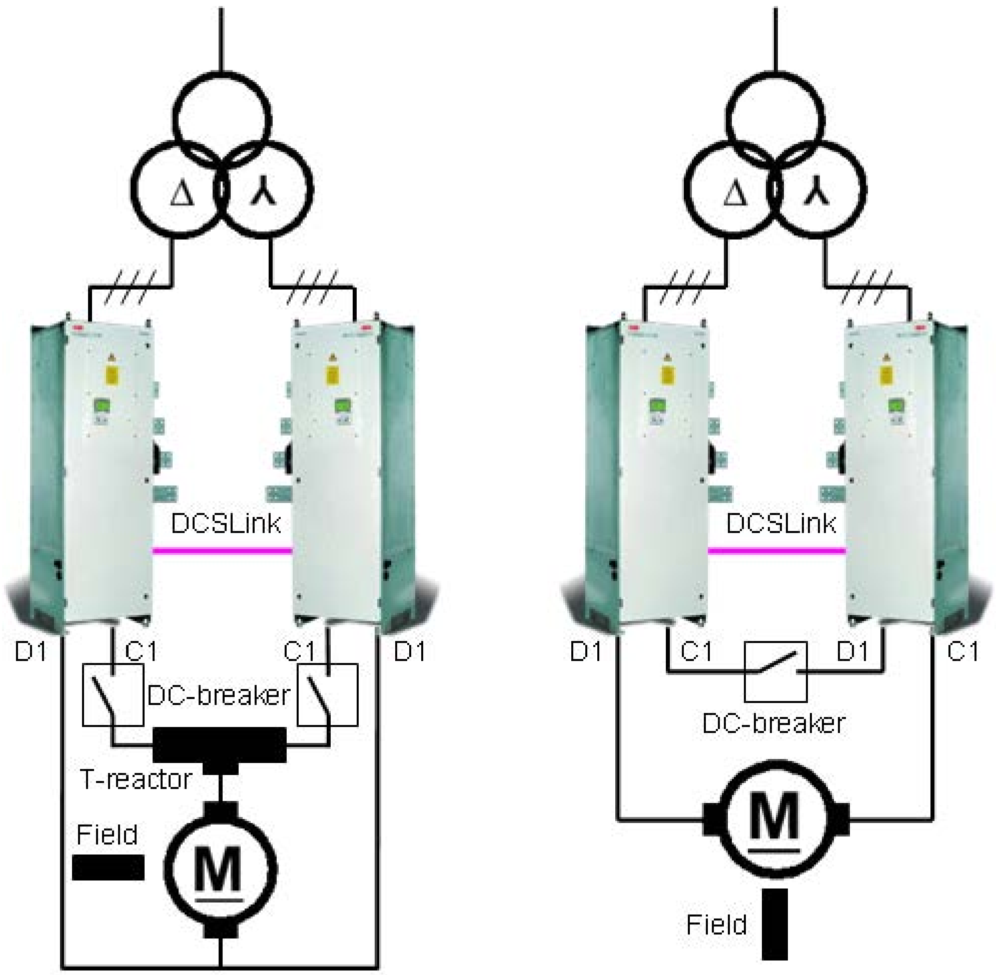
DCS800

12-pulse Manual
DCS800 Drives (20 to 5200 A / 10400 A)



ABB

DCS800 Drive Manuals

		Language							
	Public. number	E	D	I	ES	F	CN	RU	PL
DCS800 Quick Guide	3ADW000191	x	x	x	x	x			
DCS800 Tools & Documentation CD	3ADW000211	x							
DCS800 Converter module									
Flyer DCS800	3ADW000190	x	x		x	x			
Technical Catalogue DCS800	3ADW000192	x	x	x	x	x	x	x	
Hardware Manual DCS800	3ADW000194	x	x	x	x	x	x	x	x
Hardware Manual DCS800 update DCF503B/DCF504B	3ADW000194Z0301	x							
Firmware Manual DCS800	3ADW000193	x	x	p	x	x	x	x	x
Installation according to EMC	3ADW000032	x							
Technical Guide	3ADW000163	x							
Service Manual DCS800	3ADW000195	x	x						
12-Pulse Manual	3ADW000196	x							
CMA-2 Board	3ADW000136	p							
Flyer Hard - Parallel	3ADW000213	x							
Drive Tools									
DriveWindow 2.x - User's Manual	3BFE64560981	x							
DriveOPC 2.x - User's Manual	3BFE00073846	x							
Optical DDCS Communication Link	3AFE63988235	x							
DDCS Branching Units - User's Manual	3BFE64285513	x							
DCS800 Applications									
PLC Programming with CoDeSys	CoDeSys_V23	x	x			x			
61131 DCS800 target +tool description - Application Program	3ADW000199	x							
DCS800 Crane Drive									
DCS800 Crane Drive Manual suppl.	3AST004143	x							
DCS800 Crane Drive Product note	PDC5 EN REVA	p							
DCS800 Winder ITC									
DCS800 Winder Product note	PDC2 EN	x							
DCS800 Winder description ITC	3ADW000308	x							
Winder Questionnaire	3ADW000253z	x							
DCS800-E Panel Solution									
Flyer DCS800-E Panel solution	3ADW000210	x							
Hardware Manual DCS800-E	3ADW000224	x							
DCS800-A Enclosed Converters									
Flyer DCS800-A	3ADW000213	x							
Technical Catalogue DCS800-A	3ADW000198	x							
Installation of DCS800-A	3ADW000091	x	x						
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Flyer DCS800-R	3ADW000007	x	x						
DCS800-R Manual	3ADW000197	x							
DCS500/DCS600 Size A5...A7, C2b, C3 and C4 Upgrade Kits	3ADW000256	x							
Extension Modules									
RAIO-01 Analogue IO Extension	3AFE64484567	x							
RDIO-01 Digital IO Extension	3AFE64485733	x							
RRIA-01 Resolver Interface Module	3AFE68570760	x							
RTAC-01 Pulse Encoder Interface	3AFE64486853	x							
RTAC-03 TTL Pulse Encoder Interface	3AFE68650500	x							
AIMA R-slot extension	3AFE64661442	x							
Serial Communication									
Drive specific serial communication									
NETA Remote diagnostic interface	3AFE64605062	x							
Fieldbus Adapter with DC Drives RPBA- (PROFIBUS)	3AFE64504215	x							
Fieldbus Adapter with DC Drives RCAN-02 (CANopen)									
Fieldbus Adapter with DC Drives RCNA-01 (ControlNet)	3AFE64506005	x							
Fieldbus Adapter with DC Drives RDNA- (DeviceNet)	3AFE64504223	x							
Fieldbus Adapter with DC Drives RMBA (MODBUS)	3AFE64498851	x							
Fieldbus Adapter with DC Drives RETA (Ethernet)	3AFE64539736	x							
x -> existing p -> planned									
Status 04.2010									

DCS800 Drives
20 to 5200 A / 10400 A

12-pulse Manual

Code: 3ADW000196R0201 Rev B

DCS800 12-pulse Manual e b.doc

Effective: 02.2012
Supersedes: Rev A 06.2008

Safety instructions

What this chapter contains

This chapter contains the safety instructions you must follow when installing, operating and servicing the drive. If ignored, physical injury or death may follow, or damage may occur to the drive, the motor or driven equipment. Read the safety instructions before you work on the unit.

To which products this chapter applies

The information is valid for the whole range of the product DCS800, the converter modules DCS800-S0x size D1 to D7, field exciter units DCF80x, etc. like the Rebuild Kit DCS800-R00-9xxx.

Usage of warnings and notes

There are two types of safety instructions throughout this manual: warnings and notes. Warnings caution you about conditions which can result in serious injury or death and/or damage to the equipment, and advise on how to avoid the danger. Notes draw attention to a particular condition or fact, or give information on a subject. The warning symbols are used as follows:

Dangerous voltage warning warns of high voltage which can cause physical injury or death and/or damage to the equipment.

General danger warning warns about conditions, other than those caused by electricity, which can result in physical injury or death and/or damage to the equipment.

Electrostatic sensitive devices warning warns of electrostatic discharge which can damage the equipment.

Installation and maintenance work

These warnings are intended for all who work on the drive, motor cable or motor. Ignoring the instructions can cause physical injury or death and/or damage to the equipment.

WARNING!

- **Only qualified electricians are allowed to install and maintain the drive!**
- Never work on the drive, motor cable or motor when main power is applied.
  Always ensure by measuring with a multimeter (impedance at least 1 Mohm) that:
  1. Voltage between drive input phases U1, V1 and W1 and the frame is close to 0 V.
  2. Voltage between terminals C+ and D- and the frame is close to 0 V.
- Do not work on the control cables when power is applied to the drive or to the external control circuits. Externally supplied control circuits may cause dangerous voltages inside the drive even when the main power on the drive is switched off.
- Do not make any insulation resistance or voltage withstand tests on the drive or drive modules.
- Isolate the motor cables from the drive when testing the insulation resistance or voltage withstand of the cables or the motor.
- When reconnecting the motor cable, always check that the C+ and D- cables are connected with the proper terminal.

Note:

- The motor cable terminals on the drive are at a dangerously high voltage when the main power is on, regardless of whether the motor is running or not.
- Depending on the external wiring, dangerous voltages (115 V, 220 V or 230 V) may be present on the relay outputs of the drive system (e.g. SDCS-IOB-2 and RDIO).
- DCS800 with enclosure extension: Before working on the drive, isolate the whole drive system from the supply.

Grounding

These instructions are intended for all who are responsible for the grounding of the drive. Incorrect grounding can cause physical injury, death and/or equipment malfunction and increase electromagnetic interference.

WARNING!

- Ground the drive, motor and adjoining equipment to ensure personnel safety in all circumstances, and to reduce electromagnetic emission and pick-up.
- Make sure that grounding conductors are adequately sized and marked as required by safety regulations.
- In a multiple-drive installation, connect each drive separately to protective earth (PE ⏚).
- Minimize EMC emission and make a 360° high frequency grounding (e.g. conductive sleeves) of screened cable entries at the cabinet lead-through plate.
- Do not install a drive equipped with an EMC filter to an ungrounded power system or a high resistance-grounded (over 30 ohms) power system.

Note:

- Power cable shields are suitable as equipment grounding conductors only when adequately sized to meet safety regulations.
- As the normal leakage current of the drive is higher than 3.5 mA AC or 10 mA DC (stated by EN 50178, 5.2.11.1), a fixed protective earth connection is required.

Printed circuit boards and fiber optic cables

These instructions are intended for all who handle the circuit boards and fiber optic cables. Ignoring the following instructions can cause damage to the equipment.

WARNING! The printed circuit boards contain components sensitive to electrostatic discharge. Wear a grounding wrist band when handling the boards. Do not touch the boards unnecessarily.

Use grounding strip:

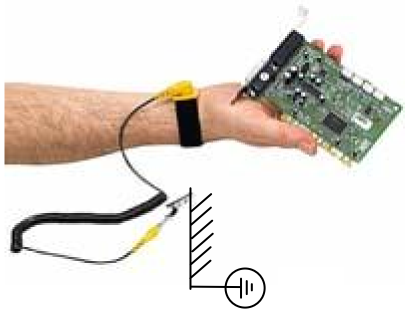


ABB order no.: 3ADV050035P0001

WARNING! Handle the fiber optic cables with care. When unplugging optic cables, always grab the connector, not the cable itself. Do not touch the ends of the fibers with bare hands as the fiber is extremely sensitive to dirt. The minimum allowed bend radius is 35 mm (1.38 in.).

Mechanical installation

These notes are intended for all who install the drive. Handle the unit carefully to avoid damage and injury.

WARNING!

- DCS800 sizes D4 ... D7: The drive is heavy. Do not lift it alone. Do not lift the unit by the front cover. Place units D4 and D5 only on its back.
  DCS800 sizes D5 ... D7: The drive is heavy. Lift the drive by the lifting lugs only. Do not tilt the unit. The unit will overturn from a tilt of about 6 degrees.
- Make sure that dust from drilling does not enter the drive when installing. Electrically conductive dust inside the unit may cause damage or lead to malfunction.
- Ensure sufficient cooling.
- Do not fasten the drive by riveting or welding.

Operation

These warnings are intended for all who plan the operation of the drive or operate the drive. Ignoring the instructions can cause physical injury or death and/or damage to the equipment.

WARNING!

- Before adjusting the drive and putting it into service, make sure that the motor and all driven equipment are suitable for operation throughout the speed range provided by the drive. The drive can be adjusted to operate the motor at speeds above and below the base speed.
- Do not control the motor with the disconnecting device (disconnecting mains); instead, use the control panel keys and , or commands via the I/O board of the drive.
- Mains connection
  You can use a disconnect switch (with fuses) to disconnect the electrical components of the drive from the mains for installation and maintenance work. The type of disconnect switch used must be as per EN 60947-3, Class B, so as to comply with EU regulations, or a circuit-breaker type which switches off the load circuit by means of an auxiliary contact causing the breaker's main contacts to open. The mains disconnect must be locked in its "OPEN" position during any installation and maintenance work.
- EMERGENCY STOP buttons must be installed at each control desk and at all other control panels requiring an emergency stop function. Pressing the STOP button on the control panel of the drive will neither cause an emergency stop of the motor, nor will the drive be disconnected from any dangerous potential.
  To avoid unintentional operating states, or to shut the unit down in case of any imminent danger according to the standards in the safety instructions it is not sufficient to merely shut down the drive via signals "RUN", "drive OFF" or "Emergency Stop" respectively "control panel" or "PC tool".
- Intended use
  The operating instructions cannot take into consideration every possible case of configuration, operation or maintenance. Thus, they mainly give such advice only, which is required by qualified personnel for normal operation of the machines and devices in industrial installations.
  If in special cases the electrical machines and devices are intended for use in non-industrial installations - which may require stricter safety regulations (e.g. protection against contact by children or similar) - these additional safety measures for the installation must be provided by the customer during assembly.

Note:

- When the control location is not set to Local (L not shown in the status row of the display), the stop key on the control panel will not stop the drive. To stop the drive using the control panel, press the LOC/REM key and then the stop key .

Table of contents

Introduction to this manual

How to use this manual

The purpose of this manual is to provide detailed information about:

- the different types of 12-pulse configurations,
- their operation principles,
- the required hardware,
- the required software,
- the needed parameters and
- the start-up of a 12-pulse configuration

using DCS800 thyristor converters.

Contents of this manual

The ***Safety instructions*** can be found at the beginning of this manual.

Introduction to this manual, the chapter you are currently reading, introduces you to this manual.

12-pulse technology describes:

- 12-pulse technology,
- types of 12-pulse configurations,
- types of transformers,
- needed T-reactors,
- high speed DC-breakers,
- galvanic isolation,
- advanced current measurement,
- DCSLink and
- drive logic.

12-pulse parallel configurations describes:

- firmware configuration,
- hardware configurations,
- 12-pulse parallel with one motor and
- 12-pulse parallel with two motors.

12-pulse serial / serial sequential configurations describes:

- firmware configuration,
- hardware configurations,
- measuring the DC voltage
- 12-pulse serial / serial sequential with one motor,
- 12-pulse serial / serial sequential with two motors and
- 12-pulse serial / serial sequential in sandwich configuration.

Start-up provides information on how to commission the 12-pulse configurations using DCS800 thyristor converters.

This manual is designed to help those responsible for planning, installing, starting-up and servicing converter modules.

Associated publications

A list of associated publications is published on the inner page of this manual's cover, see ***DCS800 Drive Manuals***. Here is a list of the most important ones:

– The *DCS800 Hardware Manual* (3ADW000194) describes all hardware components of the DCS800 thyristor converters, their connections and settings (e.g. jumpers).
– The *DCS800 Firmware Manual* (3ADW000193) gives an overview of the DCS800 firmware, describes all parameters, describes the function of the DCS800 Control Panel, gives support in case of faults and alarms and gives information about communication.

The above listed documentation can be found on the CD-ROM being attached to the *DCS800 Quick Guide* (3ADW000191).

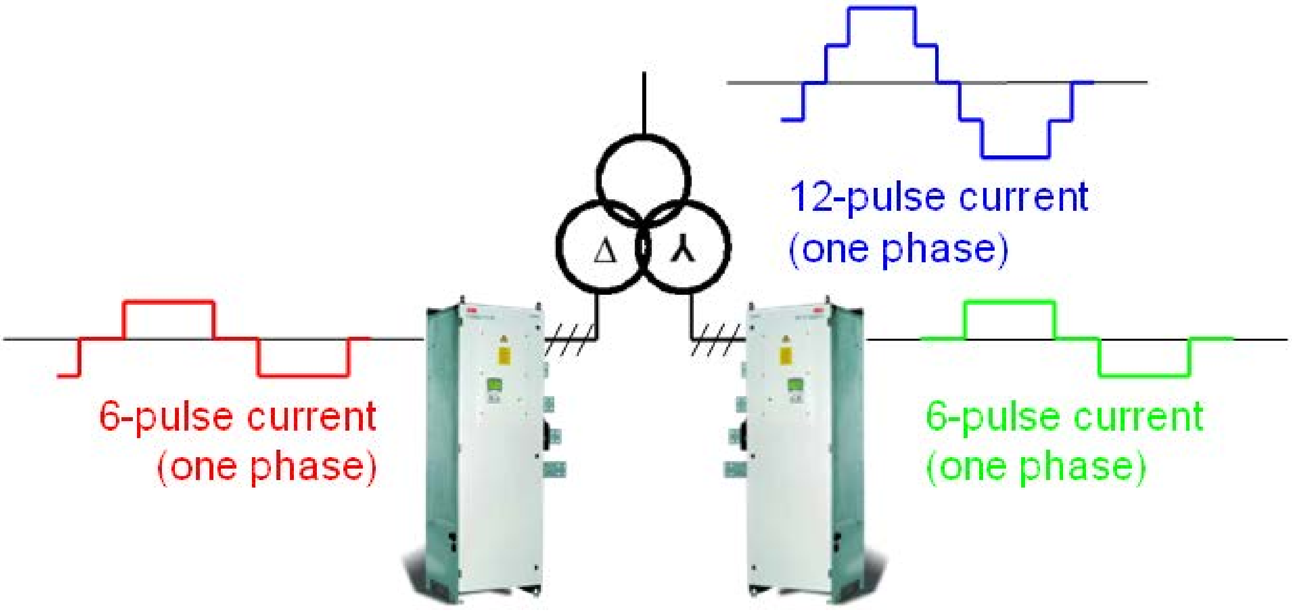
12-pulse technology

Definition of 12-pulse

The characteristic features of 12-pulse are:

– a DC drive consisting of two 6-pulse thyristor converters,
– a dedicated three winding 12-pulse transformer provides the AC power for both converter modules from separate secondary windings and
– the phase shift of the windings differs by 30°.

An example is a Delta / Delta / Star transformer:



12-pulse configuration

Advantages of 12-pulse

The most significant advantages of 12-pulse technology are:

– reduced level of harmonics on the primary side of the transformer,
– expansion of the power range by doubling the drives output current (⇨ parallel configuration) or voltage (⇨ serial configuration),
– possibility of emergency operation with one converter module in case of a breakdown in the other one and
– improved motor efficiency due to reduced DC current ripple

12-pulse harmonics

Harmonics on the AC side of a 6-pulse bridge (line current):

	h	5	7	11	13	17	19	23	25
Idealized	I_h / I_1	20 %	14 %	9 %	7 %	6 %	5 %	4 %	4 %
Typical	I_h / I_1	26 %	10 %	9 %	5 %	2 %	1 %	1 %	1 %

⇨ $THD_{Current}$ = 36.1 % (Total Harmonic Distortion of line current)

Harmonics on the AC side of a 12-pulse bridge (line current):

	h	5	7	11	13	17	19	23	25
Idealized	I_h / I_1	0 %	0 %	9 %	7 %	0 %	0 %	4 %	4 %
Typical	I_h / I_1	3 %	2 %	9 %	5 %	1 %	1 %	2 %	1 %

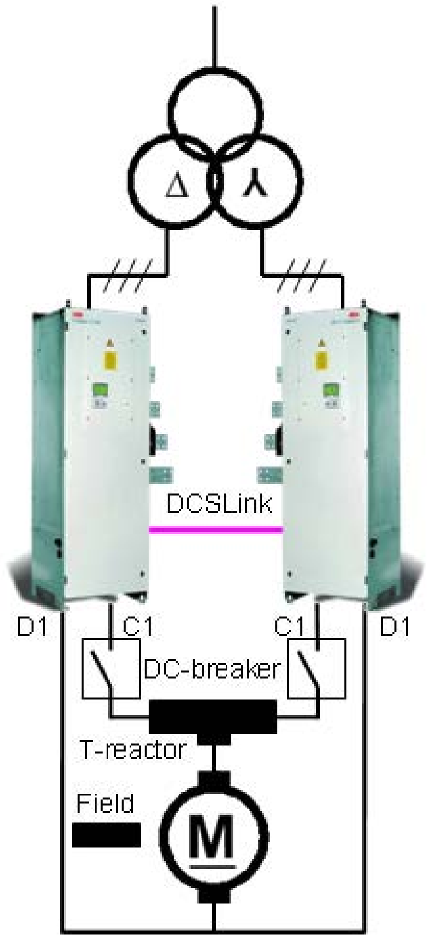
⇨ $THD_{Current}$ = 11.8 % (Total Harmonic Distortion of line current)

Types of 12-pulse configurations

12-pulse parallel configuration

Characteristics of 12-pulse parallel configuration:

- extension of power range by doubling the DC current,
- suppression of line harmonics: 5^{th}, 7^{th}, 17^{th}, 19^{th}, … ,
- 75 % less DC current ripple compared to 6-pulse,
- reduced motor noise level,
- higher motor efficiency,
- communication between the converter modules via SDCS-DSL-4 board,
- high speed DC-breakers are provided by ABB,
- iron core T-reactors (interphase transformers) are provided by ABB,
- emergency operation (one converter module only) with full speed at maximum 50 % torque possible,
- maximum mains voltage is 525 V_{AC} for D1 to D4, 690 V_{AC} for D5, 800 V_{AC} for D6 and 1200 V_{AC} for D7 converter modules,
- the supply voltage for both converters has to have the same level (e.g. 690 V_{AC}).

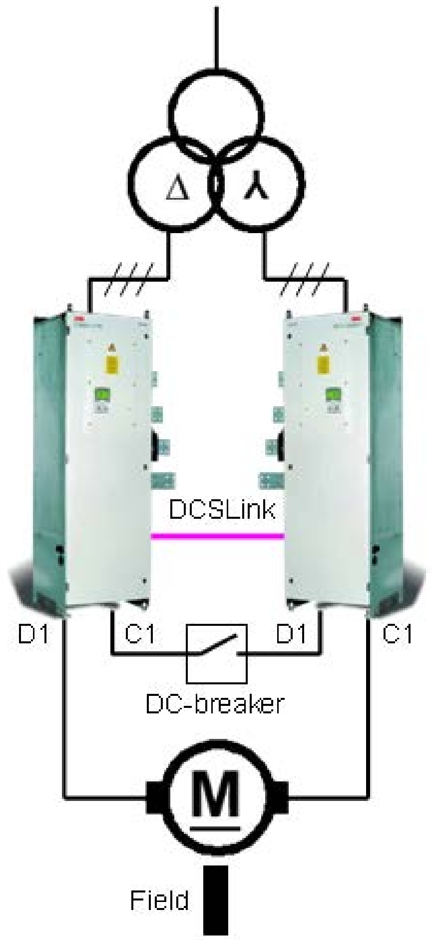


12-pulse parallel configuration

12-pulse serial configuration

Characteristics of 12-pulse serial configuration:

- extension of power range by doubling the DC voltage,
- suppression of line harmonics: 5th, 7th, 17th, 19th, … ,
- 75 % less DC current ripple compared to 6-pulse,
- reduced motor noise level,
- higher motor efficiency,
- communication between the converter modules via SDCS-DSL-4 board,
- high speed DC-breaker is provided by ABB,
- emergency operation (one converter module only) with maximum half speed at 100 % torque possible,
- maximum mains voltage is 2 * 350 V_{AC} for D5 and 2 * 600 V_{AC} for D6 / D7 converter modules (higher voltages for D7 converter modules on request).
- D1 to D4 are not used for 12-pulse serial.

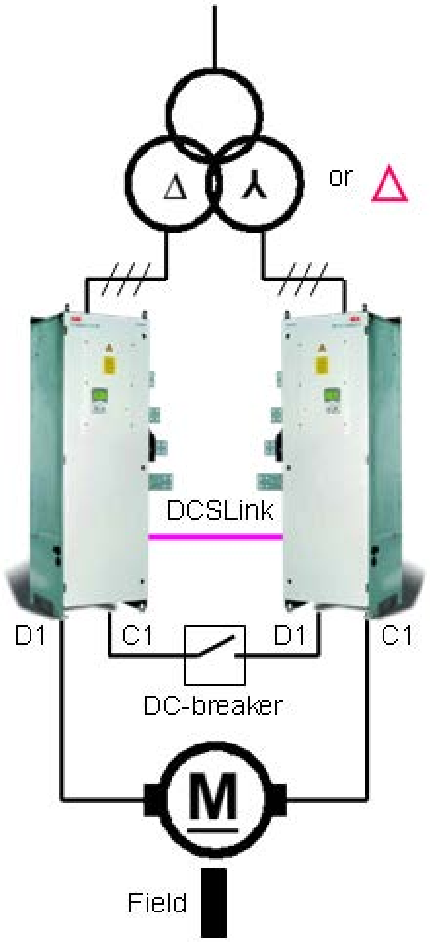


12-pulse serial configuration

Serial sequential configuration

Characteristics of serial sequential configuration:

- extension of power range by doubling the DC voltage,
- the motor gets the sum of both converters DC voltages but normally they are not equal,
- reduced consumption of reactive power,
- motor current is a mix between 12- and 6-pulse when using a transformer with 30° phase shift,
- communication between the converter modules via SDCS-DSL-4 board,
- high speed DC-breaker is provided by ABB,
- emergency operation (one converter module only) with maximum half speed at 100 % torque possible,
- maximum mains voltage is 2 * 350 V_{AC} for D5 and 2 * 600 V_{AC} for D6 / D7 converter modules (higher voltages for D7 converter modules on request).
- D1 to D4 are not used for 12-pulse serial.



