**in** motion

# DMC$^2$

Digital Motion Control Sysytem
Part A

# User's Manual 5.0

**Art.No. 9032 0027 01 (A)**

**21.03.2001**

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# Introduction

## ABOUT DMC$^2$ DOCUMENTATION

This version replaces all previous versions of this document. Inmotion Technologies AB has made every effort to insure this document is complete and accurate at the time of printing. In accordance with our policy of continuing product improvement, all data in this document is subject to change or correction without prior notice.

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## SCOPE OF DMC$^2$ USER'S MANUAL

This manual is intended for users of the DMC$^2$ (Digital Motion Controller) who will be designing, integrating and installing motion control systems based on the DMC$^2$. The manual presents requirements, guidelines and examples for utilizing the DMC$^2$ along with other motion system components.

## RELATED DOCUMENTATION

For comprehensive information on details on the DMC$^2$ programming language and programming tools and controller firmware refer to the User's Manual 5.x Part B.

## WARNING, CAUTION AND INFORMATION NOTICES

Special attention must be paid to the information presented in Warning, Caution and information notices when they appear in this manual. Examples of Caution, Warning and information notices along with an explanation of their purposes follow.

| | **WARNING** |
|---|---|
| ☠ | ♦ **A Warning informs the user of a hazard or potential hazard that could result in serious of fatal injury if the precautions or instructions given in the warning notice are not observed.** |

| | **CAUTION** |
|---|---|
| ⚠ | ♦ **A Caution informs the user of a hazard or potential hazard that could result in injury or damage to the equipment if the precautions or instructions given in the caution notice are not observed.** |

| | |
|---|---|
| **i** | **An Information Box contains supplemental information or references to supplemental information on a topic.** |

| STOP | Stop Box highlights important conceptual or procedural details that must be understood and applied in order to successfully use the product. |
|------|-----|

# ABOUT THE DMC$^2$ PRODUCTS

## PERSONAL SAFETY

- We provide this and other manuals to assist manufacturers in using the DMC$^2$ in a correct, efficient and safe manner. Manufacturers must insure that all persons responsible for the design and use of equipment employing the DMC$^2$ have the proper professional skill and apparatus knowledge and follow the instructions in this manual.

| | **WARNING** |
|---|---|
| ⚠ | ♦ **The DMC$^2$ contains voltages, which may be as high as 575 volts and rotating parts on motors and driven equipment. High voltage and moving parts can cause serious or fatal injury. Only qualified personnel familiar with this manual, software control of the DMC$^2$ and machinery driven by this equipment should attempt to start up or troubleshoot this equipment.** |
| | ♦ **DO NOT touch electrical components, power devices or connections without first insuring that high voltage is not present. Storage capacitors within the equipment require 20 seconds to discharge after AC power is removed.** |
| | ♦ **The unit must be properly grounded. DO NOT apply AC power until all earth grounds have been installed.** |
| | ♦ **Incorrect programs, faulty equipment or faulty or incorrect connections may cause sudden, violent motion of the motor shaft and driven equipment. Be certain that unexpected motor shaft movement will not cause injury to personnel or damage to equipment. Peak torque of several times rated motor torque can occur during a control failure.** |
| | ♦ **High voltages may be present at the motor whenever AC power is applied, even when the motor is not moving.** |

## INTENDED USE OF THE DMC$^2$

The Digital Motion Controller$^{TM}$ (DMC$^2$) is intended for precise torque, speed and position control applications in different industrial equipment.

## OEM'S RESPONSIBILITY

OEM's are responsible for ensuring that DMC$^2$ are used for their intended purpose only, safe function of the system and for compliance with all applicable regulations.

Responsibility for the safe functioning of the system reverts to the owner or user in all cases in which a non-professional has done installation, service or repair and when the system is used for other than its intended purpose.

