Application SINAMICS DCM as a DC voltage source
Compact User Manual

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

### DANGER

indicates that death or severe personal injury will result if proper precautions are not taken.

### WARNING

indicates that death or severe personal injury may result if proper precautions are not taken.

### CAUTION

indicates that minor personal injury can result if proper precautions are not taken.

### NOTICE

indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by personnel qualified for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

### WARNING

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.
Table of contents

1 Instructions ........................................................................................................................................... 2
2 Introduction .......................................................................................................................................... 2
3 SINAMICS DCM for charging and discharging batteries .................................................................. 3
4 SINAMICS DCM as a constant voltage source for DC motors as load .................................................. 4
5 SINAMICS DCM for resistive load, e.g. resistance heating .................................................................. 5
6 SINAMICS DCM for electrolytic applications ....................................................................................... 6
7 SINAMICS DCM for the DC link infeed of pulse inverters ................................................................... 7
8 References ............................................................................................................................................. 8

1 Instructions

Note
This application document does not claim to contain all details and versions of units, or to take into account all conceivable operational cases and applications. The standard applications do not represent specific customer solutions, but are only intended to provide support in the implementation of typical applications. The operator is responsible for the correct operation of the products described. Should you require further information or encounter specific problems which have not been handled in enough detail, please contact your local Siemens office. The contents of this application document are not part of an earlier or existing contract, agreement or legal relationship, nor do they change such contracts, agreements or legal relationships. The contract of sale in each case outlines all the obligations of the I DT Drive Technologies Division of Siemens AG. The warranty conditions specified in the contract between the parties are the only warranty conditions accepted by the I DT Drive Technologies Division. Any statements contained herein neither create new warranties nor modify the existing warranty.

WARNING

Observe safety notices in the associated operating instructions
The units listed here contain dangerous electric voltages, dangerous rotating machine parts (fans) and control rotating mechanical parts (drives). Failure to follow the relevant operating instructions may result in death, serious injury or extensive material damage.

Technical Support
You can also find help for technical issues through our Technical Support:
www.siemens.de/automation/support-request (German)
www.siemens.com/automation/support-request (English)

2 Introduction
The SINAMICS DCM is primarily used to control DC motors.
The universal suitability of the SINAMICS DCM as a DC drive also allows it to be used as an adjustable voltage source. Since the integrated field supply is not required in this case, the SINAMICS DCM can be used with option L10 (without field power unit).
Several examples of how to use the SINAMICS DCM as a voltage regulator are described below.
Perform commissioning according to Chapter 8.2 of the SINAMICS DCM DC Converter operating instructions.
3 SINAMICS DCM for charging and discharging batteries

Schematic circuit diagram

1. Matching transformer, 4% uk
   \[ S[VA] = U_V[V] \times 1.35 \times 1.05 \times I_{DC}[A] \]
2. Line contactor (optional) acc. to Catalog IC10
3. Semiconductor fuse acc. to Catalog D23.1
4. SINAMICS DCM acc. to Catalog D23.1
   - 2Q: Charge battery, \( U_{DC \ max}[V] = U_V[V] \times 1.2 \)
   - 4Q: Charge and discharge the battery: \( U_{DC \ max} = U_V \times 1.05 \)
5. DC fuse, (only for 4Q) acc. to Catalog D23.1
6. Smoothing reactor for 5% ripple
7. Isolation amplifier, output 0 - 10 V
8. Analog input SINAMICS DCM, e.g. tachometer input terminal 103 / 104
9. Load / battery

Smoothing reactor
Since the internal resistance of the battery is very low, there is a high current ripple. Using a smoothing reactor in the DC circuit is therefore recommended.

Configuration of the smoothing reactor for 5% current ripple

<table>
<thead>
<tr>
<th>Rated direct current</th>
<th>Smoothing reactor</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 A</td>
<td>50 mH</td>
</tr>
<tr>
<td>100 A</td>
<td>15 mH</td>
</tr>
<tr>
<td>300 A</td>
<td>5 mH</td>
</tr>
<tr>
<td>1000 A</td>
<td>1.5 mH</td>
</tr>
</tbody>
</table>

Commissioning
Carry out the wiring according to the schematic circuit diagram.
Use an isolation amplifier with evaluation via an analog input (e.g. tachometer input) to record the battery voltage: Terminal 103 / 104.
Setting p50083 = 1, p50741 normalization of maximum voltage for battery. p2000 must be set to a value that deviates from the factory setting. The speed controller now operates as a voltage regulator.

Optimization
Disconnect the battery and replace with a jumper (possible only if a smoothing reactor is used).
Perform current controller optimization p50051 = 25.
Connect the battery and optimize the voltage regulator manually, refer to FAQ fault diagnosis (Internet). Set current limit to maximum charging/discharging current.
4 SINAMICS DCM as a constant voltage source for DC motors as load

Schematic circuit diagram

DCM SINAMICS DCM acc. to Catalog D23.1

Maximum output voltage:

- 2Q: \( U_{DC} = UV \times 1.2 \)
- 4Q: \( U_{DC} = UV \times 1.05 \)

F1 DC fuse acc. to Catalog D23.1; only for 4Q

RV Starter resistor for the DC motors to prevent impermissibly high motor current during startup of the motors, if necessary, several resistors in series bypassed depending on the speed of the motors

S1 To activate and deactivate the motor groups

S2 Closed after startup of the motors to bypass the RV resistor

GM DC motors, 4 motors in 2 groups in this example

Commissioning

Adjustment is carried out to match the output voltage of the SINAMICS DCM. The speed controller operates as a voltage regulator.