Serial sequential configuration

The serial sequential configuration is identical with the 12-pulse serial configuration except that the phase shift of the two transformer secondary windings can be the same (e.g. Delta / Delta / Delta). To change from 12-pulse serial to serial sequential set *12P Mode (47.01)* = **Sequential**.

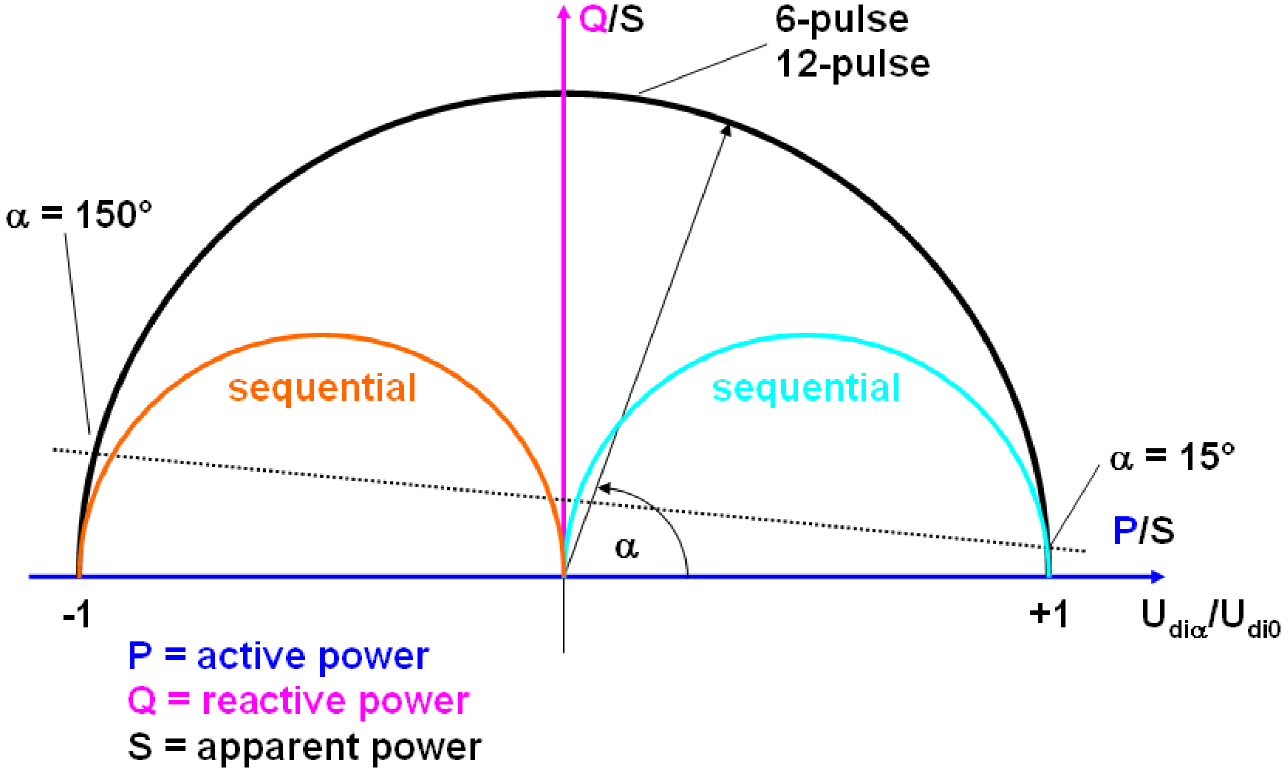
When using serial sequential the motor current is a mix between 12- and 6-pulse when using a transformer with 30° phase shift. Thus the motor must cope with a 6-pulse ripple of the armature current and the line current includes 6-pulse harmonics.

Reactive power consumption

Basically the reactive power consumption is high, when the armature voltage of a converter is low. By controlling of two converters in serial sequential, the reactive power consumption can be reduced. In serial sequential control one of the two converters is always operating with full positive or negative armature voltage (the firing angle has reached the maximum or minimum limit) while the other is being controlled.

This way only one converter at a time will consume reactive power and thus the total reactive power consumption can be reduced.

This application is typically used for operation with full torque at low speeds (e.g. mine hoists, …).



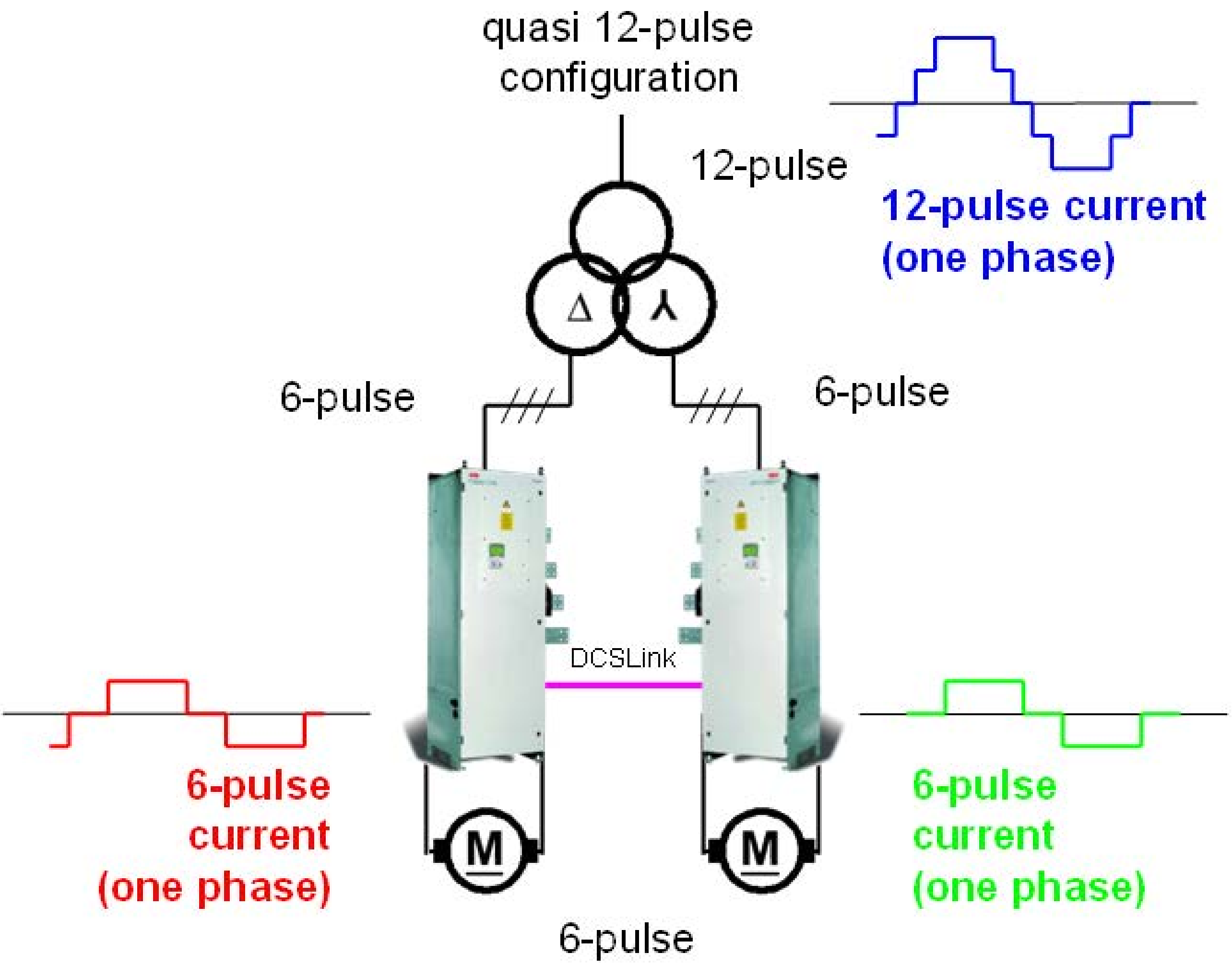
Reactive power consumption of a serial sequential configuration

The above figure shows the power consumption as a function of the armature voltage for a serial sequential configuration. As one can see the peak of the reactive power consumption decreases considerably compared to that of a 6-pulse or 12-pulse serial configuration. The difference is very obvious at low armature voltages (low speeds). For example to reach zero armature voltage one drive is supplying maximum positive voltage and the other is supplying maximum negative voltage. Thus serial sequential configurations are used for drives supplying large currents at low speeds for a lengthy time.

Quasi 12-pulse

Characteristics of quasi 12-pulse configuration:

- suppression of line harmonics: 5th, 7th, 17th, 19th, … on the primary side of the three winding 12-pulse transformer and
- communication between the converter modules via master-follower.

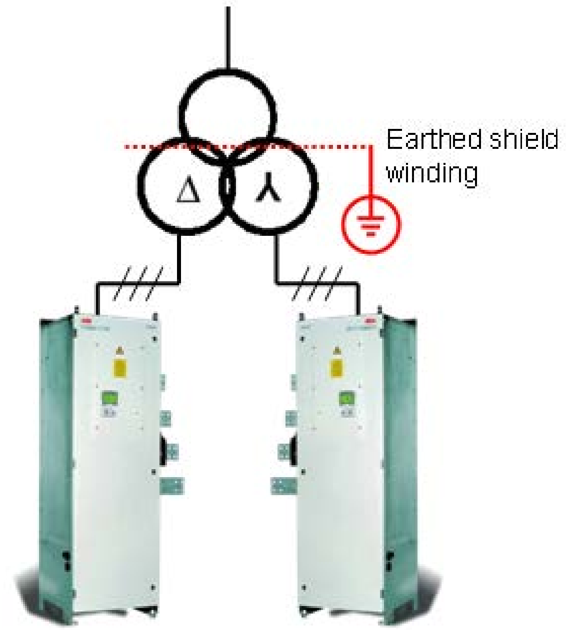


Quasi 12-pulse configuration

In a master-follower configuration the speed control is usually performed by the master. Current and field control are independently carried out by master and follower. Each motor is supplied with a 6-pulse voltage. But the line current on the primary side of the three winding 12-pulse transformer is a 12-pulse current.

Transformers used for 12-pulse configurations

In most 12-pulse systems the modules are connected to a dedicated three winding transformer. A three winding transformer has one primary winding and two secondary windings. Each of the secondary windings is only supplying one of the two converter modules, thus the name dedicated transformer.



Dedicated three winding transformer

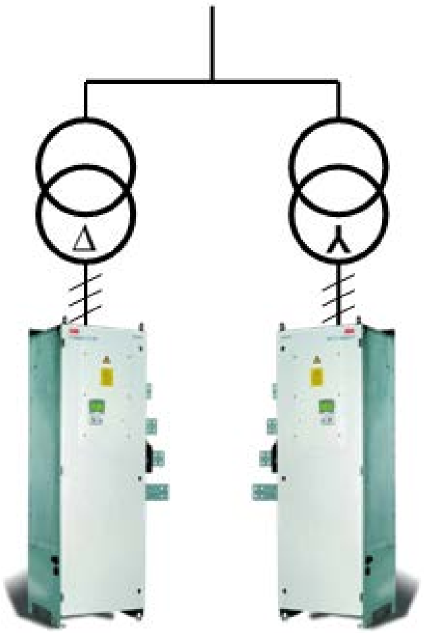
The following details have to be taken into consideration:

– When selecting and dimensioning the transformer, care must be taken to ensure that overvoltages are kept away from both converter modules when the mains voltage is connected to the primary side of the transformer. For this reason, the transformer should have an earthed shielding winding between the primary and the secondary windings. This shield is also very useful to suppress capacitive feed through during switching operations on the primary side of the transformer. In addition, the shield also suppresses EMC from the converters to the upstream network.
  A second method to avoid overvoltages is to switch on the components gradually. First connect the mains to the primary side of the transformer and then allow the power to flow between the secondary sides of the transformer and the converter modules.
  Another option is to incorporate R-C elements on the secondary sides of the transformer.
– Dimensioning is determined solely by the electrical conditions involved, like the:
  - line frequency,
  - mains voltage of the primary side,
  - the supply voltage of the converter modules,
  - rated current of the converter modules (Transformers with a high relative voltage drop - u_k - creating synchronization problems with the mains and additionally when regenerating, strongly reduce the commutation reserve. Thus drives with high peak load require transformers with a small u_k of approximately 6 %.),
  - nominal current of the motor and
  - detailed duty load cycle of the motor.

- Relationship between transformer u_k, transformer overload and β:
  - With $\alpha + \beta = 180°$ and $\alpha_{max} = 150°$ follows the absolute maximum of $\beta = 30°$. Below table shows the maximum β at transformer overload, depending on the uk.

Transformer u_k	4 %	5 %	6 %	7 %	8 %	9 %
Transformer overload	β					
150 %	22.6°	25.2°	27.5°	29.8°	31.9°	33.9°
200 %	26.1°	29.9°	31.9°	34.5°	37.0°	39.4°
250 %	29.3°	32.7°	35.5°	38.7°	41.5°	-
300 %	32.1°	35.9°	39.9°	42.6°	-	-
325 %	33.5°	37.7°	41.0°	-	-	-

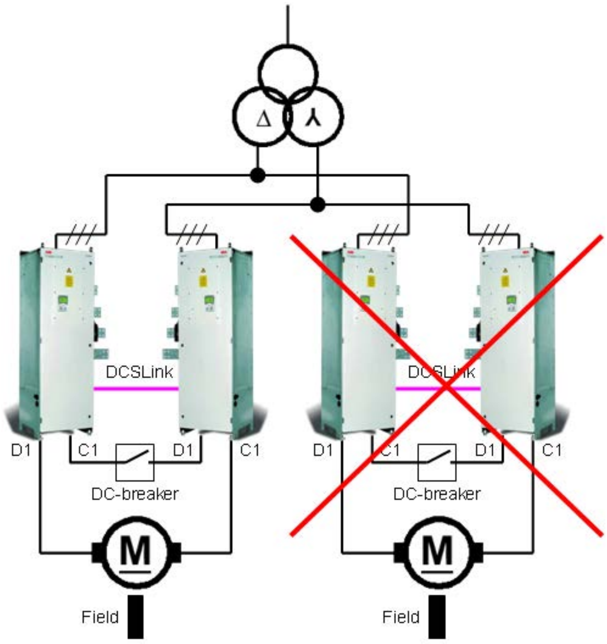
It is also possible to use two dedicated transformers with 30° phase shift, one for each converter module. The supply voltage for both converters has to have the same level (e.g. 690 V_{AC}).



Two dedicated transformers

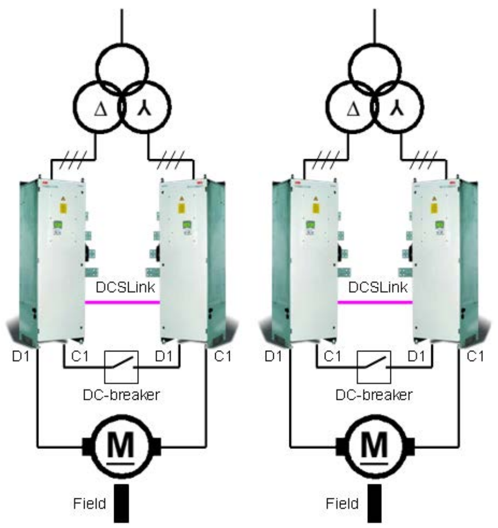
Two 12-pulse systems connected to one transformer

For physical reasons it is not possible to connect two 12-pulse systems at one common transformer. Because the voltage level between the two secondary windings (one in star and the other in delta) is controlled by the switching (control angle) of the first 12-pulse system. Connecting a second 12-pulse system creates circulating currents. Blown fuses or thyristor damages can be the result.



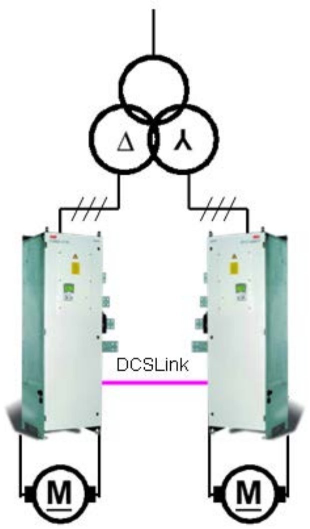
Two 12-pulse systems connected to one transformer

A permitted solution is the use of two separate transformers, thus having two separate 12-pulse systems:



Two separate 12-pulse systems

A permitted solution is the use of a quasi 12-pulse system:

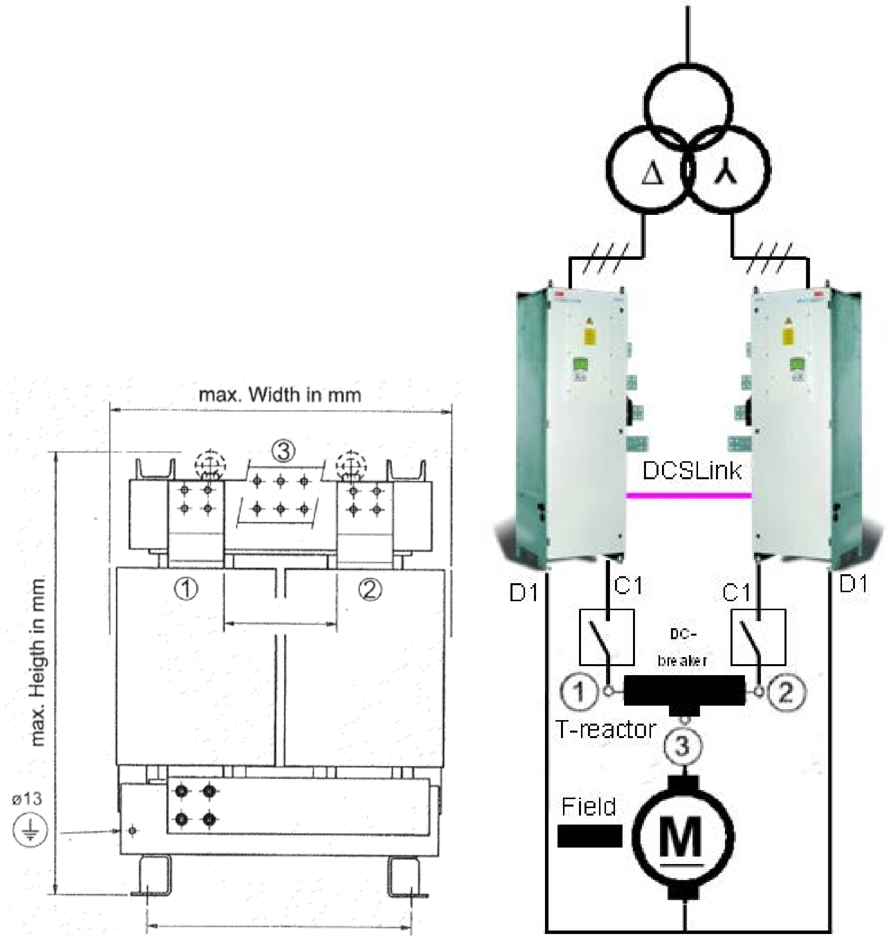


Quasi 12-pulse configuration

T-reactors (interphase transformers)

Characteristics of iron core T-reactors:

– providing a maximum decoupling between the converters with a minimum additional inductance for the motor control (in case the inductance of an air core reactor is smaller than the motor inductance the dynamics of the current control is reduced),
– used in 12-pulse parallel configurations,
– customized iron core T-reactors (interface transformers) are provided by ABB,
– have a high overload capability,
– iron core T-reactors are easy integrated into cabinets,
– Iron core T-reactors are smaller than air-core reactors.



T-reactor

T-reactors - also known as interphase transformers - are only used in 12-pulse parallel configurations. The 30° phase shift between 12-pulse master and 12-pulse slave supply voltages generates an instantaneous voltage difference between the output voltages of both converters. The maximum amount of this difference is 50 % of the peak value of the supply voltage. The T-reactor absorbs this instantaneous voltage difference and provides the typical 12-pulse current to the DC-motor.

T-reactors are provided by ABB. The sizing of a T-reactor is done in a similar way as the sizing of an autotransformer with centre tap. To be able to deliver the correct T-reactor for the drive the following data will be needed, the:

- mains voltage of both converters (the mains voltage for both converters has to have the same level; e.g. 690 V_{AC}),
- tolerance of the mains voltage (e.g. ± 10 %),
- nominal current of the motor,
- EMF of the motors normal operating point,
- line frequency and
- detailed duty load cycle of the motor.

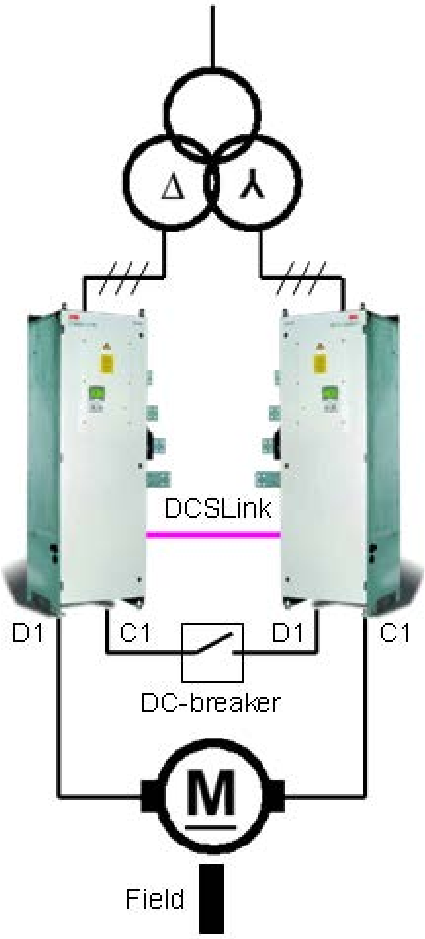
In case the drive is used for non motoric applications all details are needed, such as:

- kind of application,
- resistance of the load,
- inductivity of the load,
- capacity of the load,
- requested du/dt characteristics of the output voltage etc ...

High speed DC-breakers

Characteristics of high speed DC-breakers:

- protect the DC-motors against overcurrent,
- use fast magnetic trip coils,
- feature trip relays (**On**-**Off** relay) which are controlled by the drives,
- a special, fast trip relay is available,
- overcurrent trips are resetable, thus higher availability of the drives,
- strongly recommended for drives without AC breakers,
- high speed DC-breakers are provided by ABB and
- ABB integrates high speed DC-breakers into drive cabinets.



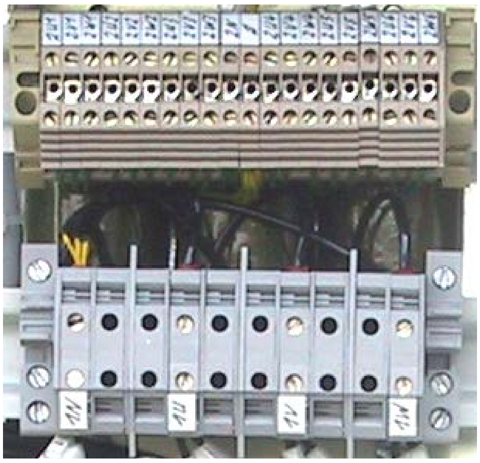
High speed DC-breaker

High speed DC-breakers are able to extinguish excessive DC currents immediately. Thus DC motors can be protected against overcurrents causing damages e. g. flash over at the commutator. Usually the high speed DC-breaker trips itself when an overcurrent occurs. This is done by means of a fast magnetic overcurrent trip coil.
It is also possible to trip the high speed DC-breaker with a trip command from the drive. This trip signal is generated by motor or drive overcurrent, mains undervoltage and too fast current rise. To reduce the delay time before the high speed DC-breaker is opened after a trip command from the drive, fast tripping relays are available.

When using high speed DC-breakers overcurrent trips become resetable, because they switch before other parts in the system - for example fuses - become damaged. Thus the availability of the whole drive increases.
High speed DC-breakers are strongly recommended when using drives without AC breakers to ensure, that the DC motors are protected against damage from overcurrent.
ABB is also providing high speed DC-breakers and integrates them into the drives lineup.