# PRODUCT IDENTIFICATION

A label (see Figure 1 for location) and Figure 2 for containing pertinent product identification information is affixed to the DMC2 unit. The product label fields relevant to product identification are described below Table 1.



*Figure 1. Product Label location.*
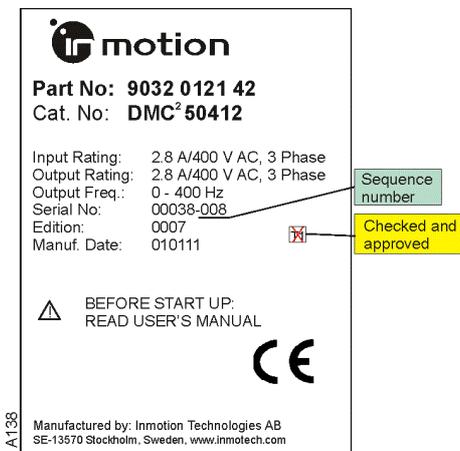


*Figure 2. DMC$^2$ Product Identification Label.*

Product Identification

| Field | Description |
|---|---|
| Part No | Unique part number assigned to DMC$^2$ with a specific Supply Voltage. |
| Edition | Indicates the revision level of the article. |
| Cat. No. DMC$^2$ model | 5 0 4 1 2 P – CAN<br><br>**Bus voltage** 5 = 570 VDC    **Cont. current (pk)** 04 = 4 A    **Max. current** 12 = 12 A    **Power supply** P = Integral Omit = No integral power supply    **Options** CAN = Extended CAN    A137 |
| Serial No. | Production lot number (assigned by the factory). The production lot numbers together with the sequence number yield a unique serial number for each DMC$^2$. |
| Sequence number | Serial number within a production lot. |
| Manufacture date | Year, month and day of manufacture. |

*Table 1. DMC$^2$ Product expressions.*

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## WARRANTY STATEMENT

We make no warranty of any kind including, but not limited to, any implied warranties of merchantability and fitness for a particular purpose with regard to this manual. We assumes no responsibility or liability for errors contained in this manual or for incidental, special or consequential damages arising out of the furnishing of this manual, or the use of this manual in operating the equipment, or in connection with the performance of the equipment when operated.

# REGULATIONS AND DIRECTIVES

## CERTIFICATION

- The DMC$^2$ shall be put into operation and be used only by authorized personnel.
- Local or national safety regulations in the field of electrical installation shall be followed.

## ELECTRICAL REGULATIONS

- The system is driven by high voltage level of 3-phase 400 VAC. Make sure that the system is not connected to mains when installation, service or repair is done.
- The system must be turned off before changing cables or accessories.
- Non-Compliance with the installation instructions in this manual can either damage the system or cause an electrical shock.
- The system can start automatically when mains are turned on depending on how the hardware and software configuration is defined.
- When a computer is connected to the DMC$^2$ unit, make sure that both the DMC$^2$ and the computer are connected to earth ground, for avoidance of unpredictable voltage swing.

## MECHANICAL REGULATIONS

- The servo motor connected to the DMC$^2$ unit consists of moving parts and can perform high torque's and/or speed in short time (within a few ms).
- Some parts of the DMC$^2$ unit can be very warm, up to 90°C.
- The system shall be installed in a cabinet that gives Pollution Degree 2

## EMC

- The DMC$^2$ unit is designed to fulfill European EMC directive 89/336/EEC referring to EN50081-2 Generic emission standard, Part 2, Industrial environment and EN50082-2 Generic immunity standard, Part 2, Industrial environment.
- The DMC$^2$ unit is designed to fulfill FCC (Federal Communications Commission) rules referring to Part 15.
- Proper installation and use according to this manual must be performed if the EMC requirements are to be fulfilled.
- The DMC$^2$ unit complies with the limits for a Class A digital device, pursuant to CISPR11 (International special committee on radio interference) This equipment generates, uses and radiate radio frequency energy and if not installed and used in accordance with this manual, may cause harmful interference to radio communications. Operation of the equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference using own expertise. A shielded cable is required to comply with the limits for a Class A digital device, pursuant to CISPR11.

