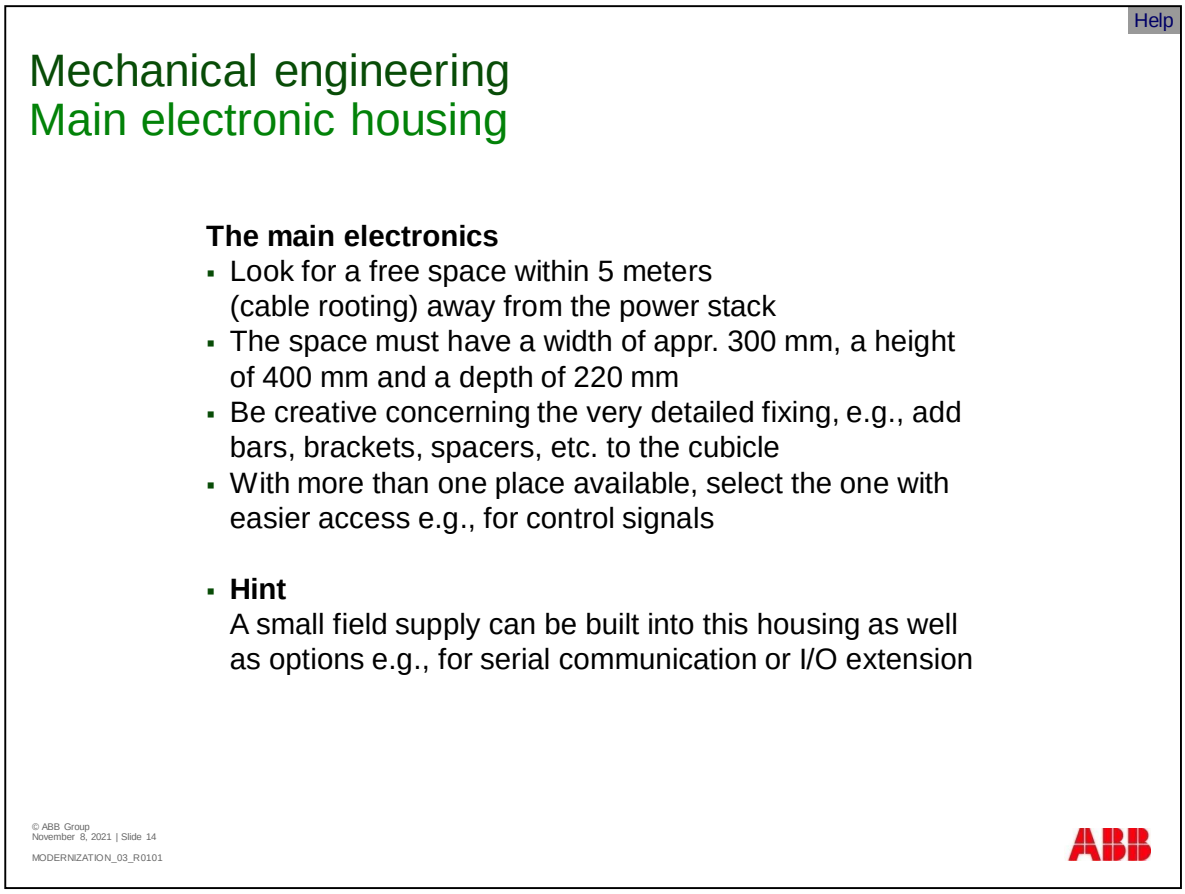
DCS800-R – Rebuild Kit
Hardware Components

Three groups of components, mounted in three different locations

- Main electronic housing
  - Mounted inside control cubicle
- SDCS-PIN-51, SDCS-REB-1, SDCS-REB-2, SDCS-REB-3
  - Mounted near the control cubicle
- SDCS-PIN-48
  - Mounted near the power part

Let us have a closer look at the hardware components of the DCS800 rebuild kit. We can divide the components into three large groups, because the mounting location is different.

- The main electronic housing will be mounted inside the control cubicle.
- The PIN-51 (spoken as one word), REB-1 (spoken as one word), REB-2 and REB-3 electronic boards are the second group of components. Those parts will be mounted near the control cubicle, but also close to the current transformers and the AC line.
- The PIN-48 board should be mounted near the power part because the maximum cable length between the thyristor and the PIN-48 board is 1 meter.



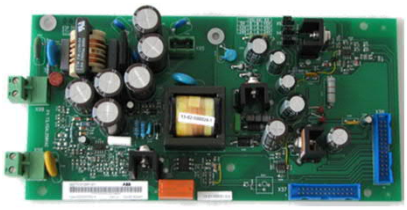
The next step is to find a location for the main electronic housing.

