



E-Learning, DC drives

DCS800-R Rebuild Kit Engineering, part 2 G566e Part 4

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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.

Objectives

This training module covers:

- Electrical engineering for the rebuild kit
- Connection and scaling for current measurement
- Connection and scaling for voltage measurement
- Commissioning steps for the rebuild kit

This training module covers:

- Electrical engineering for the rebuild kit,
- Connection and scaling for current measurement,
- Connection and scaling for voltage measurement,
- Commissioning steps for the rebuild kit.

Electrical engineering

General

The three components mounted before now need to be connected to each other and to the power stack:

- Engineering the main electronics:
 - Take the two 16 pole flat cables, check their marking (one with X12 the other with X13) or mark them
 - Connect X12 (main electronics) with X12 (SDCS-PIN-51 board); connect X13 with X13
 - Take care for proper grounding and shielding !!

Let's start with the electrical engineering for the DCS800 rebuild kit.

- The three components mounted before now need to be connected to each other and to the power stack.
- Engineering the main electronics:
 - Take the two 16-pole flat cables, check their marking or mark them.
 - Connect X12 of the main electronics with X12 of the PIN-51 board. Do the same with X13.
 - Take care for proper grounding and shielding!

Electrical Engineering SDCS-PIN-48 board



- Extra attention is now required
- 6 connections for 2-Q drives, 12 for 4-Q drives and even more with parallel bridges
- Make sure that all the thyristors are connected correctly. Incorrect wiring will cause damage to the power section (fuses and thyristors).
- Drive wiring diagrams may show the necessary information, but they have to be verified by checking the bridge with a meter

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Extra attention for the PIN-48 board is now required.

- 6 connections for 2-quadrant drives, 12 for 4-quadrant drives and even more with parallel bridges must be prepared.
- Make sure that all the thyristors are connected correctly. Incorrect wiring will cause damage to the power section.
- Drive wiring diagrams may show the necessary information, but they have to be verified by checking the bridge with a meter.

Electrical engineering

SDCS-PIN-48

The pulse transformer board SDCS-PIN-48:

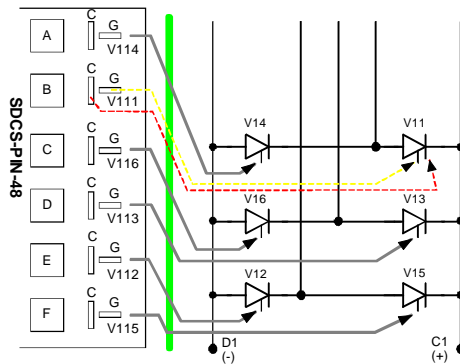
- Based on proper pre-engineering the location of the thyristor with regard to the electrical drawing is known
- Make sure the board is properly grounded via the mechanical fixing
- Start the wiring with the first thyristor V11 (phase U)
- Take one gate cable (twisted pair, two color, 6 in total)
- Mark it, if not marked (e.g. with V11 for thyristor 1)

Start the wiring like described here:

- Based on proper pre-engineering the location of the thyristor with regard to the electrical drawing is known.
- Make sure the board is properly grounded via the mechanical fixing.
- Start the wiring with the first thyristor V11.
- Take one gate cable and mark it, if not marked before, with V11 for thyristor one.

Electrical engineering

Thyristor connection



Connect the thyristors:

- Plug the first cable on channel V111
 - yellow = Gate
 - red = Cathode
- Run the twisted cable pair the shortest way up to thyristor V11 (target: less than 1 meter)
- Fix it mechanically
- Connect yellow wire to gate
- Connect red wire to cathode
- Do the same with the other thyristors: V12, V13, V14, V15, V16

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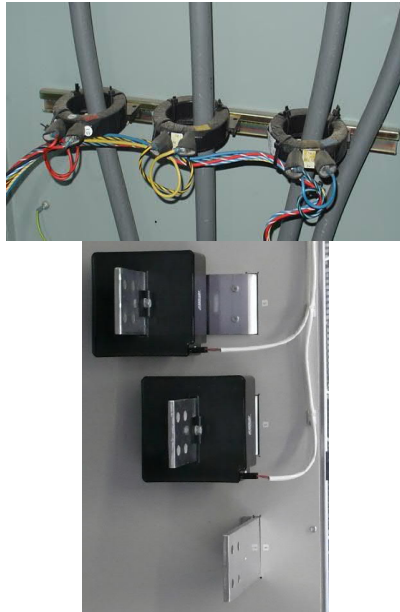
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The picture shows how to connect the thyristors.