## EUROPEAN DIRECTIVES

The DMC$^2$ unit fulfills the EC requirements and carries the European CE sign. However, they will be declared as components for building-up machines. They will therefore not be powered as long as the machine itself does not comply with the European Directives.

# DMC$^2$ MAINTENANCE NOTICE

The DMC$^2$ contains no internal adjustments, no fuses and no user-servable maintenance parts requiring removal of its protective covers.
Software programs developed and maintained by DMC$^2$ users customize the unit for each application. Maintenance personnel must be aware that a DMC$^2$ swap may also require configuring the replacement unit to be configured with the correct software for the application.

# Overview of Power Drive System

## GENERAL

The DMC$^2$ is an intelligent motion controller, which together with motor and cables, is used for control of speed, position, acceleration and torque of a motor-driven axis in a machine or process. The DMC$^2$ is also able to process, control and coordinate a number of inputs and outputs (both digital and analog). The strength of its motion and I/O capabilities make the DMC$^2$ well suited for handling complex machine or process control applications.

The remainder of this chapter is devoted to defining a machine/process controller using standard terminology established by the IEC (International Electro-technical Commission).

## SYSTEM DEFINITIONS BASED ON IEC STANDARDS

In this section the definitions of a Power Drive System as described by IEC will be stated. This is to clarify how the DMC$^2$ products are to be used in systems for a machine or process and which functional parts it is covering.

### POWER DRIVE SYSTEM

A Power Drive System (PDS) is comprised of a Complete Drive Module, System Controller and motor with its included sensors. Figure 3. shows the boundary between the PDS and the process. If the PDS has its own dedicated transformer, this transformer is included as a part of the Complete Drive Module.
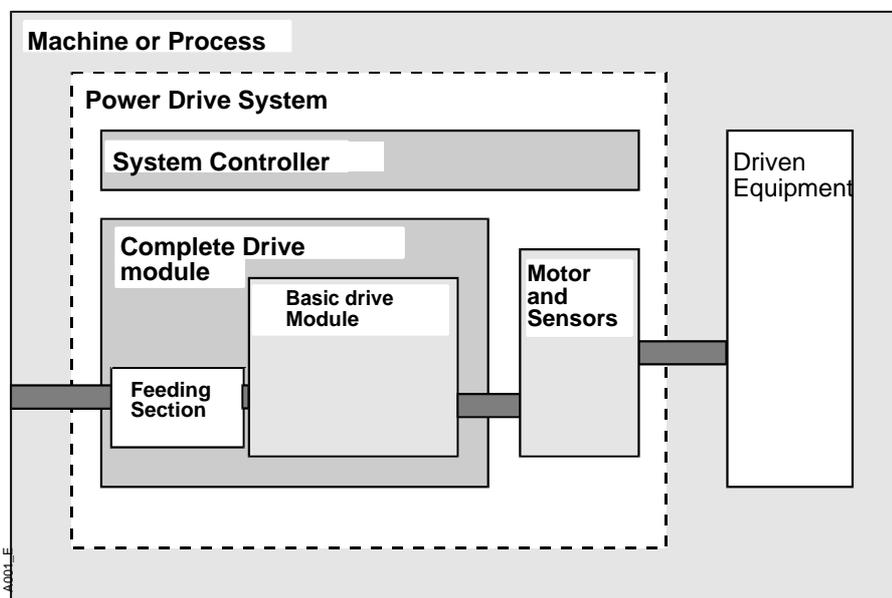


Figure 3.Power Drive System (PDS)

System Definitions based on IEC Standards

## COMPLETE DRIVE MODULE

The Complete Drive Module (CDM) consists of a Basic Drive Module (BDM) and its possible extensions or auxiliaries such as the Feeding Section.