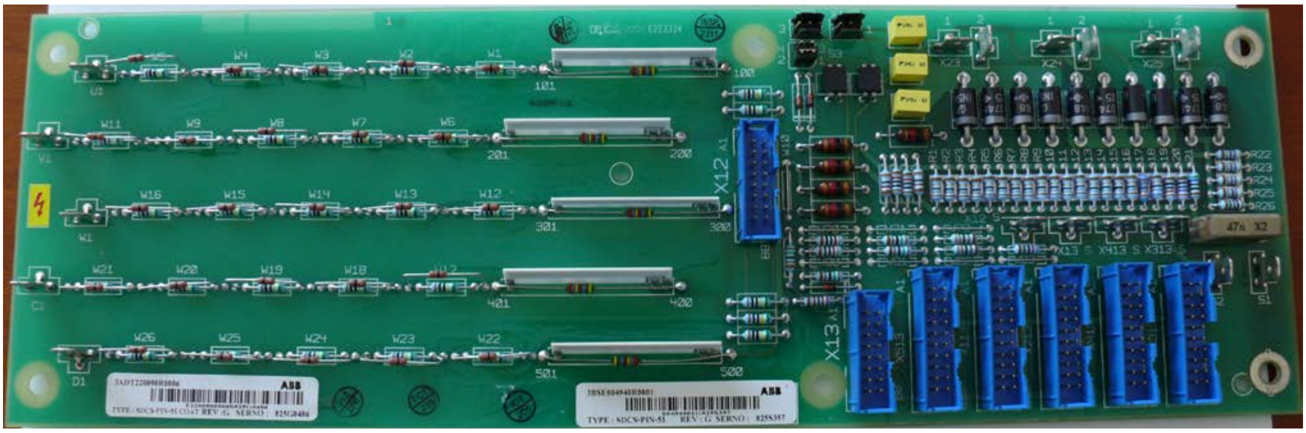
Galvanic isolation

Usually the DC- and AC-voltage is measured via high omic resistors with a scaling of 1 MΩ per 100 V. Galvanic isolation is used to isolate the DC- and AC- high resistance voltage measurement circuits of the converter modules from high DC- and AC-voltages. It is typically used when either the supply voltage or the motor voltage is greater than 690 V.
Only the DC- and AC- high resistance voltage measurement circuits have to be galvanically isolated, because the current measurement is already isolated via current transformers (CTs).
Galvanic isolation is used in both 6-pulse and 12-pulse systems.
To isolate the AC-voltage measurement a special isolation AC transformer for all three phases is needed. The DC-voltage measurement is isolated by means of a DC transducer. To complete the galvanic isolation of the voltage measurement circuit a modified SDCS-PIN-5x-1190 board is needed inside the converter module use +S198, as spare use ID-code 3ADT780007R0002). Thus galvanic isolation is only possible for converter sizes D5, D6 and D7.
The transformer, the DC-DC transducer and the modified SDCS-PIN-5x-1190 are provided by ABB.



AC transformer

DC transducer



Modified SDCS-PIN-5x-1190

Nominal supply voltage, *NomMainsVolt (99.10)*	AC transformer terminals (3ADT745047)	DC transducer position (8680A1)	Hardware coding, *S ConvScaleVolt (97.03)*
230 V - 500 V_{AC}	2U1-2V1-2W1	675 V (7)	500 V_{AC}
270 V - 600 V_{AC}	2U2-2V2-2W2	810 V (6)	600 V_{AC}
300 V - 690 V_{AC}	2U3-2V3-2W3	945 V (5)	690 V_{AC}
350 V - 800 V_{AC}	**2U4-2V4-2W4**	**1080 V (4)**	**800 V_{AC}**
450 V - 1000 V_{AC}	2U5-2V5-2W5	1350 V (2)	1000 V_{AC}
530 V - 1190 V_{AC}	2U6-2V6-2W6	1620 V (1)	1200 V_{AC}

Settings for galvanic isolation

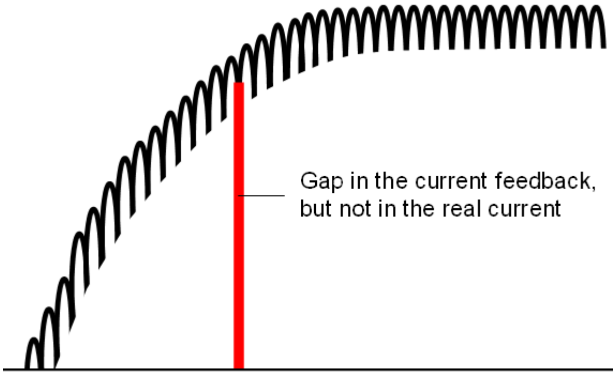
Depending on the supply voltage different settings have to be chosen. With a supply voltage of **750 V_{AC}**:

- Set *NomMainsVolt (99.10)* = **750 V**.
- The AC transducers terminals **2U4-2V4-2W4** have to be used.
- The DC transducer must be set to **position (4)** with a maximum voltage of **1080 V_{DC}**.
- The hardware coding has to be set to the maximum value of the voltage measurement circuit. In this example set *S ConvScaleVolt (97.03)* = **800 V**.
- On the modified SDCS-PIN-5x-1190 the bridges over resistors W1 to W26 are not cut and the 5 MΩ film resistors are bridged with 27.4 kΩ (R_x) resistors.

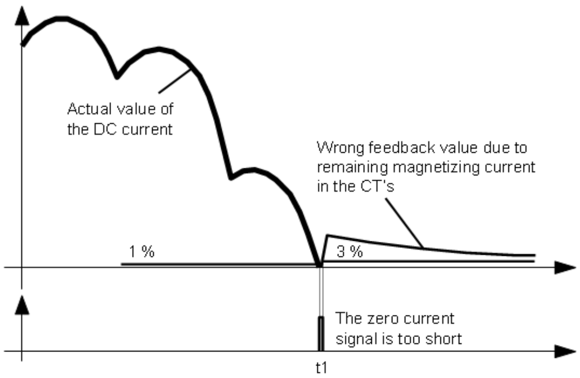
For more information see chapter *Galvanic isolation* of the *DCS800 Hardware Manual* (3ADW000194).

Advanced current measurement

For DC current measurement ABB DC-drives are equipped with CTs (current transformers) on the AC side. If such drives are connected with weak mains and the current controller is tuned for fast response an interaction between the networks and the drives can happen. All 12-pulse configurations with converter currents over 1000 A have this impact on the current measurement. The problem either appears as a current instability or an increase of the bridge reversal time due to remaining magnetizing current in the CTs.

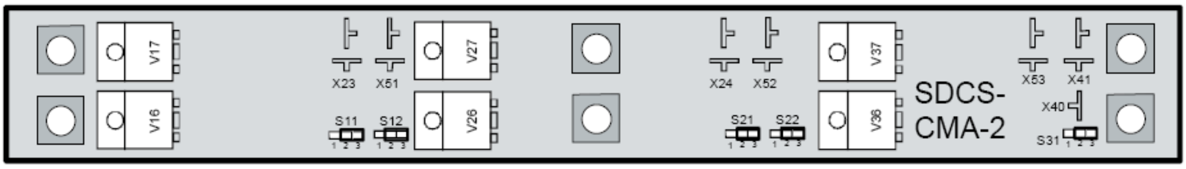


Current instability



Remaining magnetizing current in the CTs

To avoid the problems all converters over 1000 A should be equipped with the current measurement aid SDCS-CMA-2:



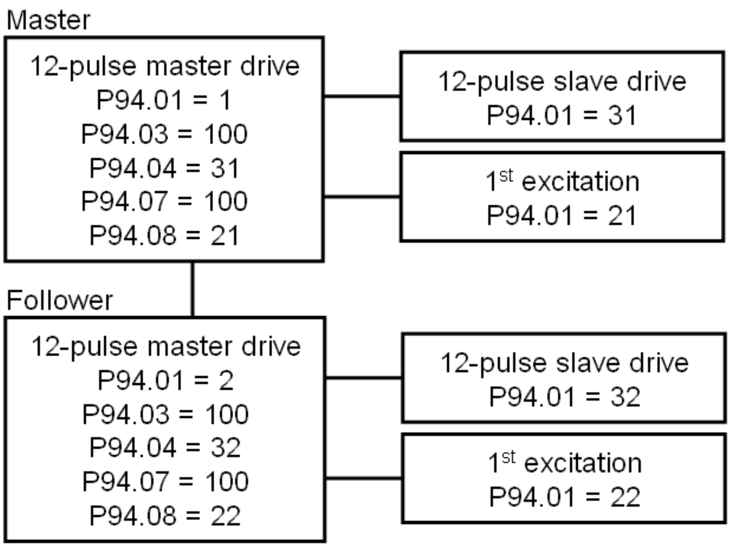
SDCS-CMA-2 board

DCSLink

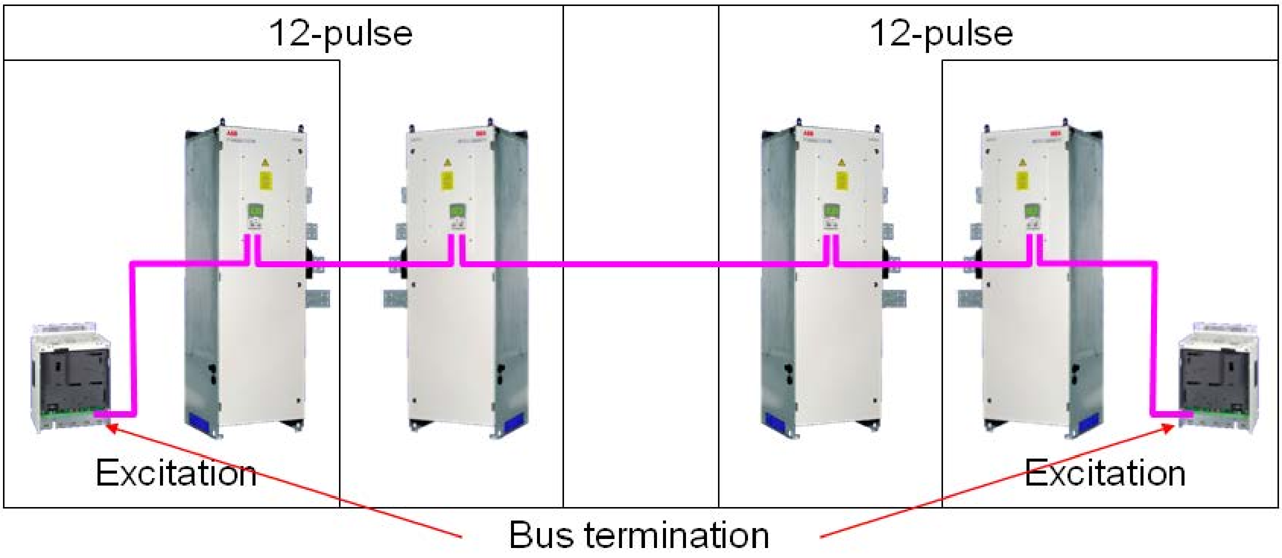
The DCS800 is equipped with the DCSLink to communicate with several different converters via the same hardware:

– communication from 12-pulse master to external field exciter,
– communication from 12-pulse master to 12-pulse slave,
– master-follower communication and
– communication supervision.

The DCSLink can be set up as follows:



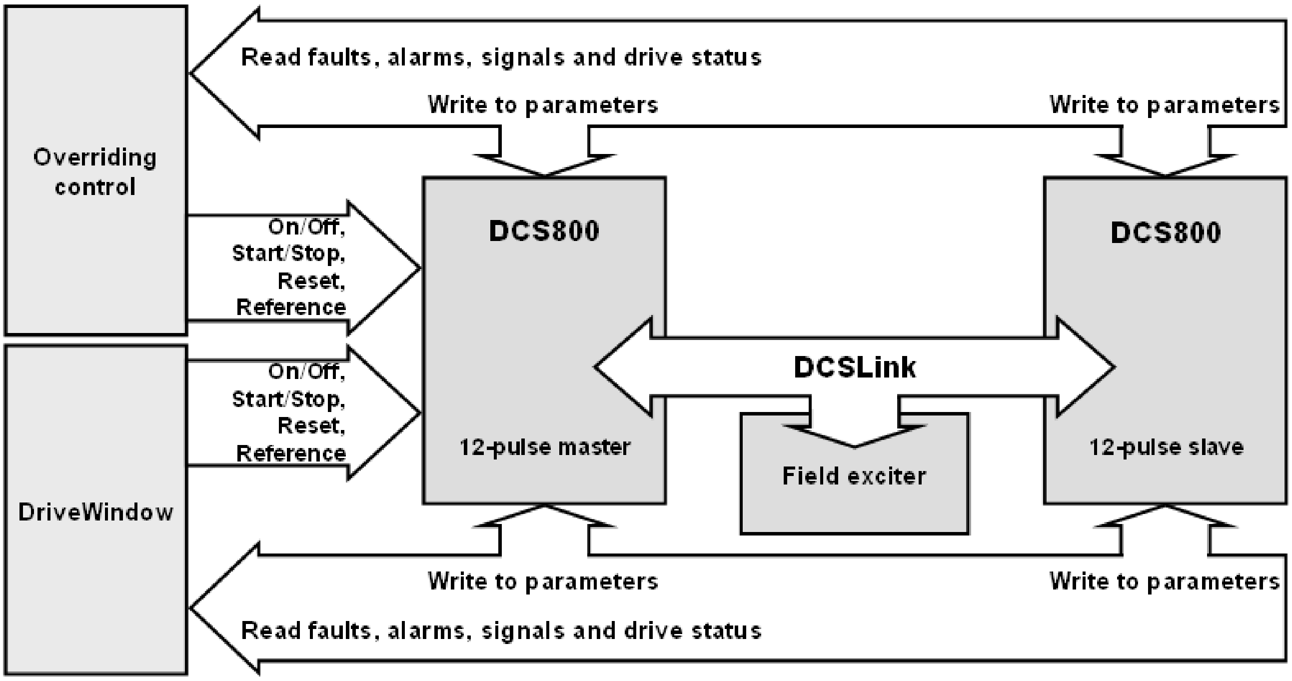
DCSLink for two 12-pulse drives in master-follower configuration



Master - follower, 12-pulse and excitation

Drive Logic

The switch-on/switch-off options for the DCS800 are multifarious, as are the possible switching and operator control locations, like unit terminals, overriding control system, DCS800 Control Panel, DriveWindow or DriveWindow Light. To not lose this flexibility, we have refrained from changing the 6-pulse standard drive logic. Thus the DCS800 12-pulse drive logic is based on the standard DCS800 drive logic.
The complete drive (12-pulse master and 12-pulse slave) is controlled by the 12-pulse master. This function is activated in the 12-pulse slave by means of *CommandSel (10.01)* = **12PLink**. Thus it is enough to connect only the 12-pulse master to the overriding control system.
It is strongly recommended to connect as well the 12-pulse slave to the overriding control system if its detailed status is needed or parameters have to be written to.
The same is valid for DriveWindow.



12-pulse control structure

The overriding control needs to send the signals **On/Off**, **Start/Stop**, **Reset** and the reference only to the 12-pulse master. Then the signals are send via *CtrlStatMas (6.09)* and the DCSLink to the *UsedMCW (7.04)* of the 12-pulse follower. The *MainCtrlWord (7.01)* of the 12-pulse slave is not valid.
In case parameters like controller gain, motor ratings, operation mode, etc. have to be changed it is better to sent them directly to the 12-pulse slave.

Emergency operation

An emergency operation can be used in case of a break down of one converter:

– the parameters for 6-pulse single operation (emergency operation) can be saved and activated in each converter by means of *ApplMacro (99.08)*,
– it is mandatory that both converters have a connection to the overriding control system,
– the field exciter is already connected to both converters by means of the DCSLink, thus only the addresses have to be changed,

– both converters need to be connected to all acknowledge signal from the auxiliary circuits. Their activation is done via group 10,
– both converters need to be connected to the emergency stop circuit. The activation is done by means of *E Stop (10.09)*,
– for 12-pulse serial / serial sequential a special short circuit busbar for emergency operation can be ordered from ABB and
– to perform an emergency operation with only one main contactor a more detailed investigation is required as the handling of the main contactor has to be switched over from the 12-pulse master to the emergency converter (usually the 12-pulse slave).

Tripping behavior

Tripping of the 12-pulse master:
– The 12-pulse master trips according the faults trip level, see *Firmware Manual* (3ADW000193). The slave is switched off via the DCSLink.

Tripping of the 12-pulse slave:
– The 12-pulse slave trips according the faults trip level, see *Firmware Manual* (3ADW000193). The 12-pulse master is tripped with **F536 12PSlaveFail** [*FaultWord3 (9.03)* bit 0] via DCSLink and is switched off.

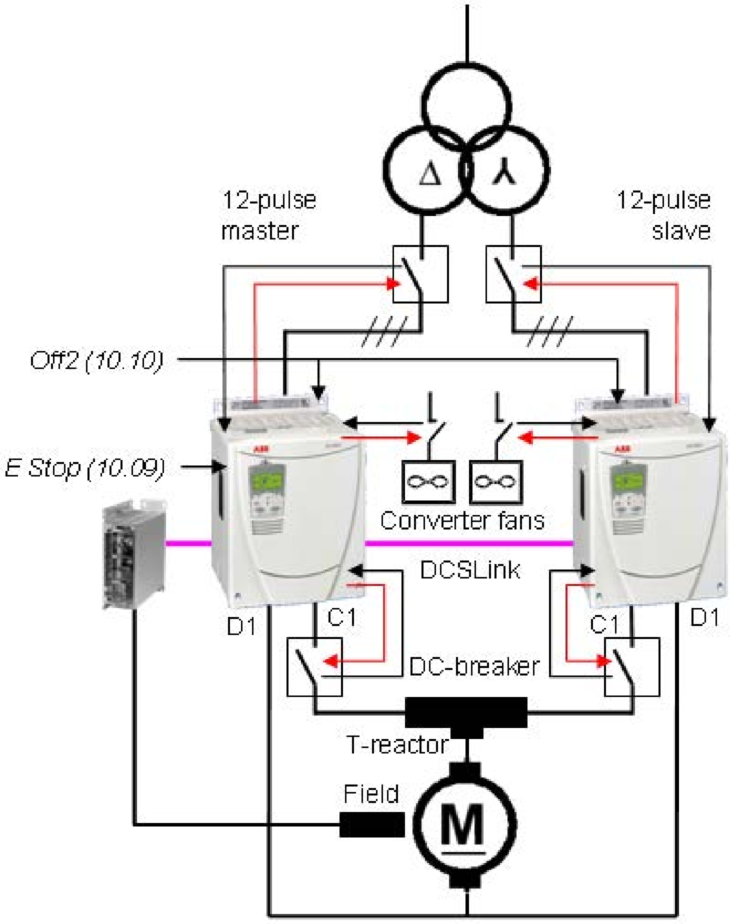
Reset sequence:
– To reset a 12-pulse drive the overriding control system has to send following commands to the 12-pulse master:
  Reset
  Off
  start sequence
– The drive can be also reset via DriveWindow, the control panel or via the hardware reset - see *Reset (10.03)*.

Hardware connections

There are a lot of possibilities to connect the control and acknowledge signals. Following connections are required:
– each converter should control its own main contactor, if existing - a single main contactor / high voltage breaker has to be connected to the 12-pulse master,
– each converter should control its DC-breaker, if existing - a single DC-breaker has to be connected to the 12-pulse master,
– each converter should control its own converter fan,
– both converters need to be connected to the coast stop circuit by means of *Off2 (10.10)*,
– the 12-pulse master needs to be connected to the emergency stop circuit by means of *E Stop (10.09)* and
– in the 12-pulse slave the emergency stop has to be deactivated by means of *E Stop (10.09)* = **NotUsed**.

12-pulse parallel configuration

The 12-pulse parallel configuration can be set up as follows:

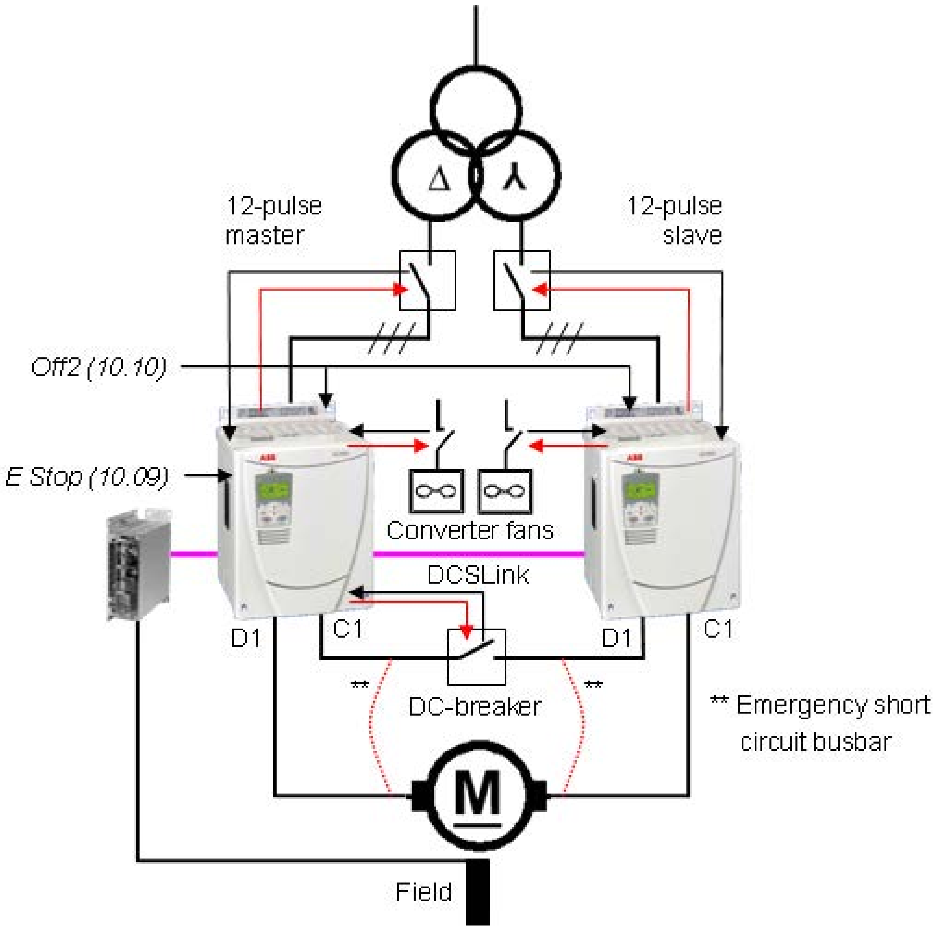


Recommended connections 12-pulse parallel configuration

One DC-breaker per converter is recommended to increases the protection of the motor and to guarantee a proper load sharing between the DC-breakers.

12-pulse serial / serial sequential configuration

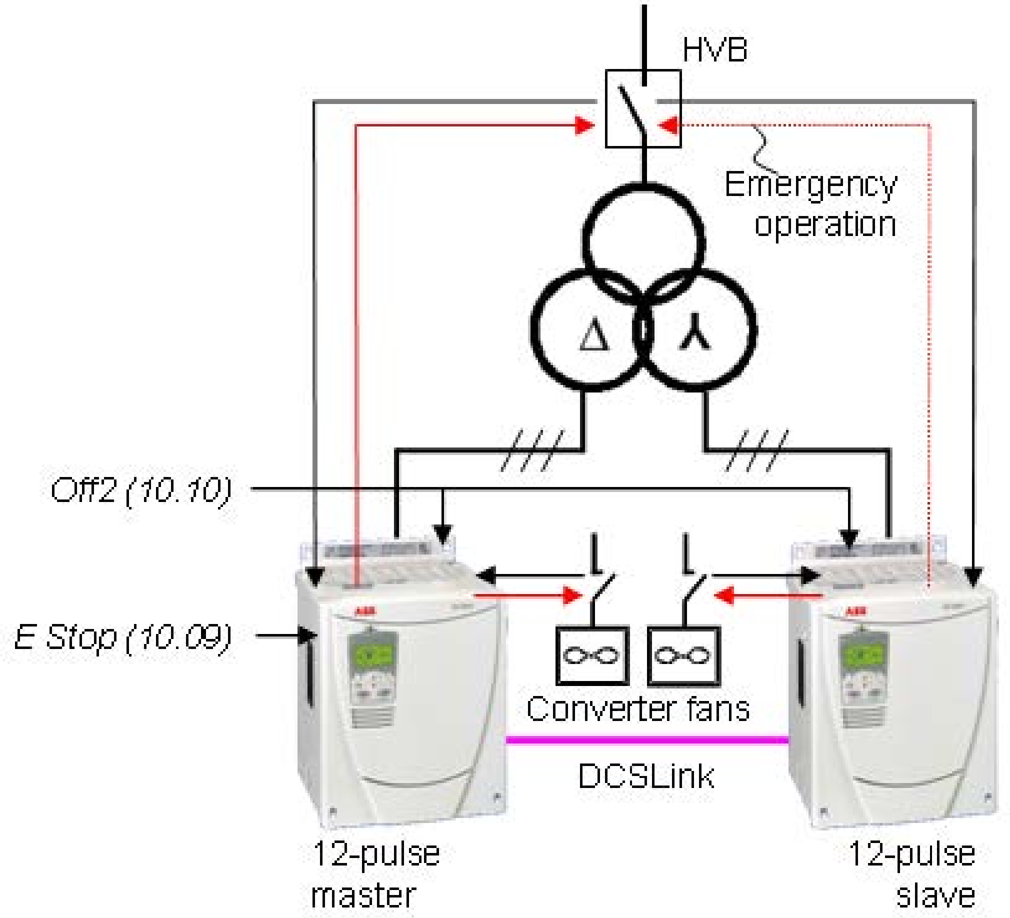
The 12-pulse serial / serial sequential configuration can be set up as follows:



Recommended connections 12-pulse serial / serial sequential configuration

A DC-breaker is recommended to increase the protection of the motor.