Since activation and deactivation of the motor groups changes the controlled system, data set switching is used for different configurations of the controller settings. The SINAMICS DCM has 4 DDS (Drive Data Sets) for this purpose. Depending on the number of motors, a different DDS is selected to perform optimization of the current controller. During operation, the corresponding data set is then selected depending on the particular configuration.

Selection of the actual voltage source: \( p50083 = 4 \), \( p50609 = 52292 \) (connector actual voltage).

Select DDS and perform current controller optimization \( p50051 = 25 \).

The voltage regulator is optimized manually, refer to FAQ fault diagnosis (Internet).
5  SINAMICS DCM for resistive load, e.g. resistance heating

Schematic circuit diagram

DCM  SINAMICS DCM, 2Q device. acc. to Catalog D23.1
U_{DC} \text{ max}\,[V] = U_{V}\,[V] \times 1.2

R  Load impedance
- Use smoothing reactor as necessary
- New connectors as of Firmware V1.4
- r52126: rms value direct current
- r52127: rms value direct voltage
- r52128: Active power

Commissioning
The SINAMICS DCM can be operated with voltage or current control.
Selection of the actual voltage source: p50083 = 4, p50609 = 52292 (connector actual voltage)
The control parameters can be left at their factory settings.
SINAMICS DCM for electrolytic applications

**Schematic circuit diagram**

- **T** Isolating; \( S[VA] = Uv[V] \times 1.35 \times 1.05 \times IoC[A] \); uk: 4%
- **F** Semiconductor fuse acc. to Catalog D23.1
- **DCM** SINAMICS DCM acc. to Catalog D23.1
- 2Q device, \( U_{DC \text{ max}}[V] = Uv[V] \times 1.2 \)
- **L\(_V\)** Smoothing reactor recommended to reduce current ripple
- **B** Load; electrolytic bath

### Rated direct current

<table>
<thead>
<tr>
<th>Current (A)</th>
<th>Smoothing reactor for 5% current ripple</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>40 mH</td>
</tr>
<tr>
<td>100</td>
<td>10 mH</td>
</tr>
<tr>
<td>300</td>
<td>4 mH</td>
</tr>
<tr>
<td>1000</td>
<td>1.2 mH</td>
</tr>
</tbody>
</table>

### Commissioning

The SINAMICS DCM can be operated with voltage or current control.

Selection of the actual voltage source: \( p50083 = 4 \), \( p50609 = 52292 \) (connector actual voltage).

The control parameters can be left at their factory settings or optimized manually if required.
7 SINAMICS DCM for the DC link infeed of pulse inverters

Note
The SINAMICS DCM cannot be used as a direct replacement for the MASTERDRIVES I/R units. The SINAMICS DCM is not suitable for highly dynamic applications. Use the SINAMICS Active Line Module (ALM) for dynamic applications.

Schematic circuit diagram

DCM  SINAMICS DCM acc. to Catalog D23.1
2Q: $U_{DC}^{\text{max}} = U_V^{\text{max}} \times 1.2$
4Q: $U_{DC}^{\text{max}} = U_V^{\text{max}} \times 1.05$
F1  Semiconductor fuse acc. to Catalog D23.1; required for 4Q only
LV  A low smoothing inductance is recommended
RES  Set base load resistor to 0.5 A
C  Load: DC link capacitor of the pulse inverter

Rated direct current  Smoothing reactor
30 A  5 mH
100 A  1.5 mH
300 A  0.5 mH
1000 A  0.15 mH
3000 A  0.05 mH

Commissioning
Selection of the actual voltage source: $p50083 = 4$, $p50609 = 52292$ (connector actual voltage).
Short circuit the DC link capacitance and perform optimization for the current controller $p5005 = 25$ (permissible only if a smoothing reactor is used)
Set $p50153 = 2$
Further settings
$p50159 = 0.01$
$p50601[5] = 52401$
$p50401 = 0.02$
Optimize the voltage regulator manually, refer to FAQ fault diagnosis (Internet).

Note
The normalization of the actual voltage $r52292$ is 100% = $p50078[0] \times 1.35$.
Normalization of the actual voltage for the control must be carried out in the setpoint channel.
$p50433[C]$: Set to the connector number for the setpoint.
$p50320[D] = \text{xxx normalization parameter}$
For $U_{DC}^{\text{max}} = U_V^{\text{max}} \times 1.05$: $\text{xxx} = 1.05 / 1.35 = 78\%$
For $U_{DC}^{\text{max}} = U_V^{\text{max}} \times 1.2$: $\text{xxx} = 1.2 / 1.35 = 89\%$
8 References

Catalog D23.1 for SINAMICS DCM and its accessories

FAQ fault diagnosis for configuration and control optimization


Trademarks

All names identified by © are registered trademarks of Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

Siemens AG
Industry Sector
Postfach 48 48
90026 NÜRNBERG

Application SINAMICS DCM as a DC voltage source
A5E33483768A, 01/2014