- Plug the first cable on channel V111 at the PIN-48 board. Yellow is the gate and red is the cathode for the thyristor.
- Run the twisted pair cable the shortest way up to thyristor V11. The distance must be less than 1 meter.
- Fix it mechanically and connect then the yellow wire to the gate of the thyristor and the red wire to the cathode of the thyristor.
- Do the same with the other thyristors V12, V13, V14, V15 and V16.

Electrical engineering

Current transformer (CT)



- The CTs are components of the power part and usually re-used
- CTs are typically used to measure the AC current of the connected mains (e.g. L1 & L3)
- The drive needs to convert the CT current into voltage. This is done by means of a burden resistor
- To adapt the drive to the existing CTs, the resistance of the burden resistor needs to be adjusted
- Therefore the ratio of the CTs (e.g. 2500:1), the nominal current I_{dN} and peak current I_{peak} of the power part must be known

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- The current transformers, in short CTs, are components of the power part and usually re-used for the modernization.
- CTs are typically used to measure the AC current of the connected mains. Normally, only two lines will be measured, for example L1 and L3.
- The drive needs to convert the CT current into voltage. This is done by means of a burden resistor.
- To adapt the drive to the existing CTs, the resistance of the burden resistor needs to be adjusted.
- Therefore, the ratio of the CTs, the nominal current and the peak current of the power part must to be known.

Electrical engineering

SDCS-PIN-51

The measuring board SDCS-PIN-51:

- Make sure the board is properly grounded via the mechanical fixing
- Make sure that the PIN-51 and the pulse transformer board's mechanical fixing have the same potential
- Plug the SDCS-REB-1 board into the SDCS-PIN-51 board (X513 to X513, X113 to X113, X213 to X213)
- Take the 20 pole flat cable, mark it, if not marked already, and connect the X613 (SDCS-REB-1) to the X113 (SDCS-PIN-48)
- Take care for proper shielding on both ends!
- Plug a 2.21KOhm resistor into the X22 for temperature simulation

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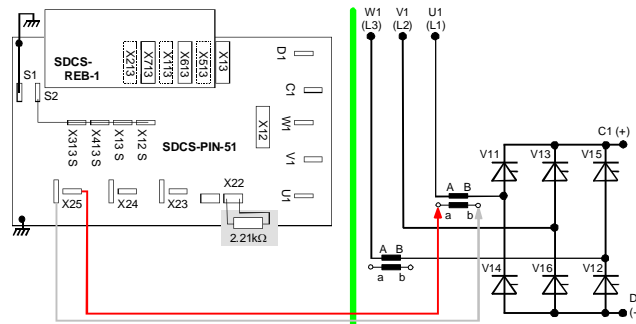


The measuring board PIN-51 will be wired now.

- Make sure the board is properly grounded via the mechanical fixing.
- Make sure that the mechanical fixing of both the PIN-51 board and the PIN-48 pulse transformer board have the same potential.
- Plug the REB-1 board into the PIN-51 board.
- Take the 20 pole flat cable, mark it, if not marked already, and connect the X613 of the REB-1 to the X113 of the PIN-48.
- Take care for proper shielding on both ends of the cable!
- Plug a 2.21 kiloohm resistor into the X22 for temperature simulation.

Electrical engineering

Current transformer (CT)



- Check all CTs for the same orientation and same type
- Take one CT cable (twisted pair, two color, 3 in total), mark it, if not marked (e.g., with X25) and plug it into X25
- Run the twisted pair cables the shortest way and not in parallel of power cables up to the CT; fix it mechanically
- Connect red to one CT pin, grey to the other

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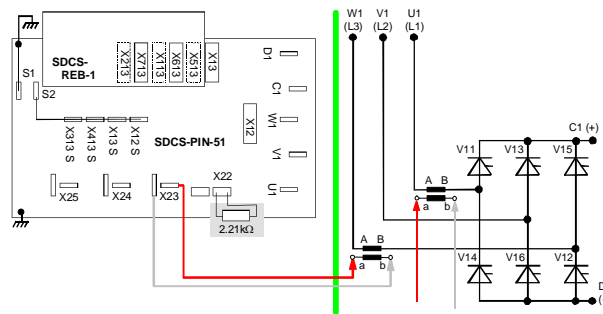
ABB