12-pulse con-figuration with a single main contactor / High Voltage Breaker (HVB)
The 12-pulse configuration with a single main contactor / high voltage breaker can be set up as follows:



Recommended connections 12-pulse configuration with a single main contactor / high voltage breaker

Main contactors / high voltage breakers should always be switched under no load conditions. Switching main contactors / high voltage breakers locally under load conditions may damage the drive. For more details please contact Your friendly ABB dealer.
To perform an emergency operation with only one main contactor / high voltage breaker a more detailed investigation is required as the handling of the main contactor / high voltage breaker has to be switched over from the 12-pulse master to the emergency converter (usually the 12-pulse slave).

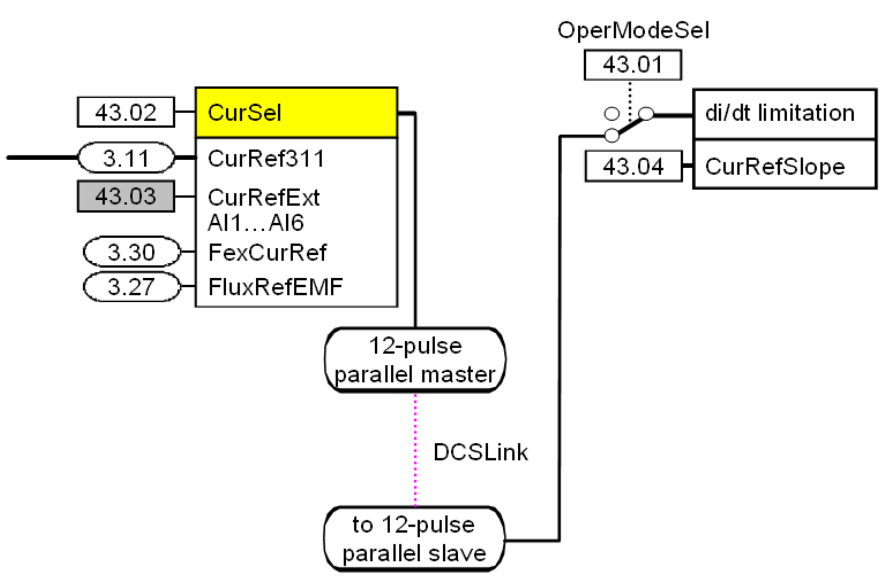
12-pulse parallel configurations

Firmware configuration

DCSLink

The communication via DCSLink is set-up by means of parameters in group 94. Its content is:

12-pulse master		12-pulse slave
CtrlStatMas (6.09)	⇨	*CtrlStatMas (6.09)*
Armature current reference (12-pulse parallel master)	⇨	Armature current reference (to 12-pulse parallel slave)



CtrlStatSla (6.10)	⇦	*CtrlStatSla (6.10)*
ArmCurActSl (1.33)	⇦	*ConvCurAct (1.16)*
-	-	*ArmVoltAct (1.14)*

12-pulse parallel communication

Firmware configuration

In the firmware the converter has to be set up either as 12-pulse master or as 12-pulse slave. This is done by means of *OperModeSel (43.01)*:

OperModeSel (43.01)	0 =	**ArmConv**	6-pulse operation
	1 =	**FieldConv**	field exciter mode
	2 =	**12PParMaster**	12-pulse parallel master
	3 =	**12PParSlave**	12-pulse parallel slave
	4 =	**12PSerMaster**	12-pulse serial master
	5 =	**12PSerSlave**	12-pulse serial slave

Configuration for 12-pulse parallel

The 12-pulse specific parameters are mainly inside group 47.

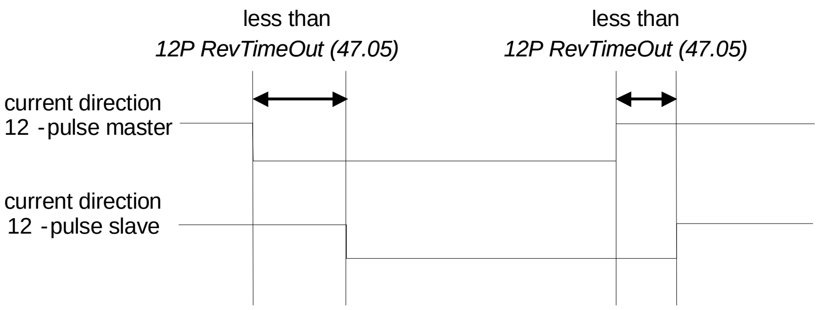
Monitoring

Following signals are available in the 12-pulse master to supervise the 12-pulse slave:
ArmCurActSl (1.33) is the actual 12-pulse slave armature current in amps.
ArmCurAll (1.35) is the sum of the actual 12-pulse master and 12-pulse slave armature current in amps.
In both the 12-pulse master and the 12-pulse slave, the current control status signals of both converters are available:

CtrlStatMas (6.09) is the control status of the 12-pulse master.
CtrlStatSla (6.10) is the control status of the 12-pulse slave.

Faults

12-pulse reversal timeout:
In 12-pulse mode the current direction of both - 12-pulse master and 12-pulse slave - bridges is monitored. The drive trips with **F533 12PRevTime** [*FaultWord3 (9.03)* bit 0] if the 2 converters have different bridges fired for more than *12P RevTimeOut (47.05)*:



Reversal timeout

Note:
12P RevTimeOut (47.05) is only active in the 12-pulse master.

12-pulse current difference (valid only for 12-pulse parallel):
In 12-pulse parallel mode the 12-pulse master also monitors the current of the 12-pulse slave. The drive trips with **F534 12PCurDiff** [*FaultWord3 (9.03)* bit 1] if *DiffCurLim (47.02)* is still exceeded when *DiffCurDly (47.03)* is elapsed.
Note:
DiffCurLim (47.02) and *DiffCurDly (47.03)* are only active in the 12-pulse parallel master.

12-pulse communication:
If the 12-pulse communication timeout set in *12P TimeOut (94.03)* has elapsed without receiving a valid message from the 12-pulse slave, the 12-pulse master activates **F535 12PulseCom** [*FaultWord3 (9.03)* bit 2].
Note:
12P TimeOut (94.03) is only active in the 12-pulse master.

12-pulse slave failure:
F536 12PSlaveFail [*FaultWord3 (9.03)* bit 3] is activated by a fault in the 12-pulse slave and trips the 12-pulse master.

Note:
F536 12PSlaveFail appears only in the 12-pulse master.

Dynamic response

The dynamic response of the 12-pulse configuration is delayed in comparison to a 6-pulse configuration by:

- 0.5 control cycles (3.3 ms at 50 Hz or 2.77 ms at 60 Hz) due to the 30° offset in the mains supply of the 12-pulse slave and
- 20 ms due to the recommended behavior during the bridge reversal - see *RevDly (43.14)*.

Current controller

Speed control mode:
In 12-pulse parallel only the speed controller of the 12-pulse master is used and generates the current reference for both units. The speed controller of the 12-pulse slave is not in use.

Measuring the current:
In 12-pulse parallel independent current flows through the 12-pulse master and the 12-pulse slave. Thus the current measurement in the 12-pulse slave has to be fully operative.

Current control mode:
In 12-pulse parallel the current reference is send from the 12-pulse master to the 12-pulse slave. Thus both current controllers in the 12-pulse master and 12-pulse slave are used. The following parameters have to have the same value in both units:

- *M1CurLimBrdg1 (20.12)*,
- *M1CurLimBrdg2 (20.13)*,
- *ArmAlphaMax (20.14)*,
- *ArmAlphaMin (20.15)*,
- *CurRefSlope (43.04)*,
- *ControlModeSel (43.05)*,
- *M1KpArmCur (43.06)*,
- *M1TiArmCur (43.07)*,
- *M1DiscontCurLim (43.08)*,
- *M1ArmL (43.09)*,
- *M1ArmR (43.10)*,
- *RevDly (43.14)*,
- *RevVoltMargin (44.21)* and
- *ZeroCurTimeOut (97.19)*.

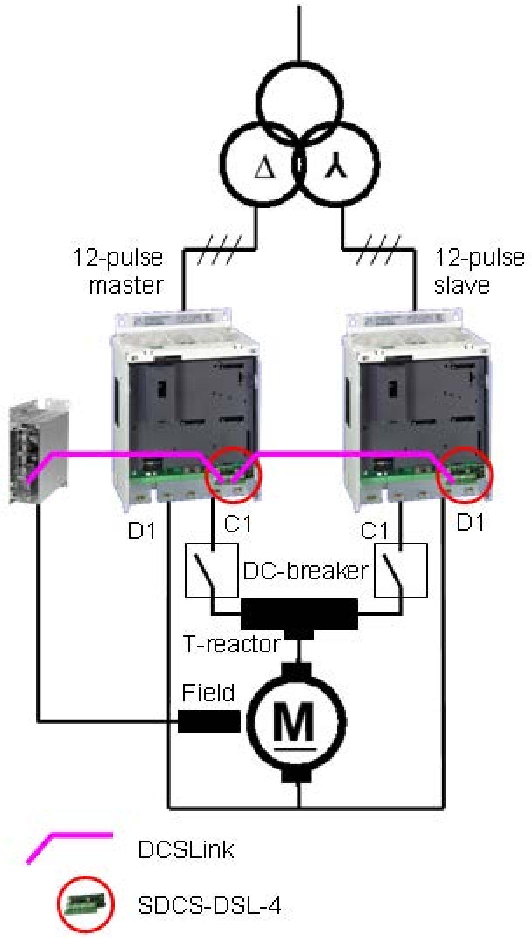
Hardware configurations

12-pulse parallel with master-follower

The following figures show the most significant features of 12-pulse parallel configuration:

- connection of two converters in parallel configuration,
- use of T-reactors,
- communication from 12-pulse master to external field exciter via DCSLink,
- communication from 12-pulse master to 12-pulse slave via DCSLink and
- master-follower via DCSLink.

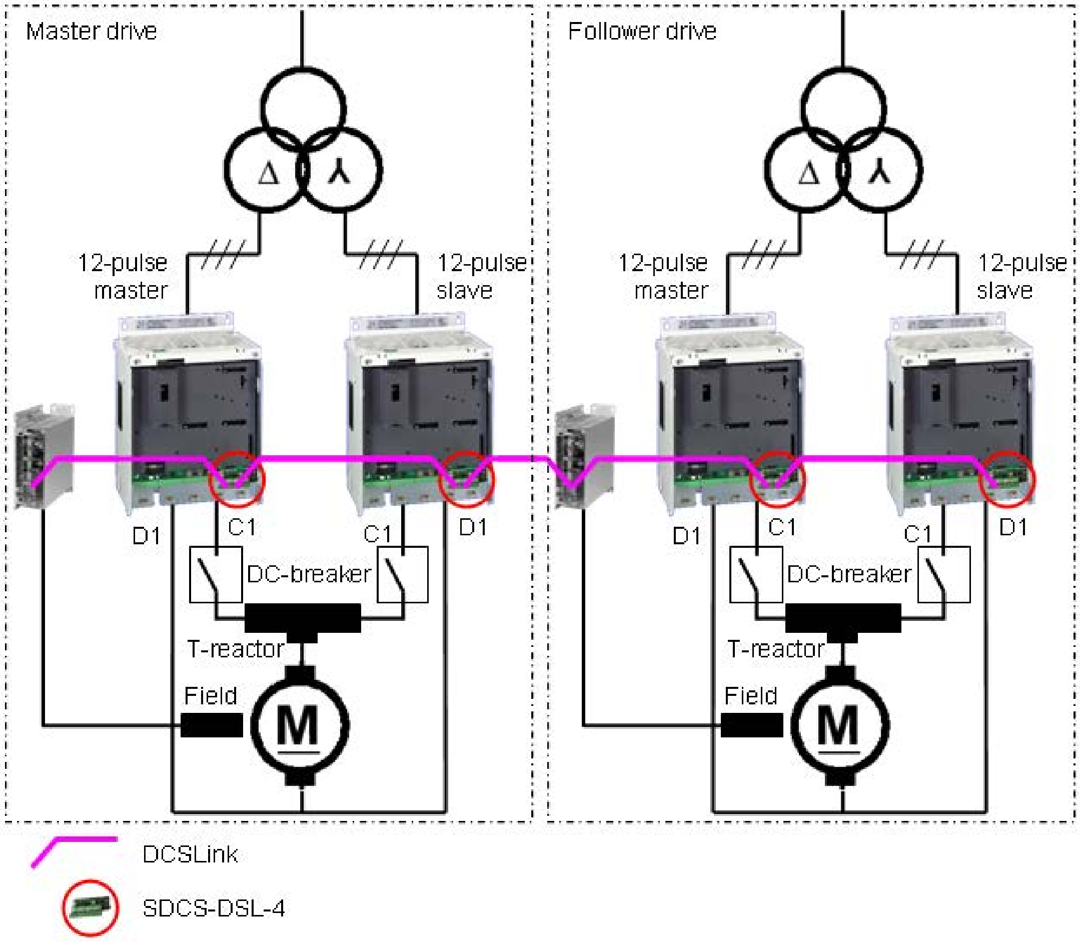
12-pulse parallel



12-pulse parallel

In this combination speed- and field control is performed by the 12-pulse master, whereas current control is carried out by both the 12-pulse master and the 12-pulse slave.

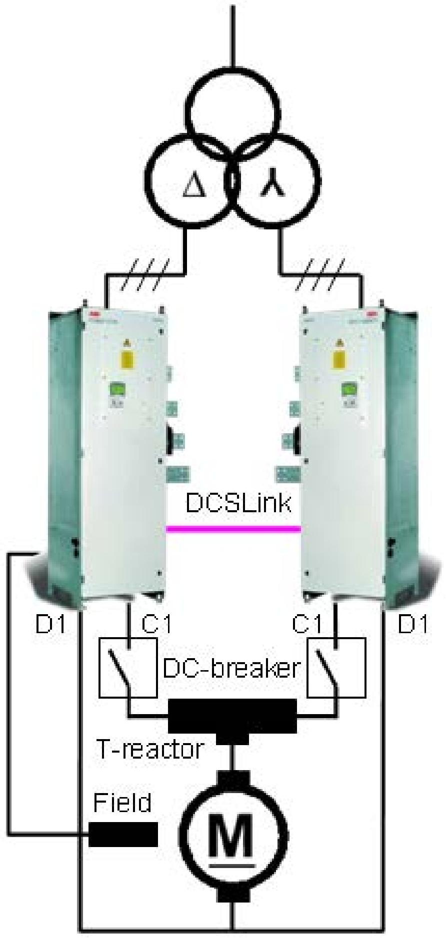
12-pulse parallel with master-follower



12-pulse parallel with master-follower

In this configuration the master-follower link transmits e.g. the speed- or torque reference.

12-pulse parallel with one motor

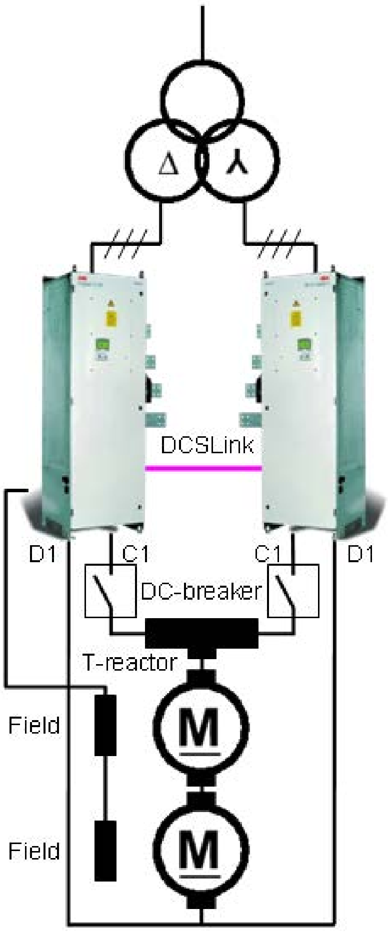


12-pulse parallel with one motor

This 12-pulse parallel configuration is supplying one motor. The motor is taking the full armature voltage and the full armature current:

- Both converters measure the full armature voltage. Thus set *AdjUDC (97.23)* = 100 %.
- Both converters supply the full armature voltage. Thus set *M1NomVolt (99.02)* = rated motor voltage.
- Each converter supplies half of the armature current. Thus set *M1NomCur (99.03)* = ½ rated motor current.

12-pulse parallel with two motors in series



12-pulse parallel with two motors in series

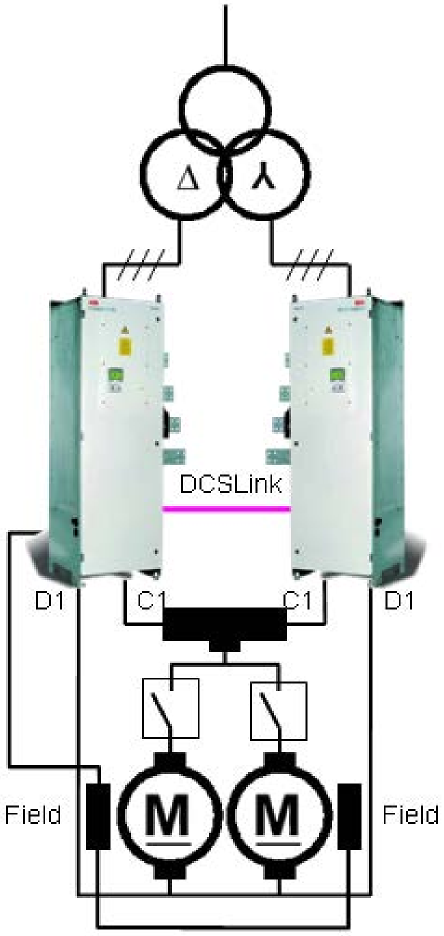
This 12-pulse parallel configuration is supplying two motors in series. Both motors are equal (M1 = M2). Each motor is taking half of the armature voltage and the full armature current:

– Both converters measure the full armature voltage. Thus set *AdjUDC (97.23)* = 100 %.
– Both converters supply the full armature voltage. Thus set *M1NomVolt (99.02) = 2* * rated motor voltage.

Each converter supplies half of the armature current. Thus set *M1NomCur*

– *(99.03)* = ½ rated motor current.
– The field windings are connected in serial. In case of a problem with the field exciter both motors loose their armature voltage and will not be damaged. In case of independently supplied fields it might happen that only one field exciter fails. In this case the complete armature voltage of both converters is over the motor with the healthy field exciter and it will be damaged.

12-pulse parallel with two motors in parallel



12-pulse parallel with two motors in parallel

This 12-pulse parallel configuration is supplying two motors in parallel. Both motors are equal (M1 = M2). Each motor is taking the full armature voltage and half of the armature current:

– Both converters measure the full armature voltage. Thus set *AdjUDC (97.23)* = 100 %.
– Both converters supply the full armature voltage. Thus set *M1NomVolt (99.02)* = rated motor voltage.
– Each converter supplies half of the armature current. Thus set *M1NomCur (99.03)* = rated motor current.
– The motor currents have to be balanced, so that each motor is taking the same load. This is especially important in field weakening.

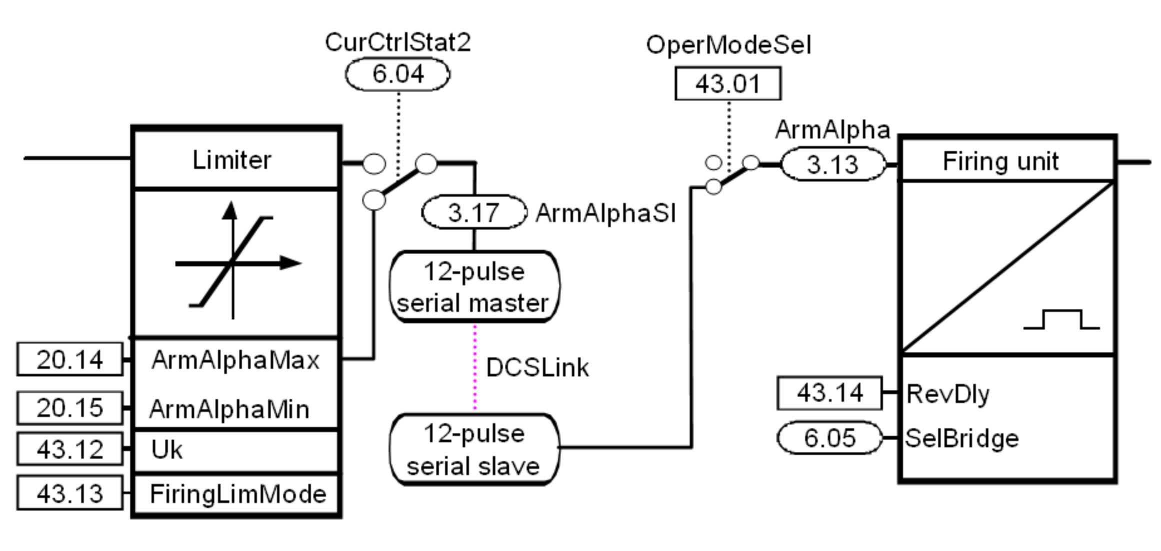
12-pulse serial / serial sequential configurations

Firmware configuration

DCSLink

The communication via DCSLink is set-up by means of parameters in group 94. Its content is:

12-pulse master		12-pulse slave
CtrlStatMas (6.09)	⇨	*CtrlStatMas (6.09)*
ArmVoltAct (1.14)	-	
ArmAlphaSl (3.17)	⇨	*ArmAlpha (3.13)*



CtrlStatSla (6.10)	⇦	*CtrlStatSla (6.10)*
ArmCurActSl (1.33)	⇦	*ConvCurAct (1.16)*
-	-	*ArmVoltAct (1.14)*

12-pulse serial / serial sequential communication

Firmware configuration

In the firmware the converter has to be set up either as 12-pulse master or as 12-pulse slave. This is done by means of *OperModeSel (43.01)*:

OperModeSel (43.01)	0 =	**ArmConv**	6-pulse operation
	1 =	**FieldConv**	field exciter mode
	2 =	**12PParMaster**	12-pulse parallel master
	3 =	**12PParSlave**	12-pulse parallel slave
	4 =	**12PSerMaster**	12-pulse serial master
	5 =	**12PSerSlave**	12-pulse serial slave

Configuration for 12-pulse serial / serial sequential

The 12-pulse specific parameters are mainly inside group 47.

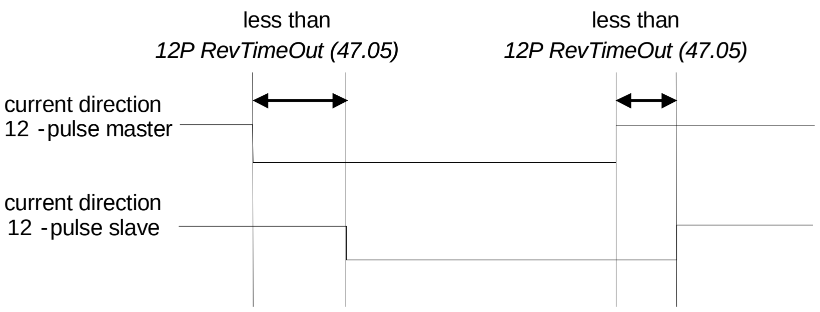
Monitoring

Following signals are available in the 12-pulse master to supervise the 12-pulse slave:
ArmCurActSl (1.33) is the actual 12-pulse slave armature current in amps.
DC VoltSerAll (1.37) is the sum of the actual 12-pulse master and 12-pulse slave armature voltage in volts.
ArmAlphaSl (3.17) is the firing angel reference which is send to the 12-pulse slave.
In both the 12-pulse master and the 12-pulse slave, the current control status signals of both converters are available:

CtrlStatMas (6.09) is the control status of the 12-pulse master.
CtrlStatSla (6.10) is the control status of the 12-pulse slave.

Faults

12-pulse reversal timeout:
In 12-pulse mode the current direction of both - 12-pulse master and 12-pulse slave - bridges is monitored. The drive trips with **F533 12PRevTime** [*FaultWord3 (9.03)* bit 0] if the 2 converters have different bridges fired for more than *12P RevTimeOut (47.05)*:



Reversal timeout

Note:
12P RevTimeOut (47.05) is only active in the 12-pulse master.

12-pulse communication:
If the 12-pulse communication timeout set in *12P TimeOut (94.03)* has elapsed without receiving a valid message from the 12-pulse slave, the 12-pulse master activates **F535 12PulseCom** [*FaultWord3 (9.03)* bit 2].
Note:
12P TimeOut (94.03) is only active in the 12-pulse master.

12-pulse slave failure:
F536 12PSlaveFail [*FaultWord3 (9.03)* bit 3] is activated by a fault in the 12-pulse slave and trips the 12-pulse master.
Note:
F536 12PSlaveFail appears only in the 12-pulse master.

Dynamic response

The dynamic response of the 12-pulse configuration is delayed in comparison to a 6-pulse configuration by:

– 0.5 control cycles (3.3 ms at 50 Hz or 2.77 ms at 60 Hz) due to the 30° offset in the mains supply of the 12-pulse slave and
– 20 ms due to the recommended behavior during the bridge reversal - see *RevDly (43.14)*.