## BASIC DRIVE MODULE

The BDM in Figure 4. is comprised of a Converter Section, and Control Section. The Converter Section changes voltage, current and/or frequency of the power distribution network to voltage/current and/or frequency of the feeding network for the motor. The Converter Section can be divided into Input Converter and Output Converter. The Input Converter can be a rectifier. The Control Section monitors and controls the Converter Section. It also handles communication, I/O-signals and feedback devices.
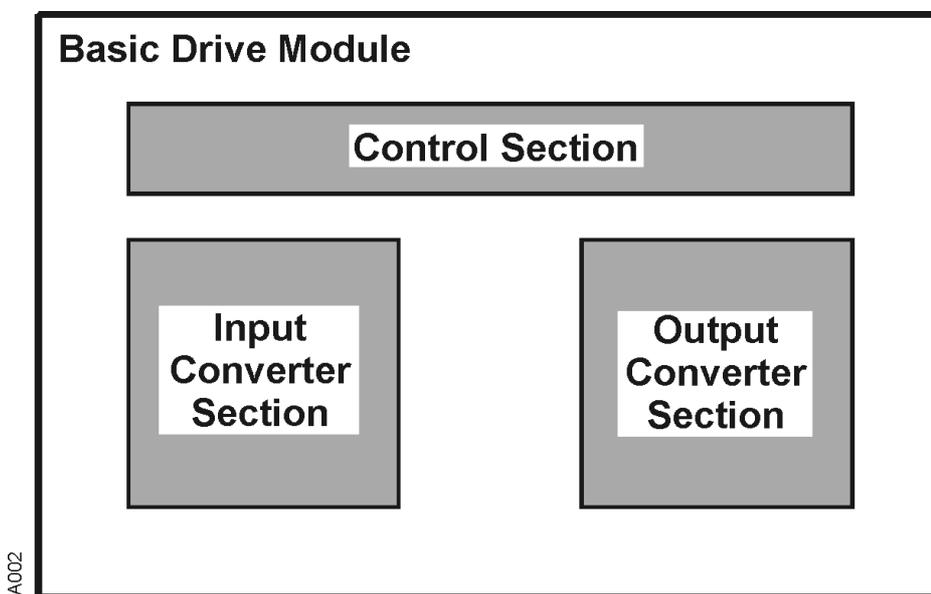


*Figure 4. Basic Drive Module (BDM).*

## FEEDING SECTION AND AUXILIARIES

The Feeding Section consists of all parts between the mains and the input to the converter section including:

- Main switch.
- Input short circuit protective devices.
- Transformer.
- Filter.
- Inrush protection.
- Earth fault detection.
- Disconnecting means for auxiliary circuit.
- Drive overloads protection.
- Auxiliaries - start, stop and emergency stop circuits.

Parts of the feeding section may be physically located within the BDM.

## MOTOR AND SENSORS

The motor (see Figure 5.) converts electrical energy to mechanical energy. By definition the motor includes those sensors, which are relevant to motor operation and interact with the CDM. The motor illustrated in Figure 5. includes the motor windings, temperature sensor, feedback device and brake include.
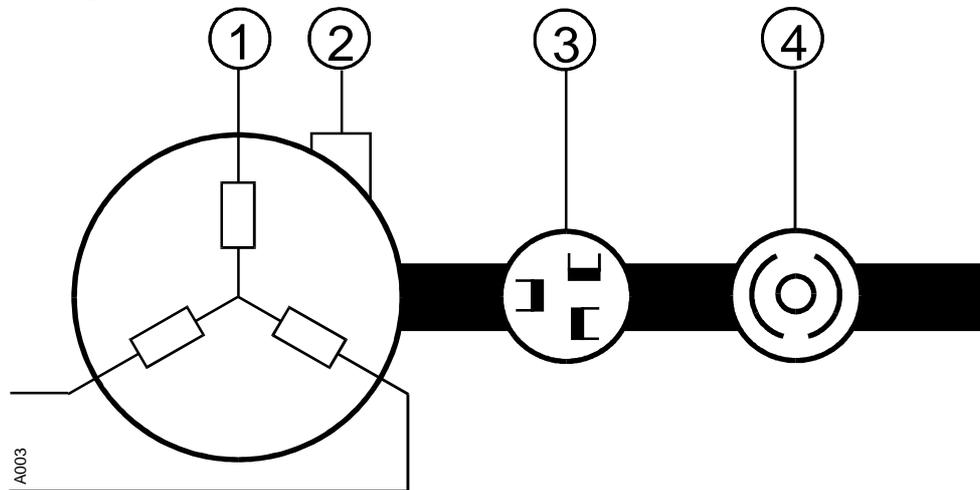