The picture shows the power part with the current transformers and the PIN-51 board. Now follow the instructions to connect the CTs properly:

- Check all CTs for the same orientation and same type.
- Take one CT cable, mark it, if not marked already, and plug it into X25.
- Run the twisted pair cables the shortest way and not in parallel of power cables up to the CT and fix it mechanically.
- Connect red to one CT pin and grey to the other one.

Electrical engineering

Current transformer (CT)



- Do the same with the other CTs
- Make sure the same terminals will be used with other CTs as were used with the first!
- It does not matter, if red is connected to 'a' or 'b'; it is important that all CTs have a connection with the same color at the same terminal!

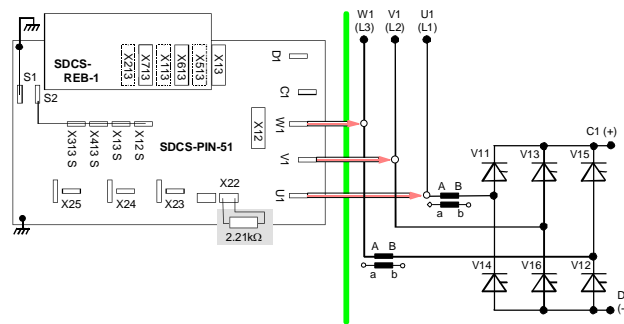
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- Now we know how to connect a CT properly to the measuring board.
- Do the same with the other CTs.
- Make sure the same terminals will be used with the other CTs as were used with the first CT!
- It does not matter, if red is connected to a or b. It is important that all CTs have a connection with the same color at the same terminal.

Electrical engineering

AC Voltage measurement



- Take one of the 5 single strand cables (white and orange), mark it, if not marked (e.g. with U1) and plug it on pin U1
- Run the cable the shortest way, but not in parallel of power cables, up to any point at phase U1; fix it mechanically and do the electrical connection
- Do the same with V1-V1 phase and W1-W1 phase

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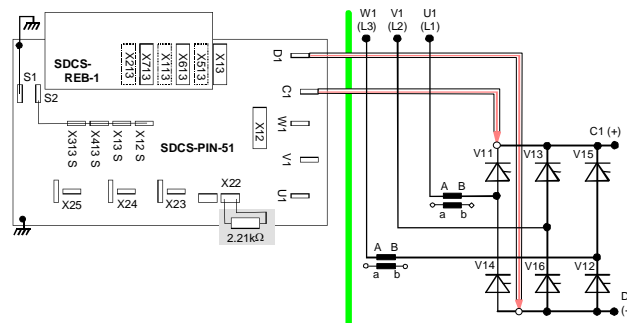
ABB

The next step is the connection of the AC voltage measurement.

- Take one of the 5 single strand cables. Mark it and plug it to pin U1 of the PIN-51 board.
- Run the cable the shortest way, but not in parallel of power cables, up to any point at the phase U1. Fix it mechanically and do the electrical connection.
- Do the same with V1 – V1 phase and W1 – W1 phase.

Electrical engineering

DC voltage measurement



- Take one of the 5 single strand cables (white and orange), mark it, if not marked (e.g. with C1) already, and plug it on pin C1
- Run the cable the shortest way, not in parallel of power cables, up to any point at C1 of the stack; fix it mechanically and do the electrical connection
- Do the same with D1-D1 stack

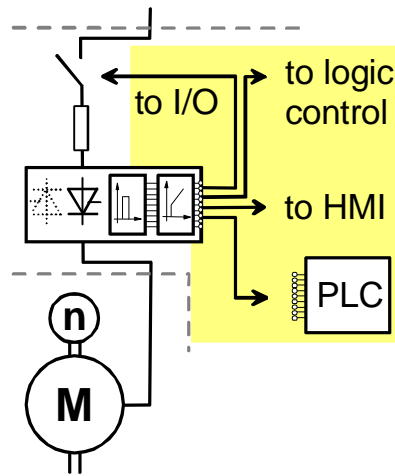
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Now the DC voltage measurement should be connected.