- Look for a free space within 5 meters cable routing of the power stack.
- The space must have a width of approximately 300 millimeters, a height of 400 millimeters and a depth of 220 millimeters.
- Be creative concerning the very detailed fixing. For example, add bars, brackets, spacers and so on to the cubicle.
- With more than one place available, select the one with easier access. This eases the connection for control signals later.

Hint: A small field supply can be built into this housing as well as options for serial communication, I/O extension and so on!

Help

DCS800-R – Rebuild Kit
Electronic housing



SDCS-CON-4

- Control board ‘brain of the drive’
- The firing pulses are generated here and sent to the SDCS-PIN-51
- Same board as in sizes D1 - D7

SDCS-POW-4

- Power supply
- Same board as in D5 - D7

SDCS-DSL-4

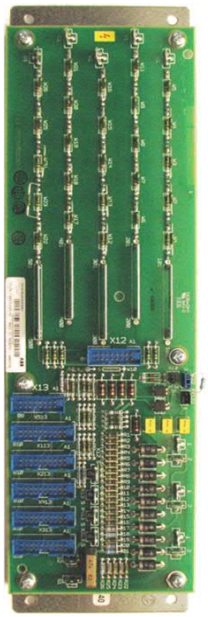
- This board mounts onto the SDCS-CON-4 and provides the DCSLink
- DCS800 Control Panel

The electronic housing consists of at least the following components.

- The CON-4 board is the brain of the drive. It is exactly the same as in all other DCS800 drives. The firing pulse is generated here and then sent to the PIN-51 board.
- The POW-4 board is the power supply for the electronics. It is the same board as for sizes D5 to D7 of DCS800 drives.
- The DSL-4 board is mounted onto the CON-4 board to provide the DCSLink, which is later used for drive-to-drive communication and the external field exciter connection.
- Inside the package is also the DCS800 Control Panel. With an additional door-mounting-kit, the DCS800 Control Panel can be mounted in cabinet doors.

Help

DCS800-R – Rebuild Kit
Measuring board PIN-51



SDCS-PIN-51

- Voltage measurement (AC and DC) and its scaling (voltage coding)
- Current measurement (CT's are connected here) and the scaling of the burden resistors (current coding)
- Sorting of firing pulses for different bridge types (e.g. D5, D6 and D7)
- Temperature supervision cannot be used for rebuild kits
- Only one is required for each drive

The PIN-51 board is very important for rebuild kit engineering.

- It is used for voltage measurement and its scaling. Scaling is to be done by high-ohmic resistors which will be adapted according to the voltage levels.
- Current measurement and its scaling are also possible here. Burden resistors adapt the ratio of the current transformer to the electronic level.
- Another task of this board is the sorting of the firing pulses.
- Note that the temperature supervision cannot be used for rebuild kits. Inside the rebuild kit package is a resistor, which is connected instead of the temperature sensor. This means if temperature measurement is required, it must be done externally!
- Only one PIN-51 board is required for each drive, regardless if it is a 2-quadrant or 4-quadrant one.

Help

Mechanical engineering
Measuring board PIN-51

The measuring board SDCS-PIN-51

- The place of this board is relatively uncritical
- It can be mounted halfway between the main electronics and pulse transformer board, but should be mounted as close as possible to the power stack (connections to the power stack will become easier)
- Once again, be creative concerning the very detailed fixing; it may become necessary now

- **Hint:**
  As with the PIN-48 board, voltage present at the power stack will be present in this board, too. Take care for clearance, creep age, isolation and proper grounding!

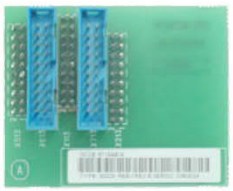
The measuring board PIN-51 must be engineered. Therefore some points need to be discussed here:

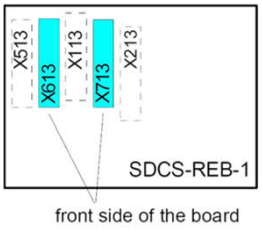
- The place of this board is relatively uncritical
- It can be mounted half way between the main electronics and the pulse transformer board, but should be mounted as close as possible to the power stack. Then connections to the power stack become easier.
- Once again, be creative concerning the very detailed fixing, as it may become necessary now.

Hint: As with the PIN-48 board, the voltage present at the power stack will be present in this board, too. Take care for clearance, creep age, isolation and proper grounding!

Help

DCS800-R – Rebuild Kit
Re-routing of firing pulses REB-1





SDCS-REB-1

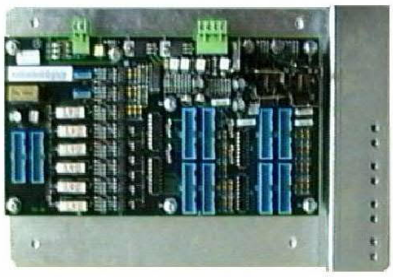
- This board has to be plugged into the SDCS-PIN-51 board
- The firing pulses are re-routed and prepared for the SDCS-REB-2
- If the SDCD-PIN-48 boards are connected directly to the SDCS-REB-1 board:
  - One SDCS-PIN-48 fires the forward bridge
  - One SDCS-PIN-48 fires the reverse bridge
- See diagram in the manual!