*Figure 5. Motor with sensors.*

1. Motor winding.        2. Temperature sensor.        3. Fedeback devise.
4. Brake.

# SYSTEM CONTROLLER

The System Controller includes all the accessories needed for the PDS to perform its required functions. The system controller could include devices such as a:

- Man machine interface.
- Single or multi axis motion controller.
- PC.
- PLC.
- Terminal.
- Motion control unit.
- Multiaxis controller.

This function may be located external to the remainder of the PDS.

## INTERNAL INTERFACES OF THE PDS

The PDS can have a signal interface for connection to a PC, terminal or PLC. It can also have a signal interface to other CDMs, or PDSes.

# Configuring Power Drive Systems

## INTRODUCTION

This chapter discusses configuring power drive systems and presents information on selection of system components including the $DMC^2$, cables, protective devices and others.

## POWER DRIVE SYSTEM WITH THE $DMC^2$

The $DMC^2$ is available in two configurations; AC Supply models, which contain an integral DC power, supply (input converter section) and DC Supply models, which have no integral DC power, supply. A stand-alone PS (power supply) unit is available for powering DC Supply models of the $DMC^2$.
A Power Drive System (PDS) utilizing $DMC^2$s may be configured in several ways depending on the number of motion axes and the requirements for each axis:

- One or more AC supplied $DMC^2$ unit(s). See Figure 6.
- One AC supplied $DMC^2$ unit supplying one or more DC supplied $DMC^2$ unit(s) with a DC bus interface. See Figure 7.
- A stand-alone PS (power supply) unit supplying one or more DC supplied $DMC^2$ unit(s) with a DC bus interface. See Figure 8.