Current controller

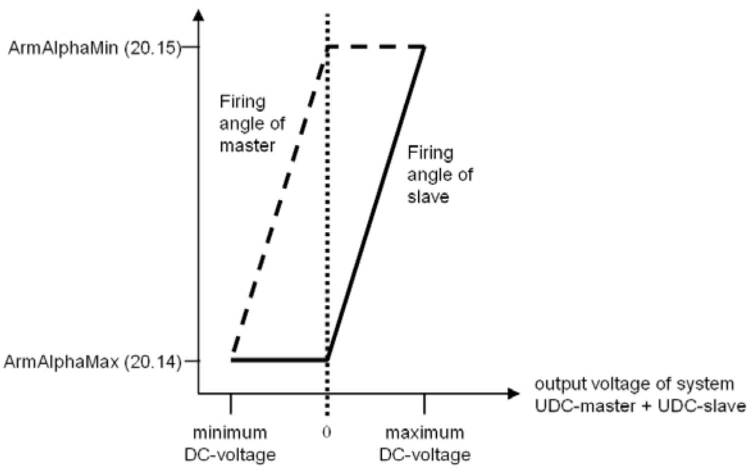
Measuring the current:
In 12-pulse serial / serial sequential the same current flows through the 12-pulse master and the 12-pulse slave. Usually the current measurement in the 12-pulse slave is fully operative. Thus the 12-pulse serial slave uses the reversal command of the 12-pulse master for its own bridge changeover, see *CtrlStatMas (6.09)* bit 12.

Attention:
In case there is no current measurement available in the 12-pulse slave following parameters have to be set properly:
– *RevDly (43.14)* = 0 and
– *ZeroCurTimeOut (97.19)* = 12000.

Current control mode:
In 12-pulse serial / serial sequential only the current controller of the 12-pulse master is used and generates the firing angles for both units. The current controller of the 12-pulse slave is not in use. Thus following parameters have to have the same value in both units:
– *ArmAlphaMax (20.14)*,
– *ArmAlphaMin (20.15)*,
– *RevDly (43.14)* and
– *ZeroCurTimeOut (97.19)*.

Serial sequential mode

The serial sequential mode is activated by means of setting *12P Mode (47.01)* = **Sequential** in both the 12-pulse master and the 12-pulse slave. The data transmission is equal to the one of the 12-pulse serial mode.
12P Mode (47.01) = **Normal**, 12-pulse master and 12-pulse slave are controlled by the same firing angle.
12P Mode (47.01) = **Sequential**, sequential control of the firing angles. Only one unit changes its firing angle, while the other unit’s firing angle is fixed at the minimum- or maximum firing angle.



Firing angel serial sequential

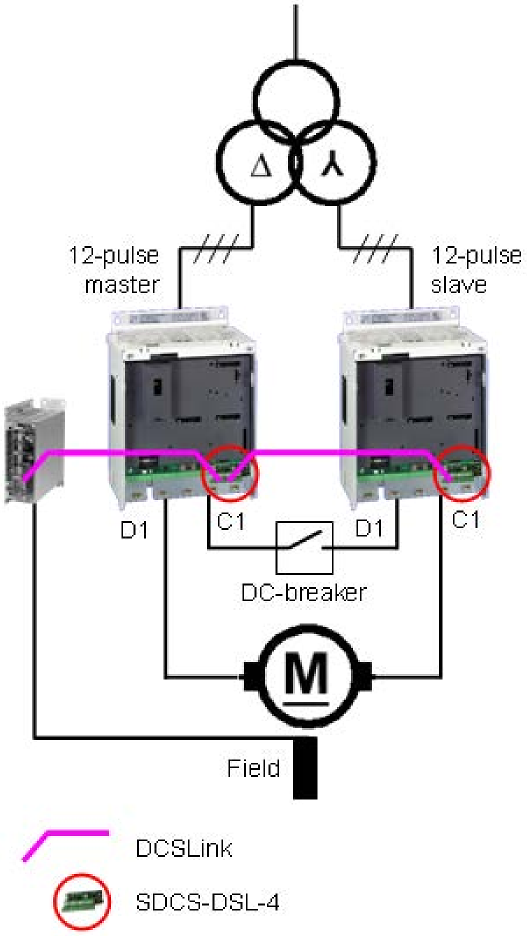
Hardware configurations

12-pulse serial / serial sequential with master-follower

The following figures show the most significant features of 12-pulse serial / serial sequential configuration (maximum output voltage 1600 V_{DC}):

– connection of two converters in serial / serial sequential configuration,
– communication from 12-pulse master to external field exciter via DCSLink,
– communication from 12-pulse master to 12-pulse slave via DCSLink and
– master-follower via DCSLink.

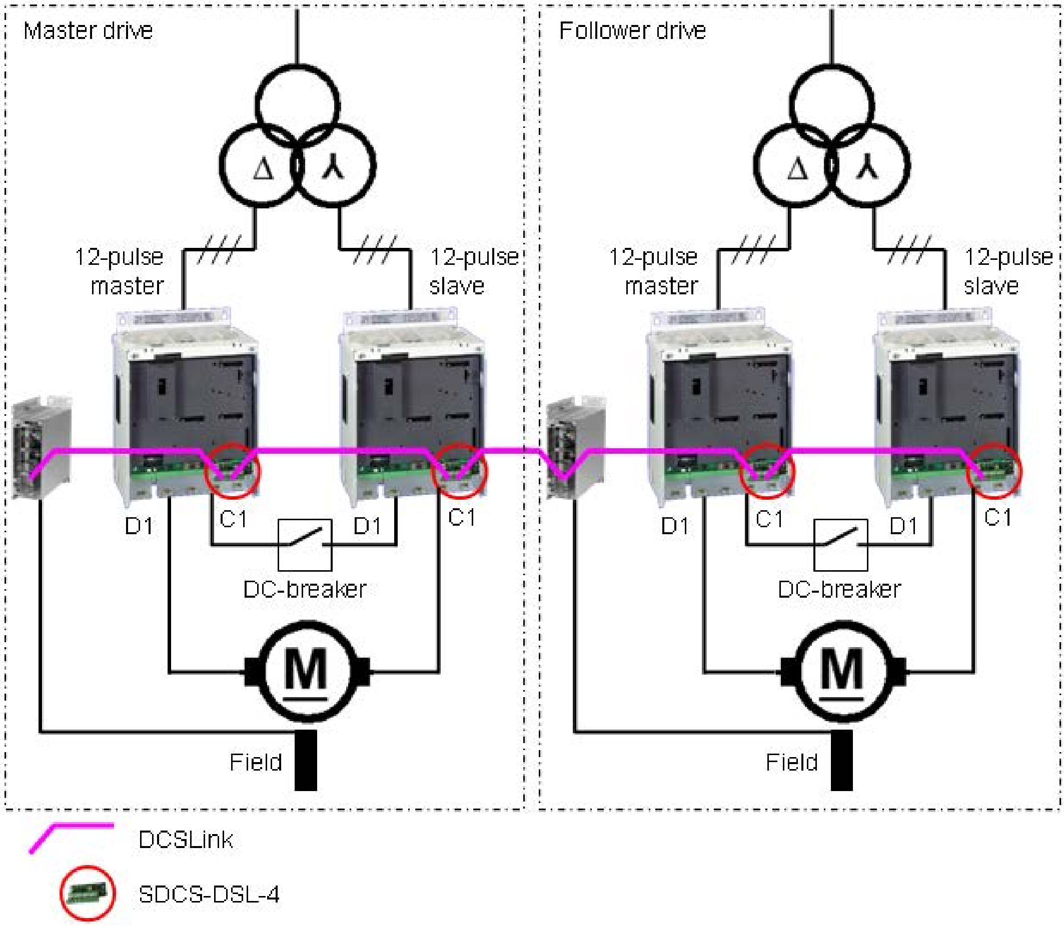
12-pulse serial / serial sequential



12-pulse serial / serial sequential

In this combination speed-, current- and field control is performed by the 12-pulse master, the firing angel is send from the 12-pulse master to the 12-pulse slave.

12-pulse serial / serial sequential with master-follower



12-pulse serial / serial sequential with master-follower

In this configuration the master-follower link transmits e.g. the speed- or torque reference.

Measuring the DC voltage

Normal 12-pulse serial / serial sequential configuration

In 12-pulse serial / serial sequential configurations the 12-pulse drive has to stand the double DC voltage of the original 6-pulse DC voltage. For that reason the design of the high resistance voltage measurement circuit in the DCS800 requires hardware changes. Theses changes on the SDCS-PIN-51 can be ordered by means of a plus code.
These hardware changes can only be applied to DCS800 units of sizes A5, A6 and A7.

Size	DC current [A]	Mains voltage [V]	High resistance voltage measurement	Galvanic isolation
D1 to D4 are not used for 12-pulse serial / serial sequential				
D5	900 - 2000	200 - 350	via modifying SDCS-PIN-51 and firmware	AC transformer and DC transducer
D6	1900 - 3000	200 - 600	via modifying SDCS-PIN-51 and firmware	AC transformer and DC transducer
D7	2050 - 4800	200 - 600*	via modifying SDCS-PIN-51 and firmware	AC transformer and DC transducer
	2050 - 5200	200 - 500*		

* higher voltages for D7 converter modules on request

Voltage measurement circuit for 12-pulse serial / serial sequential configurations

Sandwich configuration

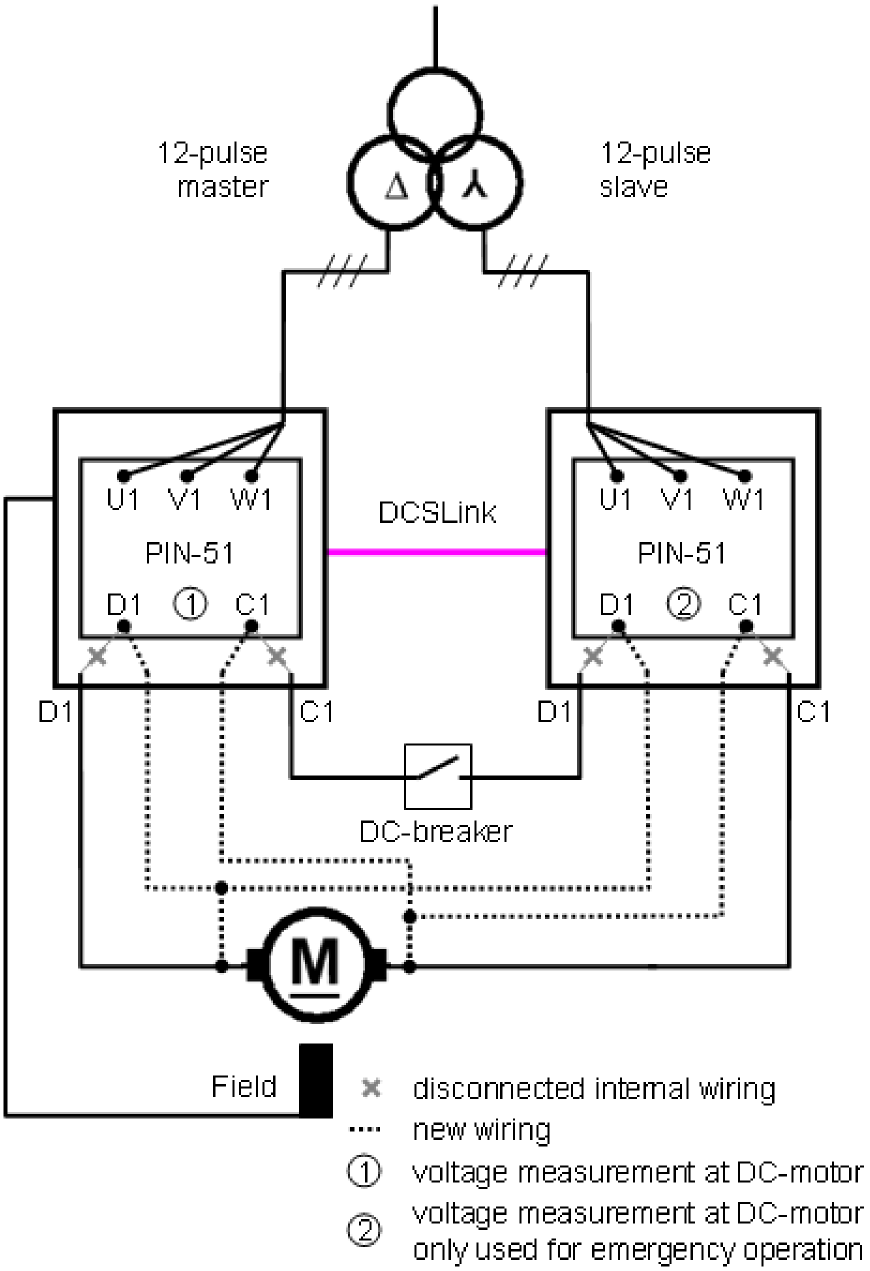
An extended voltage range can be applied by means of a special motor configuration called sandwich with a maximum supply voltage of 1000 V_{AC}.

Size	DC current [A]	Mains voltage [V]	High resistance voltage measurement	Galvanic isolation
D6	1900 - 3000	200 - 800	via modifying SDCS-PIN-51 and firmware	AC transformer and DC transducer
D7	2050 - 4000	200 - 1000	via modifying SDCS-PIN-51 and firmware	AC transformer and DC transducer
	2050 - 4800	200 - 800		
	2050 - 5200	200 - 500		

Voltage measurement circuit for 12-pulse serial / serial sequential configurations in sandwich

12-pulse serial / serial sequential with one motor

High resistance voltage measurement with one motor:



12-pulse serial / serial sequential with one motor

This 12-pulse serial configuration is supplying one motor. The motor is taking the full armature voltage and the full armature current:

- For correct EMF feedback adjust the DC voltage with *AdjUDC (97.23)* = 50 %.
- The motor voltage is supplied by 2 converters, thus *M1NomVolt (99.02)* = ½ rated motor voltage.
- Both converters have the same current, thus *M1NomCur (99.03)* = rated motor current.

Voltage class	Nominal supply voltage, *NomMainsVolt (99.10)*	SDCS-PIN-51 voltage coding	Hardware coding, *S ConvScaleVolt (97.03)*
04	200 V - 250 V_{AC}	500 V	500 V_{AC}
04	250 V - 300 V_{AC}	600 V	600 V_{AC}
04	300 V - 350 V_{AC}	690 V	690 V_{AC}
04	**350 V - 400 V_{AC}**	**800 V**	**800 V_{AC}**
05	400 V - 500 V_{AC}	1000 V	1000 V_{AC}
More information see chapter: ***Measuring the DC voltage***			

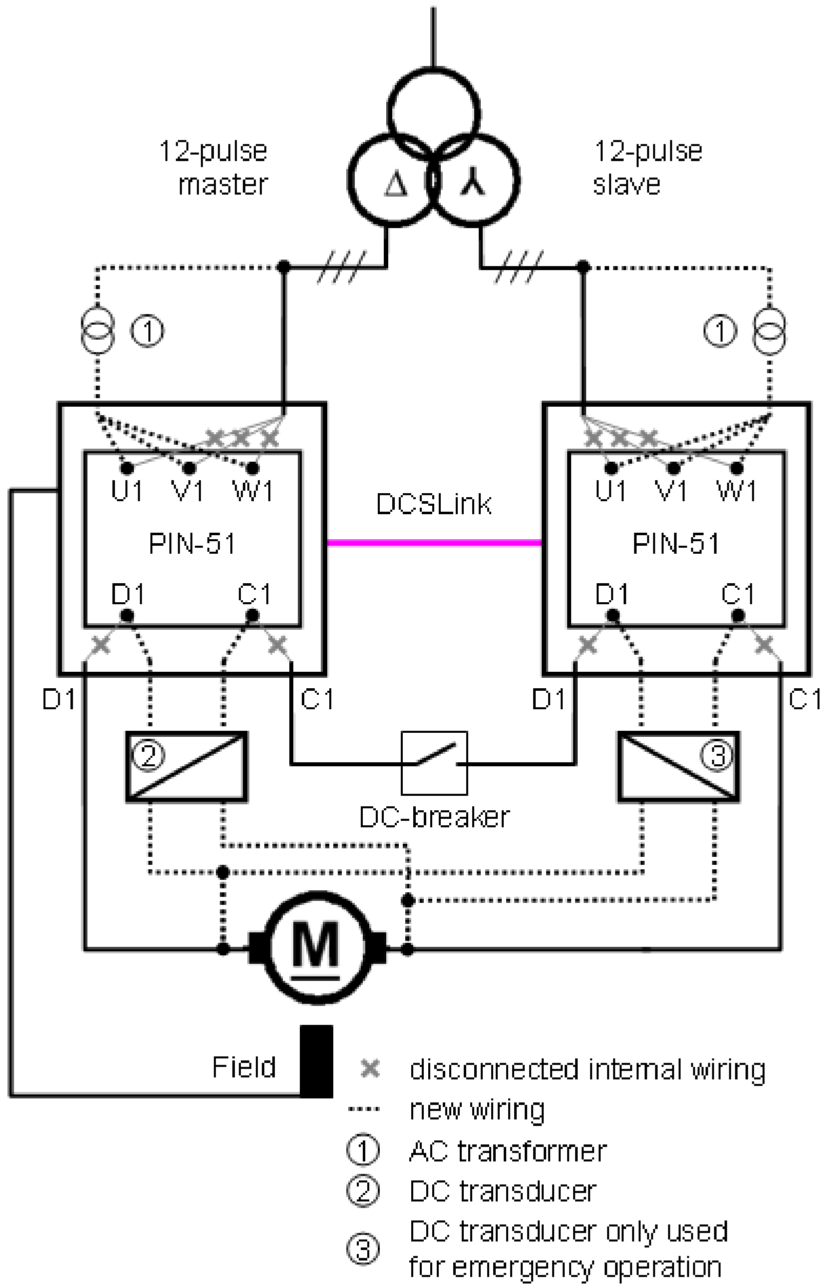
Settings for high resistance voltage measurement

Depending on the supply voltage different settings have to be chosen. With a supply voltage of **380 V_{AC}**:

– Set *NomMainsVolt (99.10)* = **380 V**.
– The SDCS-PIN-51 has to be able to stand twice the supply voltage. In this example the voltage coding has to be set to **800 V**.
– The hardware coding can be set with *S ConvScaleVolt (97.03)*. The hardware coding has to be set to the same value as the voltage coding.

For more information see chapter *Power interfaces SDCS-PIN-5x* of the *DCS800 Hardware Manual* (3ADW000194).

Galvanic isolation with one motor:



12-pulse serial / serial sequential with one motor

This 12-pulse serial configuration is supplying one motor. The motor is taking the full armature voltage and the full armature current:

– For correct EMF feedback adjust the DC voltage with *AdjUDC (97.23)* = 50 %.
– The motor voltage is supplied by 2 converters, thus *M1NomVolt (99.02)* = ½ rated motor voltage.
– Both converters have the same current, thus *M1NomCur (99.03)* = rated motor current.

Voltage class	Nominal supply voltage, *NomMainsVolt (99.10)*	AC transformer terminals (3ADT745047)	DC transducer position (8680A1)	Hardware coding, *S ConvScaleVolt (97.03)*
04	200 V - 250 V_{AC}	2U1-2V1-2W1	675 V (7)	500 V_{AC}
04	250 V - 300 V_{AC}	2U2-2V2-2W2	810 V (6)	600 V_{AC}
04	300 V - 350 V_{AC}	2U3-2V3-2W3	945 V (5)	690 V_{AC}
04	350 V - 400 V_{AC}	2U4-2V4-2W4	1080 V (4)	800 V_{AC}
05	400 V - 500 V_{AC}	2U5-2V5-2W5	1350 V (2)	1000 V_{AC}
06	**500 V - 600 V_{AC}**	**2U6-2V6-2W6**	**1620 V (1)**	**1200 V_{AC}**
More information see chapter: ***Measuring the DC voltage***				

Settings for galvanic isolation

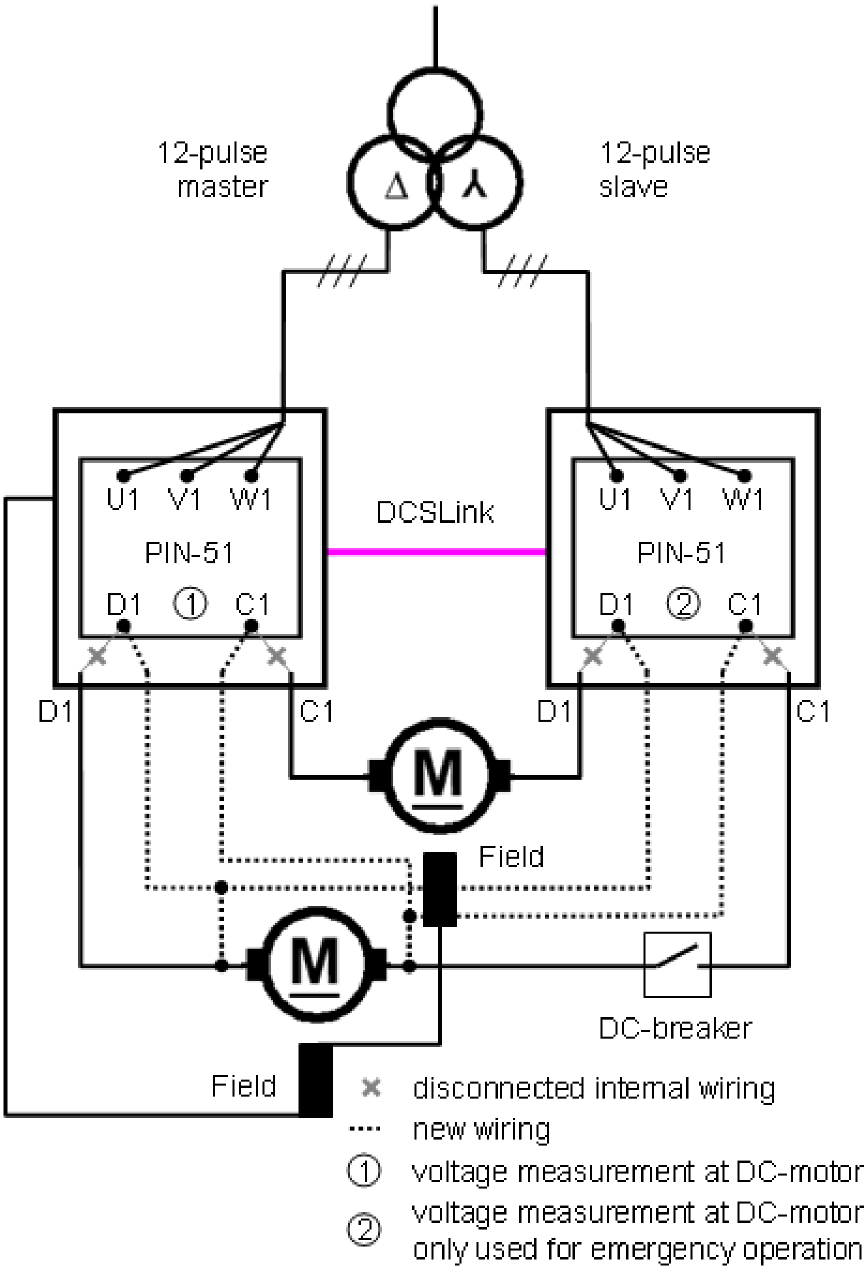
Depending on the supply voltage different settings have to be chosen. With a supply voltage of **550 V_{AC}**:

- Set *NomMainsVolt (99.10)* = **550 V**.
- The AC transducers terminals **2U6-2V6-2W6** have to be used.
- The DC transducer must be set to **position (1)** with a maximum voltage of **1620 V_{DC}**.
- The hardware coding has to be set to twice the maximum value of the voltage measurement circuit. In this example set *S ConvScaleVolt (97.03)* = **1200 V**.
- On the SDCS-PIN-51 the bridges over resistors W1 to W26 are not cut and the 5 MΩ film resistors are bridged with 27.4 kΩ resistors.

For more information see chapter *Galvanic isolation* of the *DCS800 Hardware Manual* (3ADW000194).

12-pulse serial / serial sequential with two motors configuration 1

High resistance voltage measurement with two motors:



12-pulse serial / serial sequential with two motors

This 12-pulse serial configuration is supplying two motors. Both motors are equal (M1 = M2). Each motor is taking half of the armature voltage and the full armature current:

- For correct EMF feedback adjust the DC voltage with *AdjUDC (97.23)* = 100 %.
- The motor voltage is supplied by 2 converters and taken by 2 motors (M1 = M2), thus *M1NomVolt (99.02)* = rated motor voltage.
- Both converters have the same current, thus *M1NomCur (99.03)* = rated motor current.