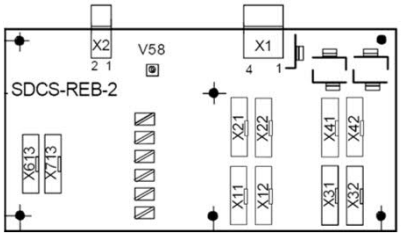
Re-routing of firing pulses is possible with the REB-1 board.

- This board has to be plugged into the PIN-51 board.
- The firing pulses are re-routed and prepared for the REB-2 board.
- In case the PIN-48 boards are connected directly to the REB-1 board:
  - One PIN-48 board fires the forward bridge and
  - One PIN-48 board fires the reverse bridge.

Help

DCS800-R – Rebuild Kit
Duplicate firing pulses with REB-2





SDCS-REB-2

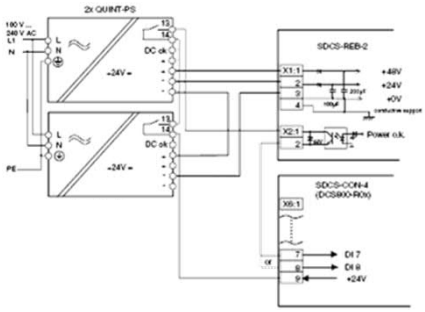
- Normally only needed with 2, 3 or 4 parallel B6 bridges
- The SDCS-REB-2 board is quadruples the firing pulses
- This board connects between the SDCS-REB-1 board and the SDCS-PIN-48. The purpose is to route firing signals to the parallel bridges
- 2, 3 or 4 parallel B6 bridges can be fired now with enough power
- Requires separate power supplies (e.g. 2 * QUINT-PS)
- Only one is required for each drive

The REB-2 board is used to duplicate firing pulses.

- This board is normally used with 2, 3 or 4 parallel B6 bridges.
- The REB-2 board quadruples the firing pulses. This could be necessary if parallel thyristors are used.
- This board connects between the REB-1 board and the PIN-48 board. The purpose is to route firing signals to parallel bridges.
- Typically, an external power supply is necessary to supply the thyristors with enough power.

Help

DCS800-R – Rebuild Kit
Enough power for the thyristors



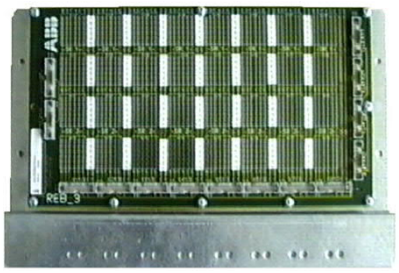
Power supply (2 * QUINT-PS)

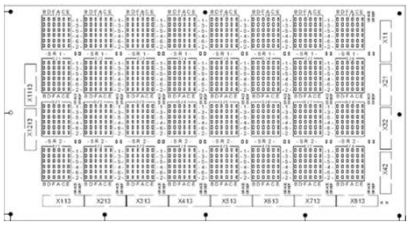
- The SDCS-REB-2 is always used together with 2 external 24 VDC / 2.5 A power supplies
- Needed for +24 VDC and +48 VDC supply
- Monitoring signals are available to allow the PLC to shut down the drive in case of power loss

The connection diagram shows how to connect the two power supplies. Then 24 volts and 48 volts are available at the REB-2 board.

Help

DCS800-R – Rebuild Kit
Individual design required?





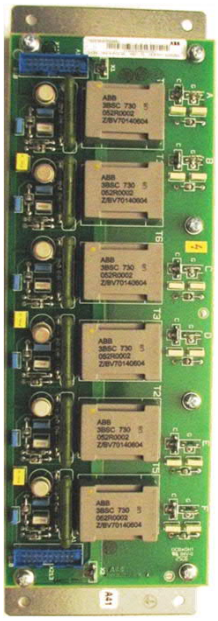
SDCS-REB-3

- SDCS-PIN-51, SDCS-REB-1 and SDCS-REB-2 are designed to ensure that the firing pulses for complete B6 bridges are available at the SDCS-PIN-48 board
- The SDCS-REB-3 enables the firing pulses to be individually assigned to the pulse transformers
- If used, the SDCS-REB-3 is always located between the SDCS-REB-2 and SDCS-PIN-48 board

Sometimes a customized design is necessary. The REB-3 board provides a free design area for the PIN-48 board. Then the REB-3 board enables the firing pulses to be individually assigned to the pulse transformers. If used, the REB-3 board is always located between the REB-2 and the PIN-48 board.