- Take one of the 5 single strand cables, mark it and plug it to pin C1 of the PIN-51 board.
- Run the cable the shortest way, but not in parallel of power cables, up to any point at C1 of the stack. Fix it mechanically and do the electrical connection.
- Do the same with the D1 – D1 stack.

Control engineering Interface



- DCS800-R0x uses, as all the other DCS800 products do, the same SDCS-CON-4 for control. So, the Control Engineering is identical!
- Control engineering covers items like:
 - Definition of signals sent to and received from
 - Any relay logic,
 - Any type of sensors,
 - The PLC,
 - The Human Machine Interface
 - Definition of logical functions, any calculation or re-scaling

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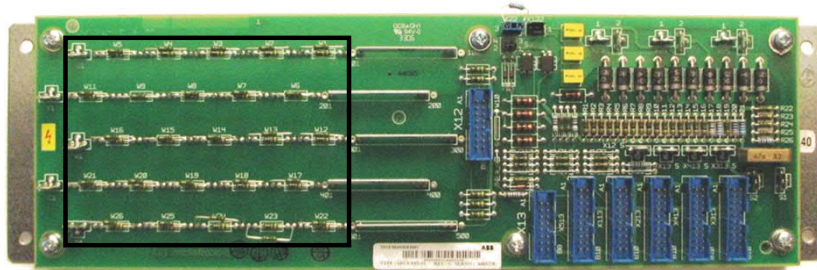
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Every drive has to be controlled to give references, i.e. start – stop commands and further commands.

- DCS800 rebuild kits use, as do all the other DCS800 products, the same CON-4 board for control. So, the control engineering is completely identical.
- Control engineering covers items like:
 - Definition of signals sent to and received from any relay logic, any type of sensor, the PLC or the human machine interface.
 - Definition of logical functions, any calculation or re-scaling necessary for drive operation.

Preparation for Commissioning

Voltage coding



| Voltage applied to the power stack | appr. 200...500 V | 501...600 V | 601...700 V | 701...800 V | 801...990 V |
|------------------------------------|-------------------|------------------|------------------|------------------|------------------|
| Value for S ConvScaleVolt (97.03) | 500 | 600 | 690 | 800 | 1000 |
| W1, 6, 12, 17, 22 | ○—○ | ⊗ × ○ | ⊗ × ○ | ⊗ × ○ | ⊗ × ○ |
| W2, 7, 13, 18, 23 | ○—○ | ○—○ | ⊗ × ○ | ⊗ × ○ | ⊗ × ○ |
| W3, 8, 14, 19, 24 | ○—○ | ○—○ | ○—○ | ⊗ × ○ | ⊗ × ○ |
| W4, 9, 15, 20, 25 | ○—○ | ○—○ | ○—○ | ○—○ | ⊗ × ○ |
| W5, 11, 16, 21, 26 | ○—○ | ○—○ | ○—○ | ○—○ | ⊗ × ○ |

⊗~~×~~○ indicates a removed jumper

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Now all cables are connected and the next step is the voltage coding.

- Voltage coding will be done by resistors at the PIN-51 board.
- Have a look at the coding table and find out which voltage is at the power stack and read the resistors to be removed for the correct coding.
- Note that the scaling from the resistors must also be used for the software scaling in parameter 97.03

Preparation for Commissioning

Voltage coding

There are a few actions to be done specifically for the DCS800-R0x :

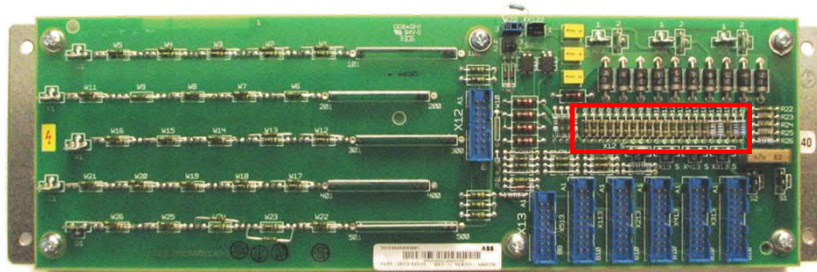
- Nominal voltage scaling via jumper and parameter; (jumper and parameter must represent the same value)
- Select a column from the coding table, which represents the nominal line voltage applied to the power stack
- Cut the jumper as indicated on the SDCS-PIN-51 board
- Use that value given at that column in parameter [97.03]
- Check software accepted scaling in parameter [4.04]

There are a few rebuild kit actions to be done specifically to set up the voltage coding.