Voltage class	Nominal supply voltage, *NomMainsVolt (99.10)*	SDCS-PIN-51 voltage coding	Hardware coding, *S ConvScaleVolt (97.03)*
04	**200 V - 250 V_{AC}**	**500 V**	**500 V_{AC}**
04	250 V - 300 V_{AC}	600 V	600 V_{AC}
04	300 V - 350 V_{AC}	690 V	690 V_{AC}
04	350 V - 400 V_{AC}	800 V	800 V_{AC}
05	400 V - 500 V_{AC}	1000 V	1000 V_{AC}
More information see chapter: ***Measuring the DC voltage***			

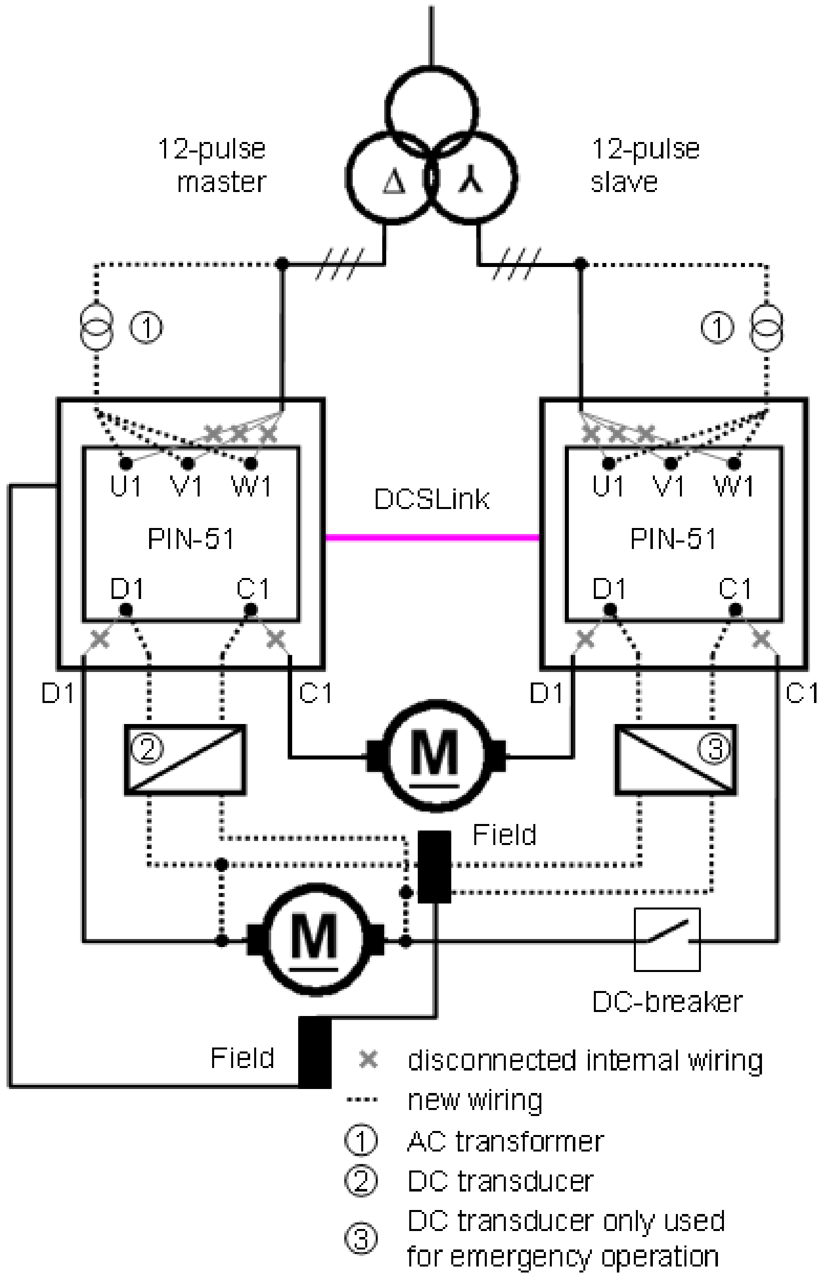
Settings for high resistance voltage measurement

Depending on the supply voltage different settings have to be chosen. With a supply voltage of **220 V_{AC}**:

– Set *NomMainsVolt (99.10)* = **220 V**.
– The SDCS-PIN-51 has to be able to stand twice the supply voltage. In this example the voltage coding has to be set to **500 V**.
– The hardware coding can be set with *S ConvScaleVolt (97.03)*. The hardware coding has to be set to the same value as the voltage coding.
– The field windings are connected in serial. In case of a problem with the field exciter both motors loose their armature voltage and will not be damaged. In case of independently supplied fields it might happen that only one field exciter fails. In this case the complete armature voltage of both converters is over the motor with the healthy field exciter and it will be damaged.

For more information see chapter *Power interfaces SDCS-PIN-5x* of the *DCS800 Hardware Manual* (3ADW000194).

Galvanic isolation with two motors:



12-pulse serial / serial sequential with two motors

This 12-pulse serial configuration is supplying two motors. Both motors are equal (M1 = M2). Each motor is taking half of the armature voltage and the full armature current:

– For correct EMF feedback adjust the DC voltage with *AdjUDC (97.23)* = 100 %.
– The motor voltage is supplied by 2 converters and taken by 2 motors (M1 = M2), thus *M1NomVolt (99.02)* = rated motor voltage.
– Both converters have the same current, thus *M1NomCur (99.03)* = rated motor current.

Voltage class	Nominal supply voltage, *NomMainsVolt (99.10)*	AC transformer terminals (3ADT745047)	DC transducer position (8680A1)	Hardware coding, *S ConvScaleVolt (97.03)*
04	200 V - 250 V_{AC}	2U1-2V1-2W1	675 V (7)	500 V_{AC}
04	250 V - 300 V_{AC}	2U2-2V2-2W2	810 V (6)	600 V_{AC}
04	300 V - 350 V_{AC}	2U3-2V3-2W3	945 V (5)	690 V_{AC}
04	350 V - 400 V_{AC}	2U4-2V4-2W4	1080 V (4)	800 V_{AC}
05	**400 V - 500 V_{AC}**	**2U5-2V5-2W5**	**1350 V (2)**	**1000 V_{AC}**
06	500 V - 600 V_{AC}	2U6-2V6-2W6	1620 V (1)	1200 V_{AC}
More information see chapter: ***Measuring the DC voltage***				

Settings for galvanic isolation

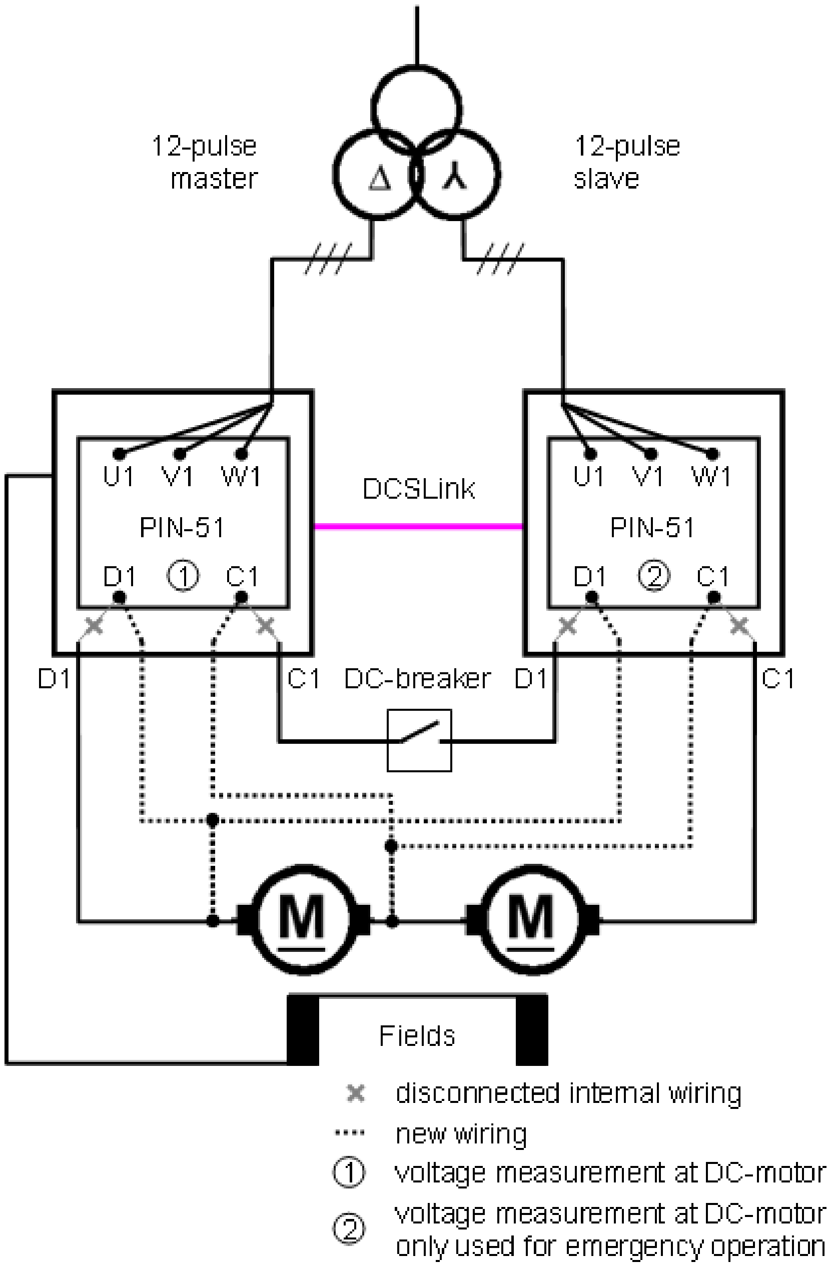
Depending on the supply voltage different settings have to be chosen. With a supply voltage of **440 V_{AC}**:

– Set *NomMainsVolt (99.10)* = **440 V**.
– The AC transducers terminals **2U5-2V5-2W5** have to be used.
– The DC transducer must be set to **position (2)** with a maximum voltage of **1350 V_{DC}**.
– The hardware coding has to be set to twice the maximum value of the voltage measurement circuit. In this example set *S ConvScaleVolt (97.03)* = **1000 V**.
– On the SDCS-PIN-51 the bridges over resistors W1 to W26 are not cut and the 5 MΩ film resistors are bridged with 27.4 kΩ resistors.
– The field windings are connected in serial. In case of a problem with the field exciter both motors loose their armature voltage and will not be damaged. In case of independently supplied fields it might happen that only one field exciter fails. In this case the complete armature voltage of both converters is over the motor with the healthy field exciter and it will be damaged.

For more information see chapter *Galvanic isolation* of the *DCS800 Hardware Manual* (3ADW000194).

12-pulse serial / serial sequential with two motors configuration 2

High resistance voltage measurement with two motors:



12-pulse serial / serial sequential with two motors

This 12-pulse serial configuration is supplying two motors. Both motors are equal (M1 = M2). Each motor is taking half of the armature voltage and the full armature current:

- For correct EMF feedback adjust the DC voltage with *AdjUDC (97.23)* = 100 %.
- The motor voltage is supplied by 2 converters and taken by 2 motors (M1 = M2), thus *M1NomVolt (99.02)* = rated motor voltage.
- Both converters have the same current, thus *M1NomCur (99.03)* = rated motor current.

Voltage class	Nominal supply voltage, *NomMainsVolt (99.10)*	SDCS-PIN-51 voltage coding	Hardware coding, *S ConvScaleVolt (97.03)*
04	**200 V - 250 V_{AC}**	**500 V**	**500 V_{AC}**
04	250 V - 300 V_{AC}	600 V	600 V_{AC}
04	300 V - 350 V_{AC}	690 V	690 V_{AC}
04	350 V - 400 V_{AC}	800 V	800 V_{AC}
05	400 V - 500 V_{AC}	1000 V	1000 V_{AC}
More information see chapter: ***Measuring the DC voltage***			

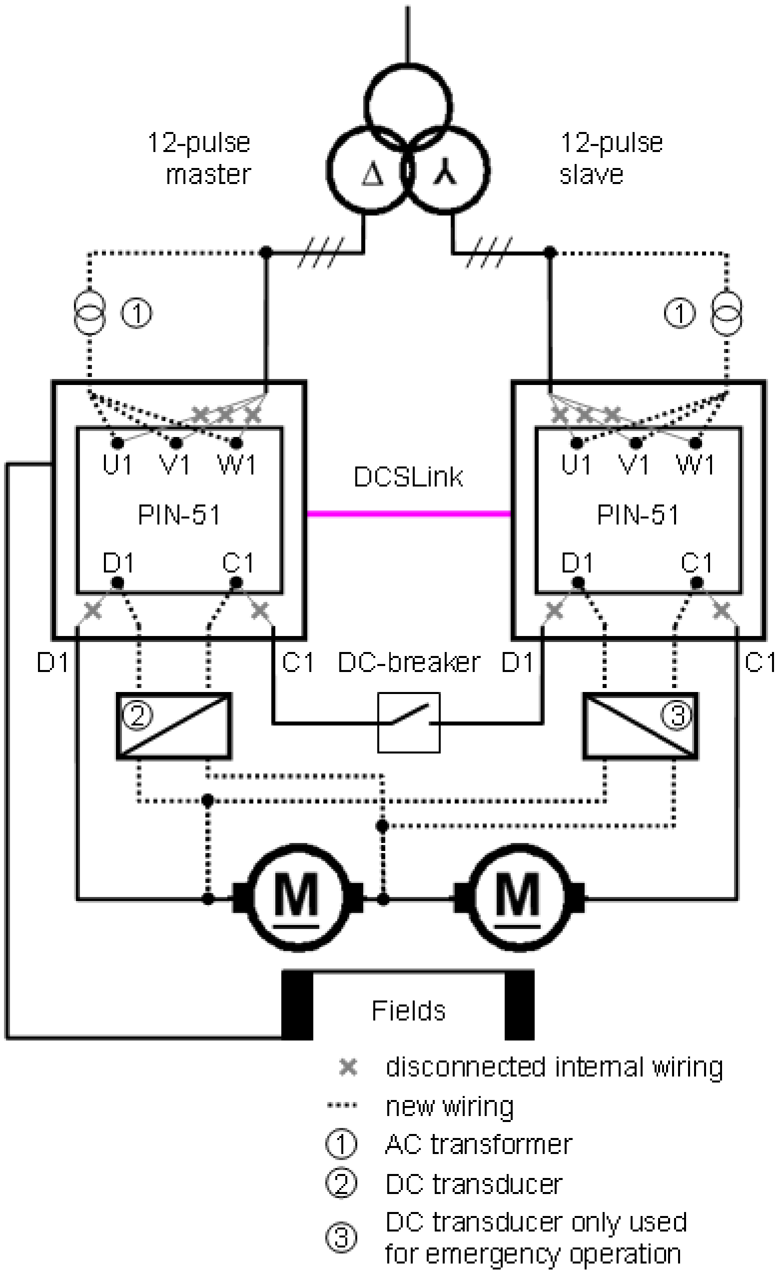
Settings for high resistance voltage measurement

Depending on the supply voltage different settings have to be chosen. With a supply voltage of **220 V_{AC}**:

- Set *NomMainsVolt (99.10)* = **220 V**.
- The SDCS-PIN-51 has to be able to stand twice the supply voltage. In this example the voltage coding has to be set to **500 V**.
- The hardware coding can be set with *S ConvScaleVolt (97.03)*. The hardware coding has to be set to the same value as the voltage coding.
- The field windings are connected in serial. In case of a problem with the field exciter both motors loose their armature voltage and will not be damaged. In case of independently supplied fields it might happen that only one field exciter fails. In this case the complete armature voltage of both converters is over the motor with the healthy field exciter and it will be damaged.

For more information see chapter *Power interfaces SDCS-PIN-5x* of the *DCS800 Hardware Manual* (3ADW000194).

Galvanic isolation with two motors:



12-pulse serial / serial sequential with two motors

This 12-pulse serial configuration is supplying two motors. Both motors are equal (M1 = M2). Each motor is taking half of the armature voltage and the full armature current:

- For correct EMF feedback adjust the DC voltage with *AdjUDC (97.23)* = 100 %.
- The motor voltage is supplied by 2 converters and taken by 2 motors (M1 = M2), thus *M1NomVolt (99.02)* = rated motor voltage.
- Both converters have the same current, thus *M1NomCur (99.03)* = rated motor current.

Voltage class	Nominal supply voltage, *NomMainsVolt (99.10)*	AC transformer terminals (3ADT745047)	DC transducer position (8680A1)	Hardware coding, *S ConvScaleVolt (97.03)*
04	200 V - 250 V_{AC}	2U1-2V1-2W1	675 V (7)	500 V_{AC}
04	250 V - 300 V_{AC}	2U2-2V2-2W2	810 V (6)	600 V_{AC}
04	300 V - 350 V_{AC}	2U3-2V3-2W3	945 V (5)	690 V_{AC}
04	350 V - 400 V_{AC}	2U4-2V4-2W4	1080 V (4)	800 V_{AC}
05	**400 V - 500 V_{AC}**	**2U5-2V5-2W5**	**1350 V (2)**	**1000 V_{AC}**
06	500 V - 600 V_{AC}	2U6-2V6-2W6	1620 V (1)	1200 V_{AC}
More information see chapter: ***Measuring the DC voltage***				

Settings for galvanic isolation

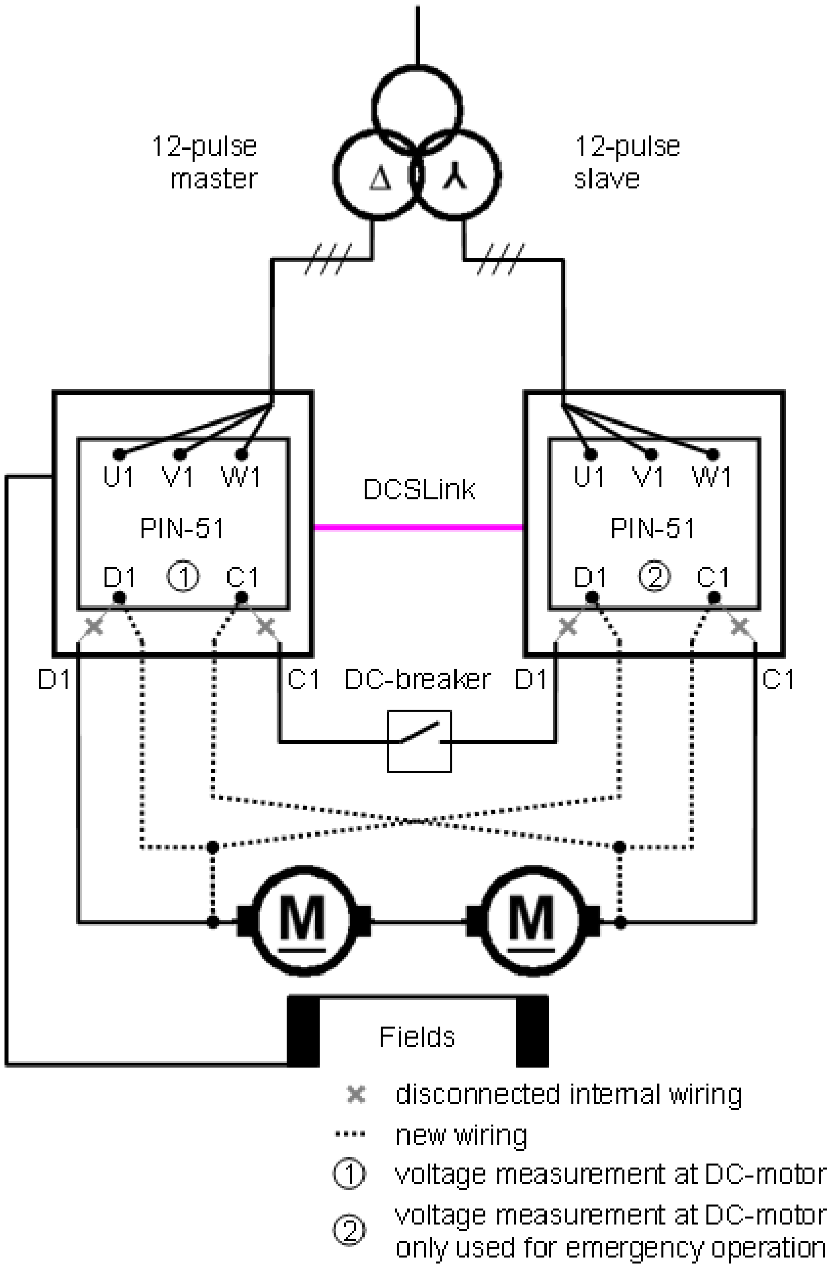
Depending on the supply voltage different settings have to be chosen. With a supply voltage of **440 V_{AC}**:

- Set *NomMainsVolt (99.10)* = **440 V**.
- The AC transducers terminals **2U5-2V5-2W5** have to be used.
- The DC transducer must be set to **position (2)** with a maximum voltage of **1350 V_{DC}**.
- The hardware coding has to be set to twice the maximum value of the voltage measurement circuit. In this example set *S ConvScaleVolt (97.03)* = **1000 V**.
- On the SDCS-PIN-51 the bridges over resistors W1 to W26 are not cut and the 5 MΩ film resistors are bridged with 27.4 kΩ resistors.
- The field windings are connected in serial. In case of a problem with the field exciter both motors loose their armature voltage and will not be damaged. In case of independently supplied fields it might happen that only one field exciter fails. In this case the complete armature voltage of both converters is over the motor with the healthy field exciter and it will be damaged.

For more information see chapter *Galvanic isolation* of the *DCS800 Hardware Manual* (3ADW000194).

12-pulse serial / serial sequential with two motors configuration 3

High resistance voltage measurement with two motors:



12-pulse serial / serial sequential with two motors

This 12-pulse serial configuration is supplying two motors. Both motors are equal (M1 = M2). Each motor is taking half of the armature voltage and the full armature current:

– For correct EMF feedback adjust the DC voltage with *AdjUDC (97.23)* = 50 %.
– The motor voltage is supplied by 2 converters and taken by 2 motors (M1 = M2), thus *M1NomVolt (99.02)* = rated motor voltage.
– Both converters have the same current, thus *M1NomCur (99.03)* = rated motor current.

Voltage class	Nominal supply voltage, *NomMainsVolt (99.10)*	SDCS-PIN-51 voltage coding	Hardware coding, *S ConvScaleVolt (97.03)*
04	**200 V - 250 V_{AC}**	**500 V**	**500 V_{AC}**
04	250 V - 300 V_{AC}	600 V	600 V_{AC}
04	300 V - 350 V_{AC}	690 V	690 V_{AC}
04	350 V - 400 V_{AC}	800 V	800 V_{AC}
05	400 V - 500 V_{AC}	1000 V	1000 V_{AC}
More information see chapter: ***Measuring the DC voltage***			

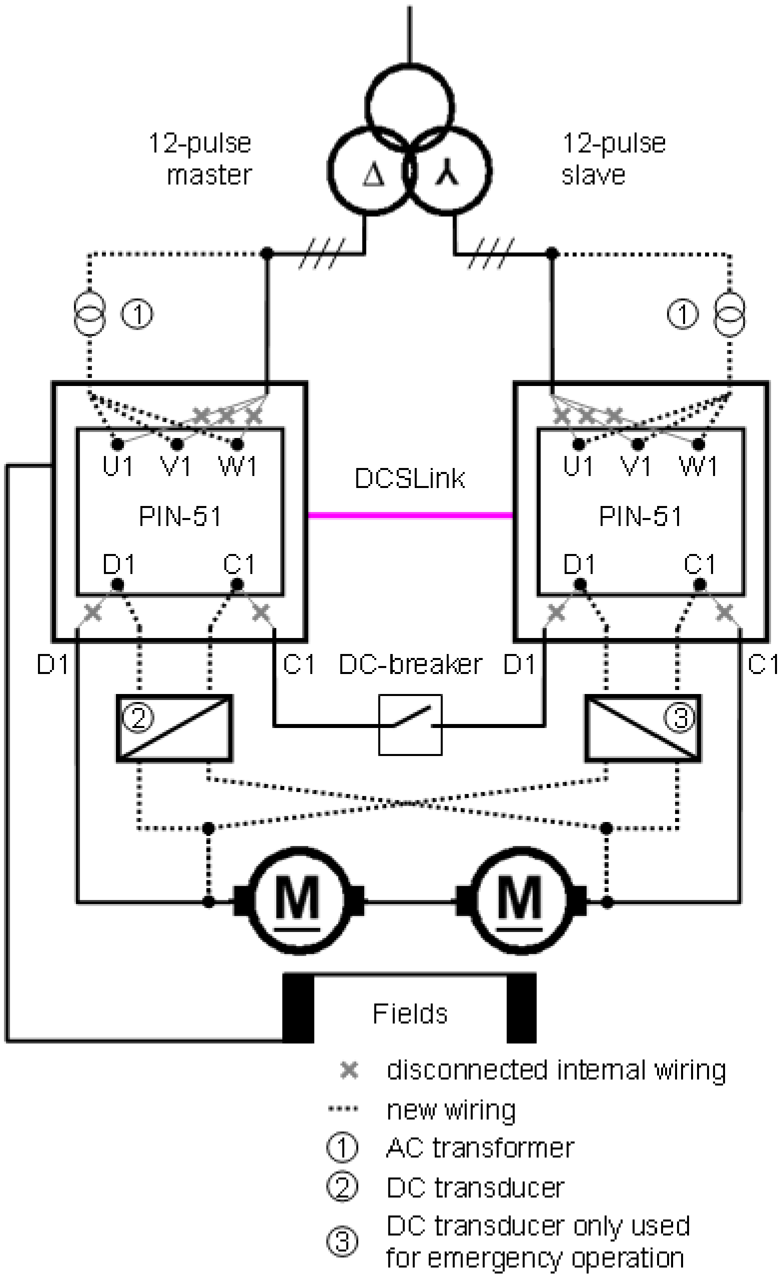
Settings for high resistance voltage measurement

Depending on the supply voltage different settings have to be chosen. With a supply voltage of **220 V_{AC}**:

- Set *NomMainsVolt (99.10)* = **220 V**.
- The SDCS-PIN-51 has to be able to stand twice the supply voltage. In this example the voltage coding has to be set to **500 V**.
- The hardware coding can be set with *S ConvScaleVolt (97.03)*. The hardware coding has to be set to the same value as the voltage coding.
- The field windings are connected in serial. In case of a problem with the field exciter both motors loose their armature voltage and will not be damaged. In case of independently supplied fields it might happen that only one field exciter fails. In this case the complete armature voltage of both converters is over the motor with the healthy field exciter and it will be damaged.