Help

DCS800-R – Rebuild Kit
Firing board PIN-48



SDCS-PIN-48

- Firing pulse transformer board which generates the pulses that control the thyristors
- Amplifying the firing pulses
- One SDCS-PIN-48 serves 6 thyristors thus follows
  - 2-Q, single bridge:
    → 1 PIN-48 board needed
  - 4-Q, forward and reverse bridge:
    → 2 PIN-48 boards needed
- To be mounted as close as possible to the thyristors (max. 1 m)

The PIN-48 is the firing pulse transformer board which generates the pulses that control the thyristors. In principle, it amplifies the firing pulses. One PIN-48 board serves 6 thyristors.

- For example, one PIN-48 board used for a 2-quadrant single bridge or two PIN-48 boards used for a 4-quadrant bridge.
- The boards have to be mounted as close as possible to the thyristors, but at a maximum of 1 meter.

Help

Mechanical engineering
Firing board PIN-48

The pulse transformer board SDCS-PIN-48

- The best performance of the new drive system can be achieved with the shortest gate cables possible
- Because of that, it is essential to select a place for that board as close as possible to the thyristors!!!
- As before, be creative concerning the very detailed fixing, e.g., add bars, brackets, spacers, etc. to the existing power stack or its cubicle

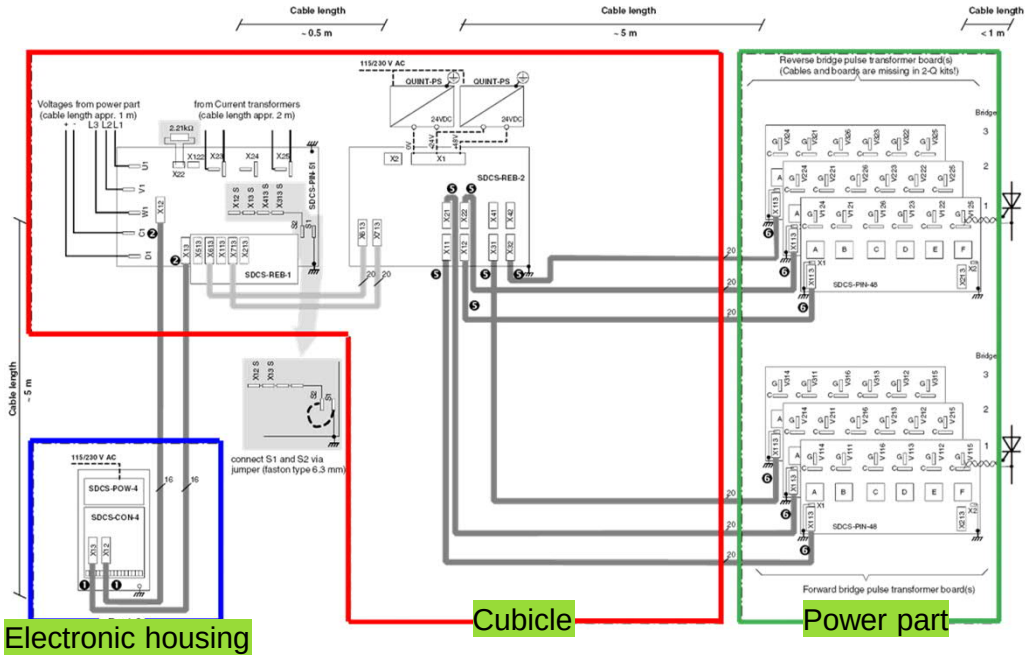
- **Hint:**
  Take care for enough clearance and creep age, correct isolation and grounding (bolting to metal parts)

The following points must be considered:

- The best performance of the new drive system can be achieved with the shortest gate cables possible.
- Because of that, it is essential to select a place for that board as close as possible to the thyristors.
- As before, be creative concerning the very detailed fixing. That means, add bars, brackets, spacers and so on to the existing power stack or its cubicle.

Hint: Take care for enough clearance and creep age, correct isolation and grounding.

DCS800-R – Rebuild Kit
Mounting location



In summary, we can say that we will have three mounting locations.

- The first one is the power part with the thyristors and the PIN-48 boards.
- In the second part, that is the control cubicle, we will mount the PIN-51 as well as the REB-2 board. It should be close to the power part because of cable limitations.
- Typically, the electronic housing can be mounted anywhere, but it is usually in the control cubicle, due to limited cable length.

Help

Summary

Key points of this module are:

- Engineering required for the DCS800 Rebuild Kit
- Hardware parts of the DCS800 Rebuild Kit
- How to connect the hardware parts

Key points of this module are:

- Engineering required for the DCS800 rebuild kit,
- Hardware parts of the DCS800 rebuild kit,
- How to connect the hardware parts.

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