- Nominal voltage scaling via jumper and parameter. Note that both jumper and parameter must represent the same value!
- Select a column from the coding table, which represents the nominal line voltage applied to the power stack.
- Cut the jumper as indicated on the PIN-51 board.
- Use that value given in that column in parameter 97.03.
- Check software accepted scaling in parameter 4.04.

Preparation for Commissioning

Current scaling



- The nominal converter current I_{dN} is equivalent to 1.5 V across the nominal current burden resistors (R1 to R21)
- The current measurement is designed to handle peak currents I_{peak} up to two times I_{dN} (equivalent to 3 V)
- The zero current detection is done automatically (no cutting required)

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Current scaling for the current transformers is required, too.

- The nominal converter current is equivalent to 1.5 volts across the nominal burden resistor R1 to R21.
- The current measurement is designed to handle peak currents up to two times its size, which is equivalent to 3 volts.
- The zero current detection is done automatically, therefore no cutting is required.

Preparation for Commissioning

Current scaling

| Current transf. ratio | | 2500A : 1A | | | | | 4000A : 1A | | | | |
|---|--------------|------------|------|------|------|------|------------|------|------|------|-----|
| Nominal current $I_{n, CT}$ [A] | | 500 | 1000 | 1500 | 2000 | 3000 | 2000 | 3000 | 4000 | 5000 | |
| Value for S.ConvScaleCur (97.02) | | 500 | 1000 | 1500 | 2000 | 3000 | 2000 | 3000 | 4000 | 5000 | |
| R1-R4 | 18 Ω | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ |
| R5 | 18 Ω | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ |
| R6 | 18 Ω | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ |
| R7 | 18 Ω | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ |
| R8 | 18 Ω | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ |
| R9 | 18 Ω | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ |
| R10 | 18 Ω | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ |
| R11 | 18 Ω | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ |
| R12 | 18 Ω | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ |
| R13 | 18 Ω | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ |
| R14 | 18 Ω | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ |
| R15 | 18 Ω | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ |
| R16 | 18 Ω | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ |
| R17 | 18 Ω | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ |
| R18 | 18 Ω | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ |
| R19 | 18 Ω | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ |
| R20 | 18 Ω | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ |
| R21 | 270 Ω | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ |
| R22 | 560 Ω | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ |
| R23 | 47 Ω | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ |
| R24 | 47 Ω | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ |
| R25 | 47 Ω | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ |
| R26 | 100 Ω | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ |
| Zero current detection; all resistors are used: | | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ | ○—○ |

○—○ indicates a removed jumper

- Nominal current scaling via jumper and parameter (jumper and parameter must both represent the same value)
- If the CTs in use have a ratio of
 - 2500A : 1A or 4000A : 1A

Select a column from the table above which represents the best the nominal current of the power stack

There is also a coding table available for the current scaling.

- Nominal current scaling via jumper and parameter. Here, the same rule is valid as for the voltage coding: jumper and parameter must both represent the same value!
- If the current transformers in use have a ratio of 2500 Ampere to 1 Ampere or 4000 Ampere to 1 Ampere, select a column from the table above which represents the best nominal current of the power stack.

Preparation for Commissioning

Current scaling

- Cut the jumper as indicated on the SDCS-PIN-51 board
- Use that value given in that column in parameter [97.02]
- If the ratio of the CTs is different:
 - Calculate necessary burden resistance R_b :
 $R_b = \text{CT ratio times } 1.5\text{V divided by the nominal current of the power stack } (I_{n_ps})$
 (equation for peak current smaller or equal to 2 times I_{n_ps})
 - Determine the resistors necessary to get R_b :
 $R_b = 1 \text{ divided by } (1/R_1 + 1/R_2 + 1/R_3 + \dots + 1/R_{20} + 1/R_{21})$
 (all resistors NOT used within this equation have to be cut at one end)
 - Cut the resistors not taken into consideration
 - Use the current value in [97.02] the calculation was based on