For more information see chapter *Power interfaces SDCS-PIN-5x* of the *DCS800 Hardware Manual* (3ADW000194).

Galvanic isolation with two motors:



12-pulse serial / serial sequential with two motors

This 12-pulse serial configuration is supplying two motors. Both motors are equal (M1 = M2). Each motor is taking half of the armature voltage and the full armature current:

– For correct EMF feedback adjust the DC voltage with *AdjUDC (97.23)* = 50 %.
– The motor voltage is supplied by 2 converters and taken by 2 motors (M1 = M2), thus *M1NomVolt (99.02)* = rated motor voltage.
– Both converters have the same current, thus *M1NomCur (99.03)* = rated motor current.

Voltage class	Nominal supply voltage, *NomMainsVolt (99.10)*	AC transformer terminals (3ADT745047)	DC transducer position (8680A1)	Hardware coding, *S ConvScaleVolt (97.03)*
04	200 V - 250 V_{AC}	2U1-2V1-2W1	675 V (7)	500 V_{AC}
04	250 V - 300 V_{AC}	2U2-2V2-2W2	810 V (6)	600 V_{AC}
04	300 V - 350 V_{AC}	2U3-2V3-2W3	945 V (5)	690 V_{AC}
04	350 V - 400 V_{AC}	2U4-2V4-2W4	1080 V (4)	800 V_{AC}
05	**400 V - 500 V_{AC}**	**2U5-2V5-2W5**	**1350 V (2)**	**1000 V_{AC}**
06	500 V - 600 V_{AC}	2U6-2V6-2W6	1620 V (1)	1200 V_{AC}
More information see chapter: ***Measuring the DC voltage***				

Settings for galvanic isolation

Depending on the supply voltage different settings have to be chosen. With a supply voltage of **440 V_{AC}**:

– Set *NomMainsVolt (99.10)* = **440 V**.
– The AC transducers terminals **2U5-2V5-2W5** have to be used.
– The DC transducer must be set to **position (2)** with a maximum voltage of **1350 V_{DC}**.
– The hardware coding has to be set to twice the maximum value of the voltage measurement circuit. In this example set *S ConvScaleVolt (97.03)* = **1000 V**.
– On the SDCS-PIN-51 the bridges over resistors W1 to W26 are not cut and the 5 MΩ film resistors are bridged with 27.4 kΩ resistors.
– The field windings are connected in serial. In case of a problem with the field exciter both motors loose their armature voltage and will not be damaged. In case of independently supplied fields it might happen that only one field exciter fails. In this case the complete armature voltage of both converters is over the motor with the healthy field exciter and it will be damaged.

For more information see chapter *Galvanic isolation* of the *DCS800 Hardware Manual* (3ADW000194).

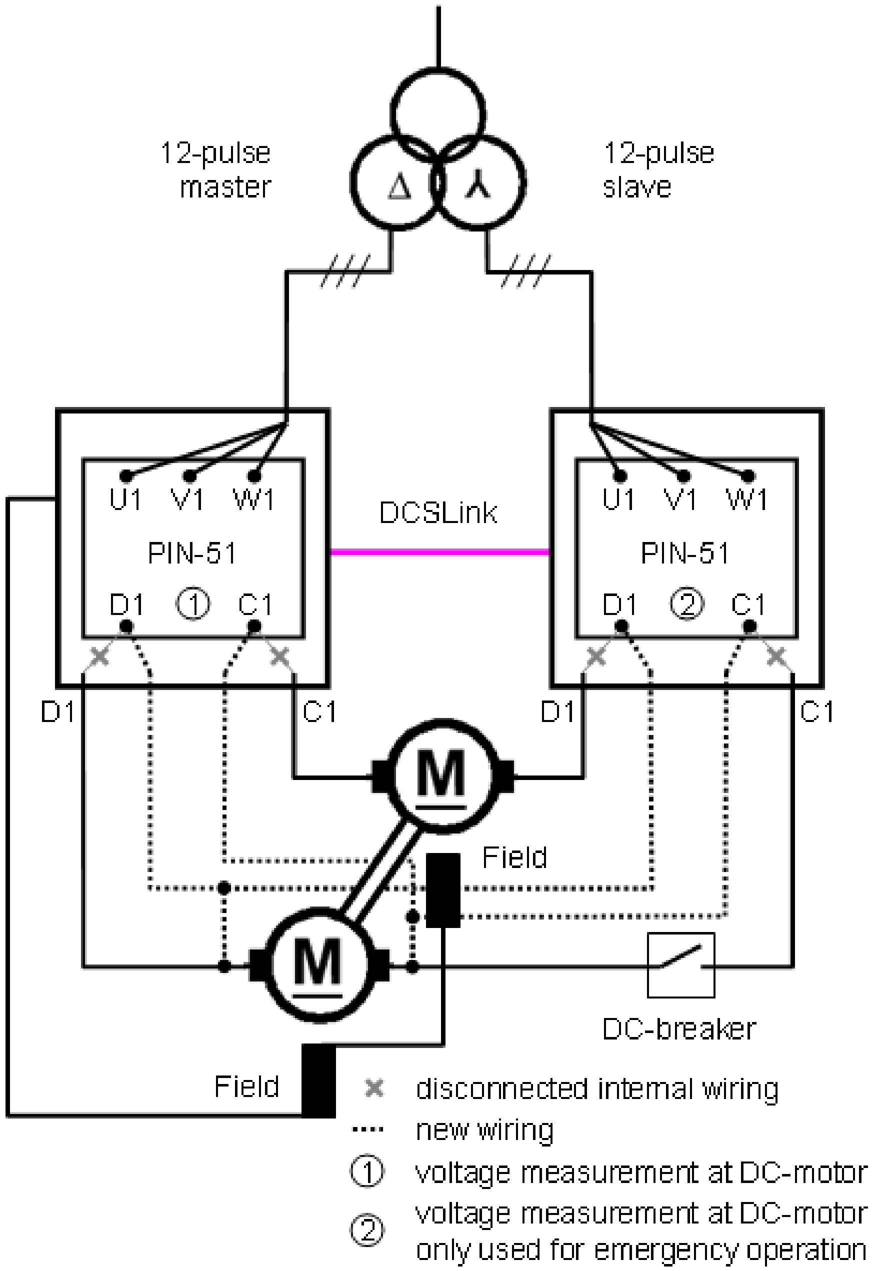
12-pulse serial / serial sequential in sandwich configuration

Extended voltage range up to 1000 V_{AC}

Increasing the mains voltage range is possible by means of the sandwich configuration. The sandwich configuration is possible, if both motors are equal (M1 = M2) and operate under the same conditions (same speed, same armature voltage, same flux, …). Thus no point of the DC power circuit has the sum of both DC converter voltages (e.g. in case of a ground fault). In consequence the insulation of e.g. the voltage measurement circuits of the SDCS-PIN-51 board must not stand twice the single converter's DC voltage. The requirements are:

- Both motors must operate under the same condition - for example same speed and same armature voltage. This is ensured by a fixed mechanical connection between both motors (e.g. both motors are on one shaft).
- Both motors must have the same flux. This is ensured by connecting both fields in series.
- Both motors must be equal (M1 = M2), which means they must be of the same type with the same motor data and ratings.
- The motors must always be located between the drives. So the configuration is always drive - motor - drive - motor.

High resistance voltage measurement in sandwich configuration:



12-pulse serial / serial sequential in sandwich configuration

This 12-pulse serial configuration is supplying two motors. Both motors are equal (M1 = M2). Each motor is taking half of the armature voltage and the full armature current:

– For correct EMF feedback adjust the DC voltage with *AdjUDC (97.23)* = 100 %.
– The motor voltage is supplied by 2 converters and taken by 2 motors (M1 = M2), thus *M1NomVolt (99.02)* = rated motor voltage.
– Both converters have the same current, thus *M1NomCur (99.03)* = rated motor current.

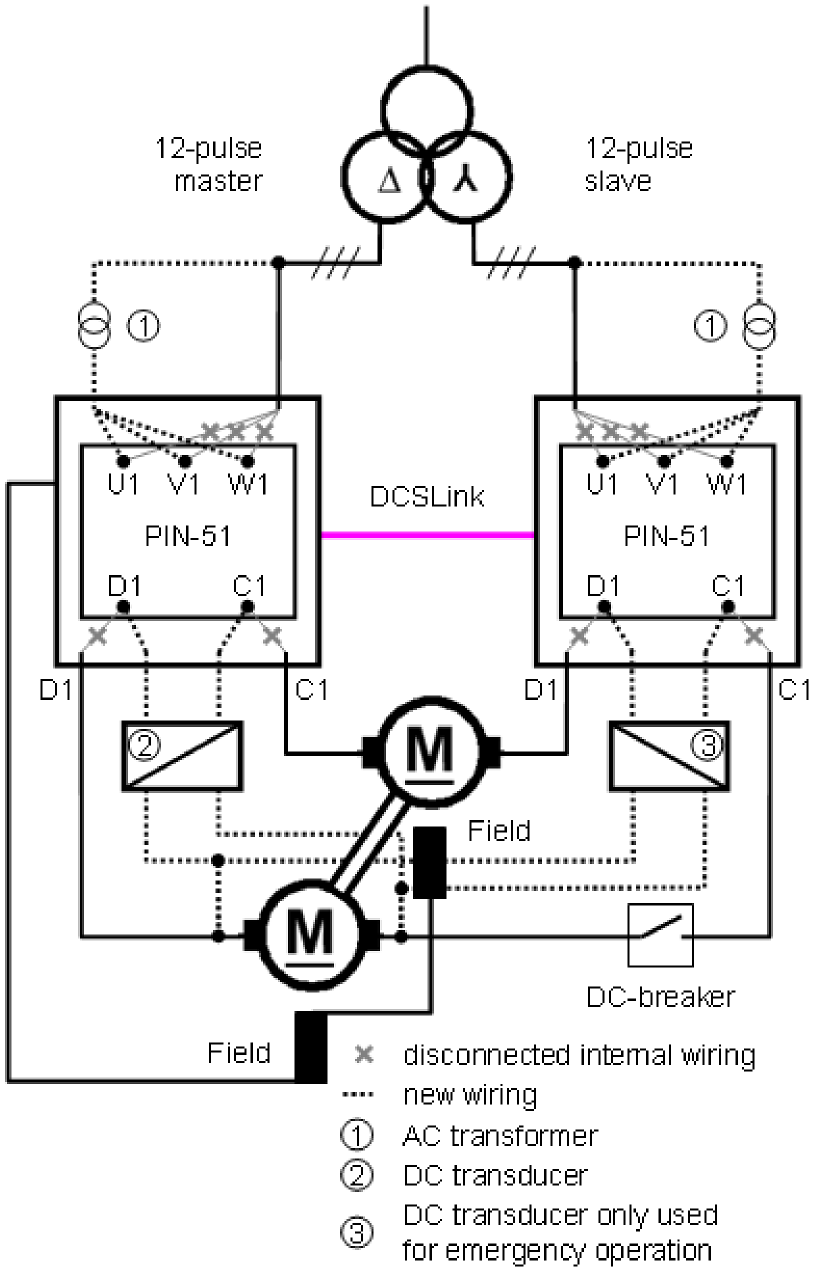
Voltage class	Nominal supply voltage, *NomMainsVolt (99.10)*	SDCS-PIN-51 voltage coding	Hardware coding, *S ConvScaleVolt (97.03)*
05	200 V - 500 V_{AC}	500 V	500 V_{AC}
06	500 V - 600 V_{AC}	600 V	600 V_{AC}
07	600 V - 690 V_{AC}	690 V	690 V_{AC}
08	690 V - 800 V_{AC}	800 V	800 V_{AC}
10	**800 V - 1000 V_{AC}**	**1000 V**	**1000 V_{AC}**
More information see chapter: ***Measuring the DC voltage***			

Settings for high resistance voltage measurement in sandwich configuration

Depending on the supply voltage different settings have to be chosen. Since this is a sandwich configuration supply voltages of more than 500 V_{AC} are possible. With a supply voltage of **890 V_{AC}**:
- Set *NomMainsVolt (99.10)* = **890 V**.
- The SDCS-PIN-51 has to stand only the supply voltage. In this example the voltage coding has to be set to **1000 V**.
- The hardware coding can be set with *S ConvScaleVolt (97.03)*. The hardware coding has to be set to the same value as the voltage coding.

For more information see chapter *Power interfaces SDCS-PIN-5x* of the *DCS800 Hardware Manual* (3ADW000194).

Galvanic isolation with two motors in sandwich configuration:



12-pulse serial / serial sequential in sandwich configuration

This 12-pulse serial configuration is supplying two motors. Both motors are equal (M1 = M2). Each motor is taking half of the armature voltage and the full armature current:

– For correct EMF feedback adjust the DC voltage with *AdjUDC (97.23)* = 100 %.
– The motor voltage is supplied by 2 converters and taken by 2 motors (M1 = M2), thus *M1NomVolt (99.02)* = rated motor voltage.
– Both converters have the same current, thus *M1NomCur (99.03)* = rated motor current.

Voltage class	Nominal supply voltage, *NomMainsVolt (99.10)*	AC transformer terminals (3ADT745047)	DC transducer position (8680A1)	Hardware coding, *S ConvScaleVolt (97.03)*
05	200 V - 500 V_{AC}	2U1-2V1-2W1	675 V (7)	500 V_{AC}
06	500 V - 600 V_{AC}	2U2-2V2-2W2	810 V (6)	600 V_{AC}
07	600 V - 690 V_{AC}	2U3-2V3-2W3	945 V (5)	690 V_{AC}
08	690 V - 800 V_{AC}	2U4-2V4-2W4	1080 V (4)	800 V_{AC}
10	**800 V - 1000 V_{AC}**	**2U5-2V5-2W5**	**1350 V (2)**	**1000 V_{AC}**
More information see chapter: ***Measuring the DC voltage***				

Settings for galvanic isolation in sandwich configuration

Depending on the supply voltage different settings have to be chosen. Since this is a sandwich configuration supply voltages of more than 500 V_{AC} are possible. With a supply voltage of **990 V_{AC}**:

- Set *NomMainsVolt (99.10)* = **990 V**.
- The AC transducers terminals **2U5-2V5-2W5** have to be used.
- The DC transducer must be set to **position (2)** with a maximum voltage of **1350 V_{DC}**.
- The hardware coding has to be set to the maximum value of the supply voltage measurement circuit. In this example set *S ConvScaleVolt (97.03)* = **1000 V**.
- On the SDCS-PIN-51 the bridges over resistors W1 to W26 are not cut and the 5 MΩ film resistors are bridged with 27.4 kΩ resistors.

For more information see chapter *Galvanic isolation* of the *DCS800 Hardware Manual* (3ADW000194).

Start-up

General

This chapter describes the commissioning procedure for a 12-pulse drive. This is done based on the procedure used for DCS800-S0x converters. Only the actions and steps, which are different, are listed here.

Safety Instructions

The 12-pulse system is formed by converter modules. Thus the danger installation and commissioning personal is exposed to during the work is similar, sometimes even higher than for plain converter modules. There is some work, which will only become necessary together with a 12-pulse system.
Because of that the ***Safety Instructions*** at the beginning of this manual have to be observed with extreme care!
When listing the different steps of the start-up procedure additional warnings will be given. Based on the possible variations caused by the individual projects not all conditions can be covered. Please take this procedure as a general guideline and be prepared to take individual decisions concerning safety and security.

Points to be observed because of the situation

All relevant safety regulations must be observed during installation, commissioning and maintenance work, since it is possible to touch the main and auxiliary connections and other electrical parts without any protection during installation of the 12-pulse system.
After the supply voltage is disconnected by means of the main switch, make sure by measuring that no part of the system has either voltage or the system is protected with sufficient touch protection before any work is started.
Be aware of live terminals inside the drive cabinet even after the supply voltage has been disconnected by the main switch, e.g. incoming busbars before the main switch itself or external auxiliary power supplies.
Avoid unnecessary voltage withstand tests on any part of the unit.
General Hint:
In addition to the work specifics for the installation of the 12-pulse system attention should be paid to features related to drives in general. There is the engineering and the interface to other components in general, the selection of control cables their routing, grounding, screening and other points which need further considerations. The manual Technical Guide gives some help within the chapter EMC Compliant Installation and Configuration for a Power Drive System. This chapter gives information specific to fulfill the needs necessary for the CE marking. Most often CE marking is not the most important target for a 12-pulse system. Nevertheless using some of the ideas will make the 12-pulse system safer.

Tools

In addition to the tools needed to maintain electrical parts some special tools are recommended:
- An oscilloscope including memory function with either galvanically isolating transformer or isolating amplifier for safe measurements.
- A clamp on current probe, in case the scaling of the DC load current needs to be checked, a DC clamp on current probe is needed.
- A voltmeter.

Make sure that all equipment in use is suitable for the voltage level applied to the power part!

DCS800 parameters 12-pulse parallel

Before starting with the commissioning set all parameters in both armature drives and the excitation drive to default by means of *ApplMacro (99.08)* = **Factory** and *ApplRestore (99.07)* = **Yes**. Check with *MacroSel (8.10)*.
Set all parameters listed below accordingly in the 12-pulse master and the 12-pulse slave.

Parameter	Master	Slave	Comments
CommandSel (10.01)	0 = **Local I/O** (def.), 1 = **MainCtrlWord**	3 = **12PLink**	
Off2 (10.08)	4 = **DI4** (def.)	4 = **DI4** (def.)	
E Stop (10.09)	5 = **DI5** (def.)	0 = **NotUsed**	Slave = **NotUsed** (otherwise the E Stop works only as coast stop)
SpeedFbFltSel (30.17)	1 = **Fault** (def.)	0 = **NotUsed**	Slave = **NotUsed** to suppress **F522 SpeedFb**
OperModeSel (43.01)	2 = **12PParMaster**	3 = **12PParSlave**	
12P Mode (47.01)	0 = **Normal** (def.)	0 = **Normal** (def.)	
M1SpeedScale (50.01)	xxx rpm	xxx rpm	n_{max} = xxx rpm; set to maximum absolute motor speed
M1SpeedFbSel (50.03)	0 = **EMF** (def.), 1 = **Encoder**, 2 = **Tacho**	3 = **External**	Slave = **External** to suppress **F532 MotOverSpeed**
M1EncPulseNo (50.04)	xxx ppr	n.a.	
12P TimeOut (94.03)	≥ 15 ms	≥ 15 ms	
AdjUDC (97.23)	100 % (def.)	100 % (def.)	do not change for 12-pulse parallel
M1NomVolt (99.02)	xxx V	xxx V	U_{MotN} = xxx V* or 2 * U_{MotN} = xxx V*; used for EMF speed feedback
M1NomCur (99.03)	xxx A	xxx A	0.5 * I_{MotN} = xxx A* or I_{MotN} = xxx A*
M1BaseSpeed (99.04)	xxx rpm	xxx rpm	n_{Base} = xxx rpm; set to motor base speed
NomMainsVolt (99.10)	xxx V	xxx V	U_{NetN} = xxx V; nominal supply voltage (AC)
M1UsedFexType (99.12)	xxx	**NotUsed**	Choose proper field exciter for the master. The slave does not have an exciter.

* depends on the motor configuration (see chapter ***12-pulse parallel configurations***)

Matching parameters 12-pulse parallel

Following parameters **must** match in the 12-pulse master and the 12-pulse slave.

Parameter	Master	Slave	Comments
M1CurLimBrdg1 (20.12)	xxx %	xxx %	
M1CurLimBrdg2 (20.13)	xxx %	xxx %	
ArmAlphaMax (20.14)	150° (def.)	150° (def.)	
ArmAlphaMin (20.15)	15° (def.)	15° (def.)	
CurRefSlope (43.04)	10 %/ms (def.)	10 %/ms (def.)	
ControlModeSel (43.05)	0 (def.)	0 (def.)	both = **Standard**
M1KpArmCur (43.06)	xxx	xxx	see ***Armature current autotuning***
M1TiArmCur (43.07)	xxx ms	xxx ms	
M1DiscontCurLim (43.08)	xxx %	xxx %	
M1ArmL (43.09)	xxx mH	xxx mH	
M1ArmR (43.10)	xxx mΩ	xxx mΩ	
RevDly (43.14)	20 ms	20 ms	after a command to change current direction the opposite current has to be reached before *ZeroCurTimeOut (97.19)* has been elapsed, (47.05) > (97.19) > (43.14)
RevVoltMargin (44.21)	xxx %	xxx %	
ZeroCurTimeOut (97.19)	70 ms	70 ms	after a command to change current direction the opposite current has to be reached before *ZeroCurTimeOut (97.19)* has been elapsed, (47.05) > (97.19) > (43.14)

Limits 12-pulse parallel

Set the limits in both the 12-pulse master and the 12-pulse slave.

Parameter	Master and slave	Comments
Speed		
M1SpeedMin (20.01)	xxx rpm	
M1SpeedMax (20.02)	xxx rpm	
ZeroSpeedLim (20.03)	xxx rpm	typical 1 % of n_{max} (maximum absolute motor speed) when an encoder is used
Torque		
TorqMax (20.05)	xxx %	parameters should match in the 12-pulse master and the 12-pulse slave
TorqMin (20.06)	xxx %	parameters should match in the 12-pulse master and the 12-pulse slave
Current		
M1CurLimBrdg1 (20.12)	xxx %	parameters must match in the 12-pulse master and the 12-pulse slave
M1CurLimBrdg2 (20.13)	xxx %	parameters must match in the 12-pulse master and the 12-pulse slave
Firing angle		
ArmAlphaMax (20.14)	150° (def.)	parameters must match in the 12-pulse master and the 12-pulse slave
ArmAlphaMin (20.15)	15° (def.)	parameters must match in the 12-pulse master and the 12-pulse slave
Current rise		
CurRefSlope (43.04)	10 %/ms (def.)	parameters must match in the 12-pulse master and the 12-pulse slave

Converter protections 12-pulse parallel

Set the converter protections in both the 12-pulse master and the 12-pulse slave.

Parameter	Master and slave	Comments
Armature Overcurrent		
ArmOvrCurLev (30.09)	xxx %	I_{LIM} = xxx A
Reversal fault		
RevDly (43.14)	20 ms	after a command to change current direction the opposite current has to be reached before *ZeroCurTimeOut (97.19)* has been elapsed, (47.05) > (97.19) > (43.14)
12P RevTimeOut (47.05)	100 ms (def.)	active only in 12-pulse master (47.05) > (97.19) > (43.14)
ZeroCurTimeOut (97.19)	70 ms	after a command to change current direction the opposite current has to be reached before *ZeroCurTimeOut (97.19)* has been elapsed, (47.05) > (97.19) > (43.14)
Current difference		
DiffCurLim (47.02)	20 %	active only in 12-pulse master
DiffCurDly (47.03)	500 ms (def.)	active only in 12-pulse master

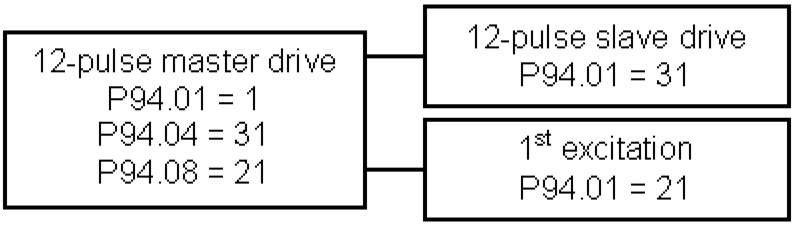
Motor protections 12-pulse parallel

Set the motor protections in both the 12-pulse master and the 12-pulse slave.

Parameter	**Master and slave**	**Comments**
Stall protection		
StallTime (30.01)		
StallSpeed (30.02)		
StallTorq (30.03)		
Armature overvoltage		
ArmOvrVoltLev (30.08)		
Overspeed protection		
M1OvrSpeed (30.16)	xxx rpm	typical 110 % of n_{max} (maximum absolute motor speed)
Motor thermal model		
M1ModelTime (31.01)		
M1AlarmLimLoad (31.03)		
M1FaultLimLoad (31.04)		
Measured motor temperature		
M1TempSel (31.05)		
M1AlarmLimTemp (31.06)		
M1FaultLimTemp (31.07)		
Klixon		
M1KlixonSel (31.08)		

DCSLink 12-pulse parallel

Set up the DCSLink.



Parameter	Master	Slave	Comments
DCSLinkNodeID (94.01)	1	31	
12P Slave Node (94.04)	31 (def.)	n.a.	

Parameter	Master	Excitation	Comments
DCSLinkNodeID (94.01)	1	21	
M1FexNode (94.08)	21 (def.)	n.a.	

Type code settings 12-pulse parallel

The type code settings are usually set by the factory. They can be checked in group 4.

Parameter	Master and slave	Comments
ConvNomVolt (4.04)		Read from *TypeCode (97.01)* or set with *S ConvScaleVolt (97.03)*
ConvNomCur (4.05)		Read from *TypeCode (97.01)* or set with *S ConvScaleCur (97.02)*
ConvType (4.14)		Read from *TypeCode (97.01)*
QuadrantType (4.15)		Read from *TypeCode (97.01)* or set with *S BlockBridge2 (97.07)*
MaxBrdgTemp (4.17)		Read from *TypeCode (97.01)* or set with *S MaxBrdgTemp (97.04)*
TypeCode (97.01)		normally set by the factory, to change use *ServiceMode (99.06)* = **SetTypeCode**
S ConvScaleCur (97.02)		automatically taken from type code
S ConvScaleVolt (97.03)		automatically taken from type code
S MaxBrdgTemp (97.04)		automatically taken from type code, air entry temperature can be set to 55 °C in hot motor rooms
S BlockBridge2 (97.07)		automatically taken from type code and thus **Auto**
ServiceMode (99.06)		10 = **SetTypeCode**

Galvanic isolation 12-pulse parallel

Details see chapter ***Galvanic Isolation***.