Power Drive System with the DMC2
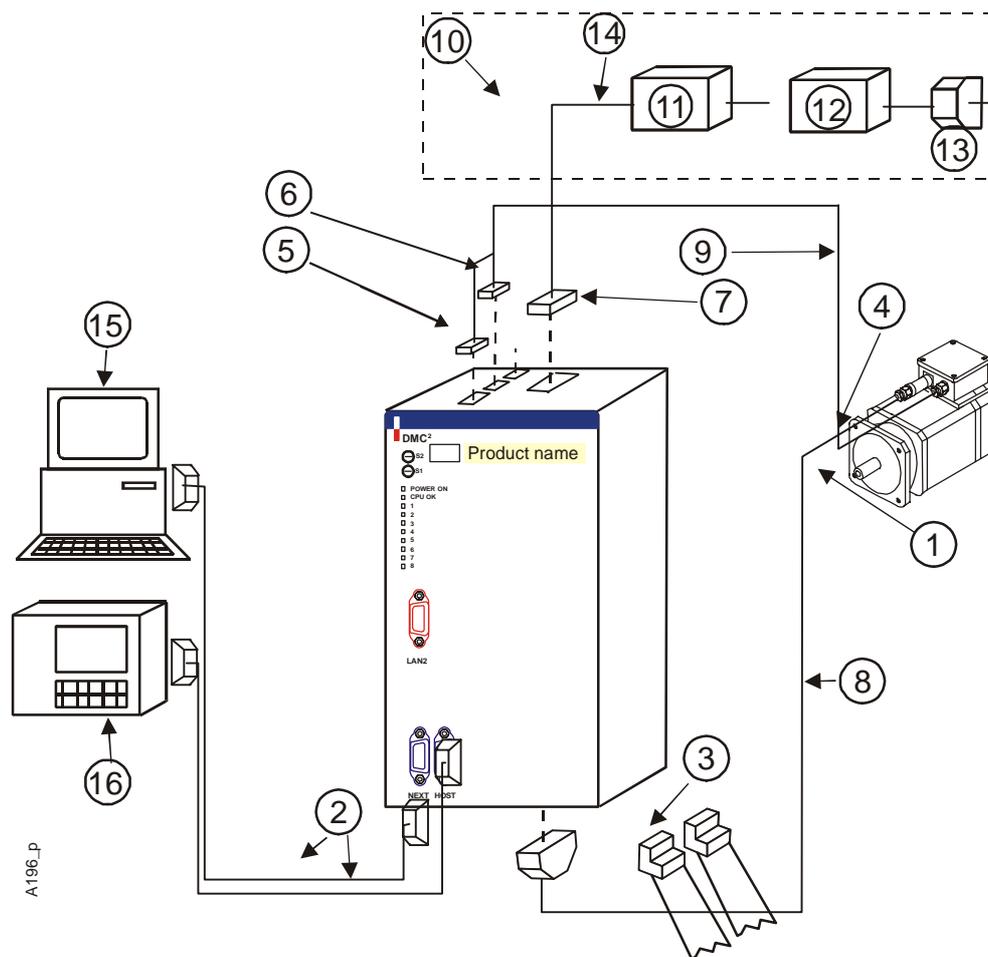


*Figure 6.Example of PDS with an AC supplied DMC$^2$ unit.*

1. Motor power connection.
2. Communication cable.
3. I/O connector.
4. Resolver connection.
5. Thermistor and brake relay connector.
6. Motor power connector.
7. Power connector.
8. Resolver cable.
9. Motor cable.
10. Feeding section.
11. Filter.
12. Contactor.
13. Fuse.
14. Power cable.
15. PC.
16. Terminal PC