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- Cut the jumper as indicated on the PIN-51 board.
- Use that value given in that column in parameter 97.02.
- If the ratio of the current transformers is different, calculate as follows:
 - Calculate the necessary burden resistance. The resistance is equivalent to the current transformer ratio multiplied by 1.5 volts and divided by the nominal current of the power stack. Note the peak current, used for overload conditions, is smaller or equal to two times the nominal current.
 - Determine the resistors necessary to get the correct resistance. The resistance can be calculated by using the equation shown. Note: all resistors not used within this equation have to be cut at one end!
 - Cut the resistors not taken into consideration.
 - Use the current value in parameter 97.02 that the calculation was based on.

Preparation for Commissioning Parameter settings

| Converter | Parameter | Parameter no. | Settings | Remarks |
|------------------------------------|------------------------|---------------|----------------------|--|
| type code | TypeCode | (97.01) | NONE | |
| nominal current | S ConvScaleCur | (97.02) | xxxxx (A) | as coded |
| nominal voltage | S ConvScaleVolt | (97.03) | xxx (V) | as coded |
| power stack temperature monitoring | S MaxBrdgTemp | (97.04) | 60 (°C) | |
| 2-Q or 4-Q mode | S BlockBridge2 | (97.07) | 1 2 | at 2-Q power part at 4-Q power part |

- Due to a non-existing type code for the rebuild kit, the so-called S-parameters must be set
- Note that nominal current and nominal voltage must be set according to coded hardware

Some parameter settings are necessary to adapt the rebuild kit hardware to the drive software. These parameters are shown in the table.

- Due to a non-existing type code for the rebuild kit, the so-called S-parameters must be set.
- Once again, note that nominal current and nominal voltage must be set according to coded hardware.

Commissioning (1)

- Commissioning a DCS800-R0x is basically the same as with all other DCS800 products!
- Start as described in the DCS800 documentation:
 - Preparation, all types of safety, engineering check, etc.
 - Perform DCS800-R0x specific hardware adaptations
 - Parameter setting, e.g. using DriveWindow Light wizard
 - Perform DCS800-R0x specific parameter settings
 - Check DCS800-R0x wiring using firing angle limitation (see manual 3 ADW 000 197 chapter START-UP)
 - Depending on the application, perform the other steps, if applicable

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- The commissioning of the DCS800 rebuild kit is basically the same as with all other DCS800 products!
- Start as described in the DCS800 documentation:
 - Preparation for all types of safety and engineering checks.
 - Perform the DCS800 rebuild kit specific hardware adaptations.
 - Parameter settings, for example, by using the DriveWindow Light wizard or any other ABB software tools.
 - Check the DCS800 rebuild kit wiring using firing angle limitation. Note: a detailed description can be found in the “Start-up” chapter of the rebuild manual!
 - Depending on the application, perform the other steps, if applicable.

Commissioning (2) Measurements

- Measure current bubbles on the DC side (AO3) by using an oscilloscope:
 - Positive current (forward bridge)
 - Negative current (reverse bridge)
- Measure correct current scaling at the DC side by using an ampere meter
 - Compare the result with [1.15] Converter Current
 - Attention: Motor current and converter current can be different!
- Measure correct voltage scaling on the AC side by using a voltmeter
 - Compare the result with [1.11] Mains Voltage

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It is useful to perform some measurements to check the correct scaling between hardware and software.

- Measure current bubbles on the DC side at analog output 3 by using an oscilloscope to check the correct function of all thyristors. Do this with positive and negative currents, to check the forward and reverse bridges respectively.
- Measure correct current scaling on the DC side by using an ampere meter. Compare the result with parameter 1.15 converter current.
- Measure correct voltage scaling on the AC side by using a voltmeter. Compare the result with parameter 1.11 mains voltage.

Summary

Key points of this module are:

- Electrical engineering
- Connection for current measurement
- Connection for voltage measurement
- Commissioning steps

Key points of this module are:

- Electrical engineering for the rebuild kit,
- Connection and scaling for current measurement,
- Connection and scaling for voltage measurement,
- Commissioning steps for the rebuild kit.

Additional information

- DCS800-R Rebuild Kits Manual (3ADW000197)

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