Parameter	Master and slave	Comments
DC / DC transducer	xxx V	e.g. 6 ≡ 810 V for incoming voltage 270 V to 600 V
AC / AC transducer	xxx A	e.g. 2U2, 2V2, 2W2 for incoming voltage 270 V to 600 V

Additional settings 12-pulse parallel

Additional setting in case of problems, when using an overriding control and DriveWindow.

Parameter	Master and slave	Comments
TorqGenMax (20.22)	325 % (def.)	The supply voltage is going down due to high load currents. To prevent regeneration operation at the commutation limit use *TorqGenMax (20.22)*.
SpeedErrFilt (23.06)	0 ms (def.)	Cyclic bridge changes (bridge reversals) can lead to **F533 12PRevTime**, **F534 12PCurDiff** or **F557 ReversalTime**. To prevent the Cyclic bridge changes it is recommended to re-tune the speed controller (making it more stable) and to use the speed error filter times. E.g. set *SpeedErrFilt (23.06)* = *SpeedErrFilt2 (23.11)* = 10 ms.
SpeedErrFilt2 (23.11)	0 ms (def.)	
RevVoltMargin (44.21)	6 % (def.)	safety margin for the motor voltage during regenerative mode
MainsCompTime (97.09)	10 ms (def.)	set when the current is distributed differently on the thyristors (fast disturbances in current)
CompUkPLL (97.12)	0 % (def.)	set slowly to higher values (e.g. 4), if the synchronization voltage is disturbed by commutation notches, to be used only with dedicated incoming transformer
KpPLL (97.14)	1	set to 1
Ch0 NodeAddr (70.01)	<number>	AC 800M
Ch3 NodeAddr (70.22)	<number>	DriveWindow
DeviceNumber (99.09)	<name>	DriveWindow, e.g. *12-pulse Master* and *12-pulse Slave*

Parameter settings for large field supplies using DCS800-S0x modules

12-pulse parallel master

Parameter	Master	Comments
M1FldMinTrip (30.12)	xxx %	sets level for **F541 M1FexLowCur**
FldCtrlMode (44.01)	1 = **EMF**	**EMF** controller released, field weakening active - depending on the application
FldMinTripDly (45.18)	2000 ms (def.)	delays **F541 M1FexLowCur**
DCSLinkNodeID (94.01)	1	
M1FexNode (94.08)	21 (def.)	Use the same node number as in *DCSLinkNodeID (94.01)* of the field exciter
FexTimeOut (94.07)	100 ms (def.)	causes **F516 M1FexCom**
M1NomFldCur (99.11)	xxx A	I_{FN} = xxx A, rated field current
M1UsedFexType (99.12)	8 = **DCS800-S01**, 9 = **DCS800-S02**	

Excitation module (DCS800-S0x)

Parameter	Excitation	Comments
CommandSel (10.01)	4 = **FexLink**	
MotFanAck (10.06)	0 = **NotUsed**	
OvrVoltProt (10.13)	2 = **DI2**	depending on hardware connection to DCF506
ArmOvrVoltLev (30.08)	500 %	to suppress **F503 ArmOverVolt** if this does not help, increase *M1NomVolt (99.02)*
OperModeSel (43.01)	1 = **FieldConv**	
CurSel (43.02)	8 = **FexCurRef**	
M1DiscontCurLim (43.08)	0 %	
RevDly (43.14)	50 ms	
FldCtrlMode (44.01)	0 = **Fix** (def.)	
DCSLinkNodeID (94.01)	21 (def.)	Use the same node number as in *M1FexNode (94.08)* of the armature module
DevLimPLL (97.13)	20 °	to suppress **F514 MainsNotSync**
M1NomVolt (99.02)	xxx V	U_{FN} = xxx V, rated field voltage
M1NomCur (99.03)	xxx A	I_{FN} = xxx A, rated field current
NomMainsVolt (99.10)	xxx V	U_{NetN} = xxx V; nominal supply voltage (AC)
M1UsedFexType (99.12)	0 = **NotUsed**	

Field current autotuning 12-pulse parallel

Field current autotuning for large field supplies using DCS800-S0x modules. The field current autotuning has to be started directly in the excitation module if a DCS800-S0x is used.

Parameter	Excitation	Comments
ServiceMode (99.06)	2 = **FieldCurAuto**	Give the **On** and **Run** command within 20 s

Note:
This autotuning does not work when started from the DriveWindow Light wizard.

Armature current autotuning 12-pulse parallel

The 12-pulse parallel master drive has to be tuned in 6-pulse mode. Thus the 12-pulse slave has to be completely de-energized and its contactors have to be kept open.
Set in the 12-pulse master:

Parameter	Master	Comments
OperModeSel (43.01)	0 = **ArmConv**	After the autotuning is finished set *OperModeSel (43.01)* back to **12PParMaster**
ServiceMode (99.06)	1 = **ArmCurAuto**	Give the **On** and **Run** command within 20 s

Do the following after a successful autotuning:

Parameter	Comments
M1KpArmCur (43.06)	Use directly in the 12-pulse master and the 12-pulse slave
M1TiArmCur (43.07)	Use directly in the 12-pulse master and the 12-pulse slave
M1DiscontCurLim (43.08)	Use directly in the 12-pulse master and the 12-pulse slave
M1ArmL (43.09)	Multiply by 2 and use in the 12-pulse master and the 12-pulse slave
M1ArmR (43.10)	Multiply by 2 and use in the 12-pulse master and the 12-pulse slave

Attention:
In case an autotuning is not starting or interrupted **A121 AutotuneFail** is set. The reason for the alarm is shown in *Diagnosis (9.11)*.

DCS800 parameters 12-pulse serial / serial sequential

Before starting with the commissioning set all parameters in both armature drives and the excitation drive to default by means of *ApplMacro (99.08)* = **Factory** and *ApplRestore (99.07)* = **Yes**. Check with *MacroSel (8.10)*.
For 12-pulse serial set *12P Mode (47.01)* = **Normal**.
For serial sequential set *12P Mode (47.01)* = **Sequential**.
Set all parameters listed below accordingly in master and slave.

Parameter	Master	Slave	Comments
CommandSel (10.01)	0 = **Local I/O** (def.), 1 = **MainCtrlWord**	3 = **12PLink**	
Off2 (10.08)	4 = **DI4** (def.)	4 = **DI4** (def.)	
E Stop (10.09)	5 = **DI5** (def.)	0 = **NotUsed**	Slave = **NotUsed** (otherwise the E Stop works only as coast stop)
SpeedFbFltSel (30.17)	1 = **Fault** (def.)	0 = **NotUsed**	Slave = **NotUsed** to suppress **F522 SpeedFb**
OperModeSel (43.01)	4 = **12PSerMaster**	5 = **12PSerSlave**	
12P Mode (47.01)	0 = **Normal** (def.), 2 = **Sequential**	0 = **Normal** (def), 2 = **Sequential**	for 12-pulse serial, for serial sequential
M1SpeedScale (50.01)	xxx rpm	xxx rpm	n_{max} = xxx rpm; set to maximum absolute motor speed
M1SpeedFbSel (50.03)	0 = **EMF** (def.), 1 = **Encoder**, 2 = **Tacho**	3 = **External**	Slave = **External** to suppress **F532 MotOverSpeed**
M1EncPulseNo (50.04)	xxx ppr	n.a.	
12P TimeOut (94.03)	≥ 15 ms	≥ 15 ms	
AdjUDC (97.23)	50 %, 100 % (def.)	50 %, 100 % (def.)	see *
M1NomVolt (99.02)	xxx V	xxx V	0.5 * U_{MotN} = xxx V* or U_{MotN} = xxx V*; used for EMF speed feedback
M1NomCur (99.03)	xxx A	xxx A	I_{MotN} = xxx A
M1BaseSpeed (99.04)	xxx rpm	xxx rpm	n_{Base} = xxx rpm; set to motor base speed
NomMainsVolt (99.10)	xxx V	xxx V	U_{NetN} = xxx V; nominal supply voltage (AC)
M1UseFexType (99.12)	xxx	**NotUsed**	Choose proper field exciter for the master. The slave does not have an exciter.

* depends on the motor configuration (see ***12-pulse serial / serial sequential configurations***)

Matching parameters 12-pulse serial / serial sequential

Following parameters **must** match in master and slave.

Parameter	Master	Slave	Comments
ArmAlphaMax (20.14)	150° (def.)	150° (def.)	
ArmAlphaMin (20.15)	15° (def.)	15° (def.)	
RevDly (43.14)	20 ms	20 ms	after a command to change current direction the opposite current has to be reached before *ZeroCurTimeOut (97.19)* has been elapsed, (47.05) > (97.19) > (43.14)
RevVoltMargin (44.21)	xxx %	xxx %	
ZeroCurTimeOut (97.19)	70 ms	70 ms	after a command to change current direction the opposite current has to be reached before *ZeroCurTimeOut (97.19)* has been elapsed, (47.05) > (97.19) > (43.14)

Limits 12-pulse serial / serial sequential

Set the limits in both master and slave.

Parameter	Master and slave	Comments
Speed		
M1SpeedMin (20.01)	xxx rpm	
M1SpeedMax (20.02)	xxx rpm	
ZeroSpeedLim (20.03)	xxx rpm	typical 1 % of n_{max} (maximum absolute motor speed) when an encoder is used
Torque		
TorqMax (20.05)	xxx %	parameters should match in master and slave
TorqMin (20.06)	xxx %	parameters should match in master and slave
Current		
M1CurLimBrdg1 (20.12)	xxx %	parameters should match in master and slave
M1CurLimBrdg2 (20.13)	xxx %	parameters should match in master and slave
Firing angle		
ArmAlphaMax (20.14)	150° (def.)	parameters must match in master and slave
ArmAlphaMin (20.15)	15° (def.)	parameters must match in master and slave
Current rise		
CurRefSlope (43.04)	10 %/ms (def.)	parameters should match in master and slave

Converter protections 12-pulse serial / serial sequential

Set the converter protections in both master and slave.

Parameter	**Master and slave**	**Comments**
Armature Overcurrent		
ArmOvrCurLev (30.09)	xxx %	I_{LIM} = xxx A
Reversal fault		
RevDly (43.14)	20 ms	after a command to change current direction the opposite current has to be reached before *ZeroCurTimeOut (97.19)* has been elapsed, (47.05) > (97.19) > (43.14)
12P RevTimeOut (47.05)	100 ms (def.)	active only in the master (47.05) > (97.19) > (43.14)
ZeroCurTimeOut (97.19)	70 ms	after a command to change current direction the opposite current has to be reached before *ZeroCurTimeOut (97.19)* has been elapsed, (47.05) > (97.19) > (43.14)
Current difference		
DiffCurLim (47.02)	20 %	active only in the master
DiffCurDly (47.03)	500 ms (def.)	active only in the master

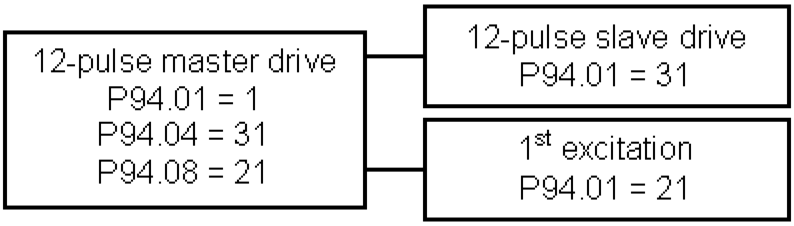
Motor protections, 12-pulse serial / serial sequential

Set the motor protections in both master and slave.

Parameter	Master and slave	Comments
Stall protection		
StallTime (30.01)		
StallSpeed (30.02)		
StallTorq (30.03)		
Armature overvoltage		
ArmOvrVoltLev (30.08)		
Overspeed protection		
M1OvrSpeed (30.16)	xxx rpm	typical 110 % of n_{max} (maximum absolute motor speed)
Motor thermal model		
M1ModelTime (31.01)		
M1AlarmLimLoad (31.03)		
M1FaultLimLoad (31.04)		
Measured motor temperature		
M1TempSel (31.05)		
M1AlarmLimTemp (31.06)		
M1FaultLimTemp (31.07)		
Klixon		
M1KlixonSel (31.08)		

DCSLink, 12-pulse serial / serial sequential

Set up the DCSLink.



Parameter	**Master**	**Slave**	**Comments**
DCSLinkNodeID (94.01)	1	31	
12P Slave Node (94.04)	31 (def.)	n.a.	

Parameter	**Master**	**Excitation**	**Comments**
DCSLinkNodeID (94.01)	1	21	
M1FexNode (94.08)	21 (def.)	n.a.	

Type code settings 12-pulse serial / serial sequential

The type code settings are usually set by the factory. They can be checked in group 4.

Parameter	**Master and slave**	**Comments**
ConvNomVolt (4.04)		Read from *TypeCode (97.01)* or set with *S ConvScaleVolt (97.03)*
ConvNomCur (4.05)		Read from *TypeCode (97.01)* or set with *S ConvScaleCur (97.02)*
ConvType (4.14)		Read from *TypeCode (97.01)*
QuadrantType (4.15)		Read from *TypeCode (97.01)* or set with *S BlockBridge2 (97.07)*
MaxBrdgTemp (4.17)		Read from *TypeCode (97.01)* or set with *S MaxBrdgTemp (97.04)*
TypeCode (97.01)		normally set by the factory, to change use *ServiceMode (99.06)* = **SetTypeCode**
S ConvScaleCur (97.02)		automatically taken from type code
S ConvScaleVolt (97.03)		automatically taken from type code
S MaxBrdgTemp (97.04)		automatically taken from type code, air entry temperature can be set to 55 °C in hot motor rooms
S BlockBridge2 (97.07)		automatically taken from type code and thus **Auto**
ServiceMode (99.06)		10 = **SetTypeCode**

Galvanic isolation 12-pulse serial / serial sequential

Details see chapter ***Galvanic Isolation***.

Parameter	Master and slave	Comments
DC / DC transducer	xxx V	e.g. 6 ≡ 810 V for incoming voltage 270 V to 600 V
AC / AC transducer	xxx A	e.g. 2U2, 2V2, 2W2 for incoming voltage 270 V to 600 V

Additional settings 12-pulse serial / serial sequential

Additional setting in case of problems, when using an overriding control and DriveWindow.

Parameter	Master and slave	Comments
TorqGenMax (20.22)	325 % (def.)	The supply voltage is going down due to high load currents. To prevent regeneration operation at the commutation limit use *TorqGenMax (20.22)*.
SpeedErrFilt (23.06)	0 ms (def.)	Cyclic bridge changes (bridge reversals) can lead to **F533 12PRevTime**, **F534 12PCurDiff** or **F557 ReversalTime**. To prevent the Cyclic bridge changes it is recommended to re-tune the speed controller (making it more stable) and to use the speed error filter times. E.g. set *SpeedErrFilt (23.06) = SpeedErrFilt2 (23.11) =* 10 ms.
SpeedErrFilt2 (23.11)	0 ms (def.)	
RevVoltMargin (44.21)	6 % (def.)	safety margin for the motor voltage during regenerative mode
MainsCompTime (97.09)	10 ms (def.)	set when the current is distributed differently on the thyristors (fast disturbances in current)
CompUkPLL (97.12)	0 % (def.)	set slowly to higher values (e.g. 4), if the synchronization voltage is disturbed by commutation notches, to be used only with dedicated incoming transformer
KpPLL (97.14)	1	set to 1
Ch0 NodeAddr (70.01)	<number>	AC 800M
Ch3 NodeAddr (70.22)	<number>	DriveWindow
DeviceNumber (99.09)	<name>	DriveWindow, e.g. *Master* and *Slave*

Parameter settings for large field supplies using DCS800-S0x modules

12-pulse serial / serial sequential master

Parameter	Master	Comments
M1FldMinTrip (30.12)	xxx %	sets level for **F541 M1FexLowCur**
FldCtrlMode (44.01)	1 = **EMF**	**EMF** controller released, field weakening active - depending on the application
FldMinTripDly (45.18)	2000 ms (def.)	delays **F541 M1FexLowCur**
DCSLinkNodeID (94.01)	1	
M1FexNode (94.08)	21 (def.)	Use the same node number as in *DCSLinkNodeID (94.01)* of the field exciter
FexTimeOut (94.07)	100 ms (def.)	causes **F516 M1FexCom**
M1NomFldCur (99.11)	xxx A	I_{FN} = xxx A, rated field current
M1UsedFexType (99.12)	8 = **DCS800-S01**, 9 = **DCS800-S02**	

Excitation module (DCS800-S0x)

Parameter	Excitation	Comments
CommandSel (10.01)	4 = **FexLink**	
MotFanAck (10.06)	0 = **NotUsed**	
OvrVoltProt (10.13)	2 = **DI2**	depending on hardware connection to DCF506
ArmOvrVoltLev (30.08)	500 %	to suppress **F503 ArmOverVolt** if this does not help, increase *M1NomVolt (99.02)*
OperModeSel (43.01)	1 = **FieldConv**	
CurSel (43.02)	8 = **FexCurRef**	
M1DiscontCurLim (43.08)	0 %	
RevDly (43.14)	50 ms	
FldCtrlMode (44.01)	0 = **Fix** (def.)	
DCSLinkNodeID (94.01)	21 (def.)	Use the same node number as in *M1FexNode (94.08)* of the armature module
DevLimPLL (97.13)	20 °	to suppress **F514 MainsNotSync**
M1NomVolt (99.02)	xxx V	U_{FN} = xxx V, rated field voltage
M1NomCur (99.03)	xxx A	I_{FN} = xxx A, rated field current
NomMainsVolt (99.10)	xxx V	U_{NetN} = xxx V; nominal supply voltage (AC)
M1UsedFexType (99.12)	0 = **NotUsed**	

Field current autotuning 12-pulse serial / serial sequential

Field current autotuning for large field supplies using DCS800-S0x modules. The field current autotuning has to be started directly in the excitation module if a DCS800-S0x is used.

Parameter	Excitation	Comments
ServiceMode (99.06)	2 = **FieldCurAuto**	Give the **On** and **Run** command within 20 s

Note:
This autotuning does not work when started from the DriveWindow Light wizard.

Armature current autotuning 12-pulse serial

The 12-pulse serial master drive has to be tuned in 12-pulse mode. Thus the 12-pulse slave fires a freewheeling pass and it is not necessary to shorten the DC output of the 12-pulse slave.

Single motor configuration or double motor configuration (the voltage measurement is over both motors)
Set in the 12-pulse serial master

Parameter	Master	Comments
12P Mode (47.01)	0 = **Normal**	
AdjUDC (97.23)	50 %	(both motors)
ServiceMode (99.06)	1 = **ArmCurAuto**	Give the **On** and **Run** command within 20 s

Do the following after a successful autotuning:

Parameter	Comments
M1KpArmCur (43.06)	Multiply by 0.5 and use into 12-pulse master
M1TiArmCur (43.07)	Use directly in 12-pulse master
M1DiscontCurLim (43.08)	Multiply by 0.5 and use into 12-pulse master
M1ArmL (43.09)	Use directly in 12-pulse master
M1ArmR (43.10)	Use directly in 12-pulse master

Double motor configuration (the voltage measurement is over one motor only)
Set in the 12-pulse serial master

Parameter	Master	Comments
12P Mode (47.01)	0 = **Normal**	
AdjUDC (97.23)	100 %	only one of two motors
ServiceMode (99.06)	1 = **ArmCurAuto**	Give the **On** and **Run** command within 20 s

Do the following after a successful autotuning:

Parameter	Comments
M1KpArmCur (43.06)	Multiply by 0.5 and use in the 12-pulse master
M1TiArmCur (43.07)	Use directly in the 12-pulse master
M1DiscontCurLim (43.08)	Multiply by 0.5 and use in the 12-pulse master
M1ArmL (43.09)	Use directly in the 12-pulse master
M1ArmR (43.10)	Use directly in the 12-pulse master

Attention:
In case an autotuning is not starting or interrupted **A121 AutotuneFail** is set. The reason for the alarm is shown in *Diagnosis (9.11)*.

Armature current autotuning serial sequential

The serial sequential master drive has to be tuned in 12-pulse mode. Thus the serial sequential slave fires a freewheeling pass and it is not necessary to shorten the DC output of the serial sequential slave.

Single motor configuration or double motor configuration (the voltage measurement is over both motors)
Set in the serial sequential master

Parameter	Master	Slave	Comments
12P Mode (47.01)	0 = **Normal**	0 = **Normal**	After the autotuning is finished set *12P Mode (47.01)* back to **Sequential**
AdjUDC (97.23)	50 %	-	(both motors)
ServiceMode (99.06)	1 = **ArmCurAuto**	-	Give the **On** and **Run** command within 20 s

There is a **30° phase shift** in the mains voltage between serial sequential master and serial sequential slave. Do the following after a successful autotuning:

Parameter	Comments
M1KpArmCur (43.06)	Use directly in the serial sequential master
M1TiArmCur (43.07)	Use directly in the serial sequential master
M1DiscontCurLim (43.08)	Multiply by 0.5 and use in the serial sequential master
M1ArmL (43.09)	Use directly in the serial sequential master
M1ArmR (43.10)	Use directly in the serial sequential master

There is a **no phase shift** in the mains voltage between serial sequential master and serial sequential slave. Do the following after a successful autotuning:

Parameter	Comments
M1KpArmCur (43.06)	Use directly in the serial sequential master
M1TiArmCur (43.07)	Use directly in the serial sequential master
M1DiscontCurLim (43.08)	Multiply by 2 and use in the serial sequential master
M1ArmL (43.09)	Use directly in the serial sequential master
M1ArmR (43.10)	Use directly in the serial sequential master

Double motor configuration (the voltage measurement over <u>one</u> motor only)
Set in the serial sequential master

Parameter	Master	Slave	Comments
12P Mode (47.01)	0 = **Normal**	0 = **Normal**	After the autotuning is finished set *12P Mode (47.01)* back to **Sequential**
AdjUDC (97.23)	100 %	-	only one of two motors
ServiceMode (99.06)	1 = **ArmCurAuto**	-	Give the **On** and **Run** command within 20 s

There is a **30° phase shift** in the mains voltage between serial sequential master and serial sequential slave. Do the following after a successful autotuning:

Parameter	Comments
M1KpArmCur (43.06)	Use directly in the serial sequential master
M1TiArmCur (43.07)	Use directly in the serial sequential master
M1DiscontCurLim (43.08)	Multiply by 0.5 and use in the serial sequential master
M1ArmL (43.09)	Use directly in the serial sequential master
M1ArmR (43.10)	Use directly in the serial sequential master

There is a **no phase shift** in the mains voltage between serial sequential master and serial sequential slave. Do the following after a successful autotuning:

Parameter	Comments
M1KpArmCur (43.06)	Use directly in the serial sequential master
M1TiArmCur (43.07)	Use directly in the serial sequential master
M1DiscontCurLim (43.08)	Multiply by 2 and use in the serial sequential master
M1ArmL (43.09)	Use directly in the serial sequential master
M1ArmR (43.10)	Use directly in the serial sequential master

Attention:
In case an autotuning is not starting or interrupted **A121 AutotuneFail** is set. The reason for the alarm is shown in *Diagnosis (9.11)*.

DCS800 family

DCS800-S modules

The versatile drive for any application

20 … 5,200 A_{DC}
0 … 1,160 V_{DC}
230 … 1,000 V_{AC}
IP00

- Compact
- Highest power ability
- Simple operation
- Comfortable assistants, e.g. for commissioning or fault tracing
- Scalable to all applications
- Free programmable by means of integrated IEC61131-PLC

DCS800-A enclosed converters

Complete drive solutions

20 … 20,000 A_{DC}
0 … 1,500 V_{DC}
230 … 1,200 V_{AC}
IP21 – IP54

- Individually adaptable to customer requirements
- User-defined accessories like external PLC or automation systems can be included
- High power solutions in 6- and 12-pulse up to 20,000 A, 1,500 V
- In accordance to usual standards
- Individually factory load tested
- Detailed documentation

DCS800-E series

Pre-assembled drive-kits

20 … 2,000 A_{DC}
0 … 700 V_{DC}
230 … 600 V_{AC}
IP00

- DCS800 module with all necessary accessories mounted and fully cabled on a panel
- Very fast installation and commissioning
- Squeezes shut-down-times in revamp projects to a minimum
- Fits into Rittal cabinets
- Compact version up to 450 A and Vario version up to 2,000 A

DCS800-R Rebuild Kit

Digital control-kit for existing powerstacks

20 … 20,000 A_{DC}
0 … 1,160 V_{DC}
230 … 1,200 V_{AC}
IP00

- Proven long life components are re-used, such as power stacks, (main) contactors, cabinets and cabling / busbars, cooling systems
- Use of up-to-date communication facilities
- Increase of production and quality
- Very cost-effective solution
- Open Rebuild Kits for nearly all existing DC drives
- tailor-made solutions for…
  - BBC PxD
  - BBC SZxD
  - ASEA TYRAK
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ABB Automation Products
Wallstadter-Straße 59
68526 Ladenburg • Germany
Tel: +49 (0) 6203-71-0
Fax:+49 (0) 6203-71-76 09
www.abb.com/motors&drives

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