# Power Drive System with the DMC2
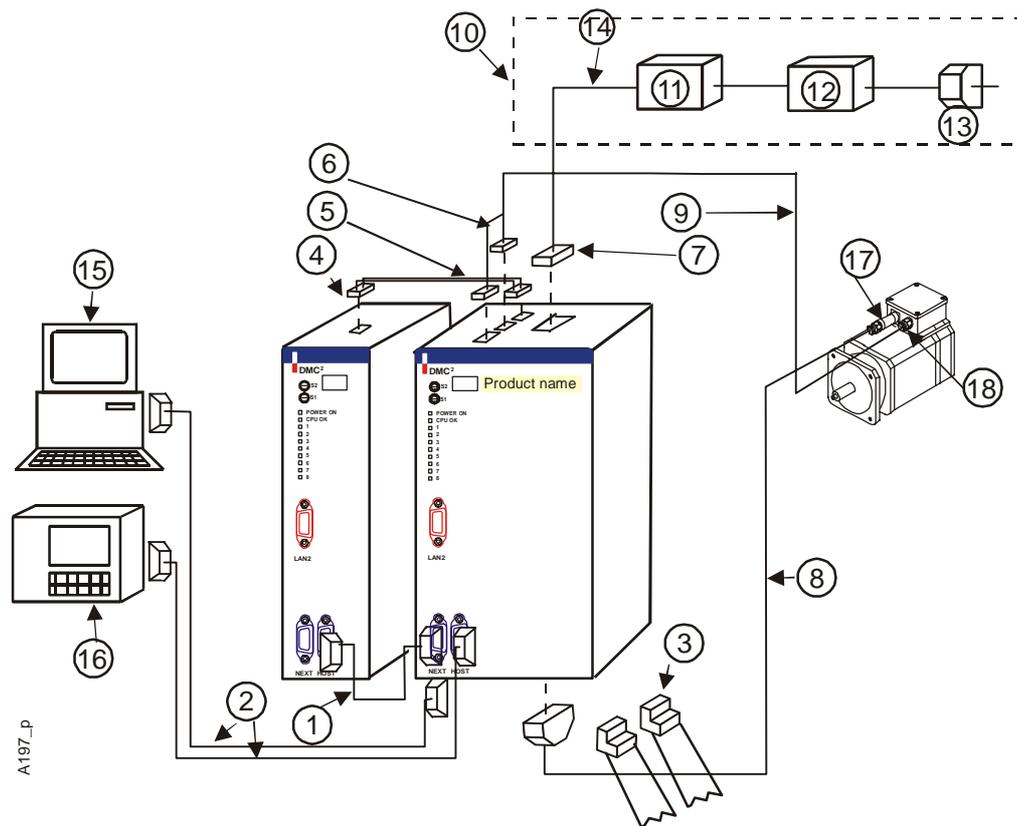


*Figure 7. Example of PDS with an AC supplied DMC$^2$ unit and a DC supplied unit.*

1. Daisy chain cable.
2. Communication cable.
3. I/O connector.
4. DC bus cable.
5. Thermistor and brake relay connector.
6. Motor power connector.
7. Power connector.
8. Resolver cable.
9. Motor cable.
10. Feeding section.
11. Filter.
12. Contactor.
13. Fuse.
14. Power cable.
15. PC.
16. Terminal PC.
17. Resolver connection.
18. Motor connection.

## Power Drive System with the DMC2
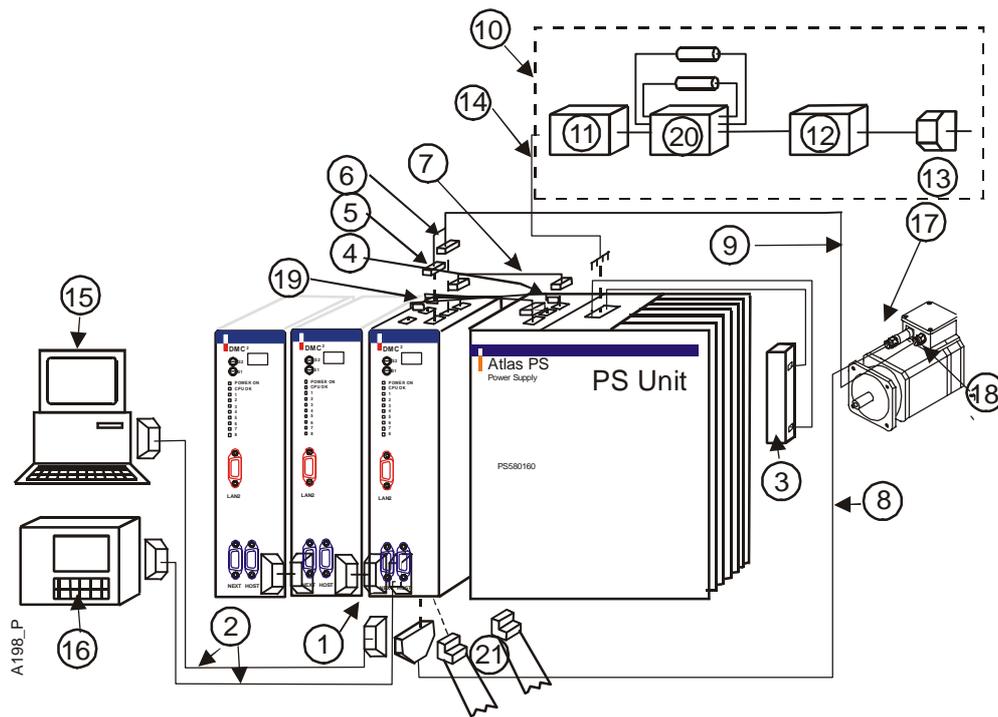


*Figure 8. Example of PDS with DC supplied DMC$^2$ unit(s) driven by stand-alone. PS (power supply) unit.*

1. Daisy chain cabel.
2. Communication cable.
3. Dynamic brake resistance.
4. Temperature switch connector.
5. Thermistor and brake relay.
6. Motor power connector.
7. DC bus cable.
8. Resolver cable.
9. Motor cable.
10. Feeding section.
11. Filter.
12. Contactor.
13. Fuse.
14. Power cable.
15. PC.
16. Terminal PC.
17. Resolver connection.
18. Motor connection.
19. Dynamic brake control.
20. Contactor for inruch protection.
21. I/O connector.

# DMC$^2$ UNIT

The DMC$^2$ is the Basic Drive Module in a Power Drive System illustrated in Figure 9. It consists of a control section, converter section and, for AC-supplied models, part of the feeding section.
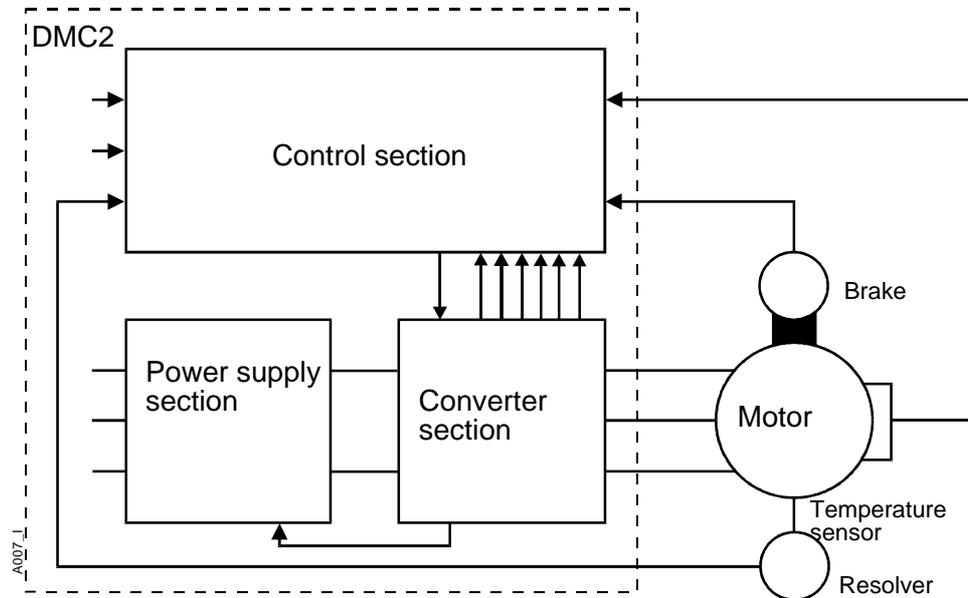


*Figure 9. Block diagram of DMC$^2$.*

## CONTROL SECTION

Figure 10. presents a block diagram of the Control Section of a DMC$^2$. Functions assigned to the blocks are described below

### CONTROL UNIT

The control unit handles the firmware flow for each servo cycle, administrates the serial communication and executes the application code. The control unit apportions CPU time among the firmware, communications and the application.

### RESOLVER MEASURING

Handles excitation and feedback signals from the resolver for control of rotor position, and axis speed and position. This function also supports a second resolver for master/slave tracking applications.

### INPUTS AND OUTPUTS

Filters and processes analog and digital inputs and outputs such that external signals complying with international requirements and standards for programmable controllers are properly interpreted. There is also a High Speed Input (HSI) for fast indication.

## DMC2 unit

### ENABLE INPUT

Hardware input that must be high before the firmware can enable the power output stage of the Converter. When this input is low, the power output stage is disabled.
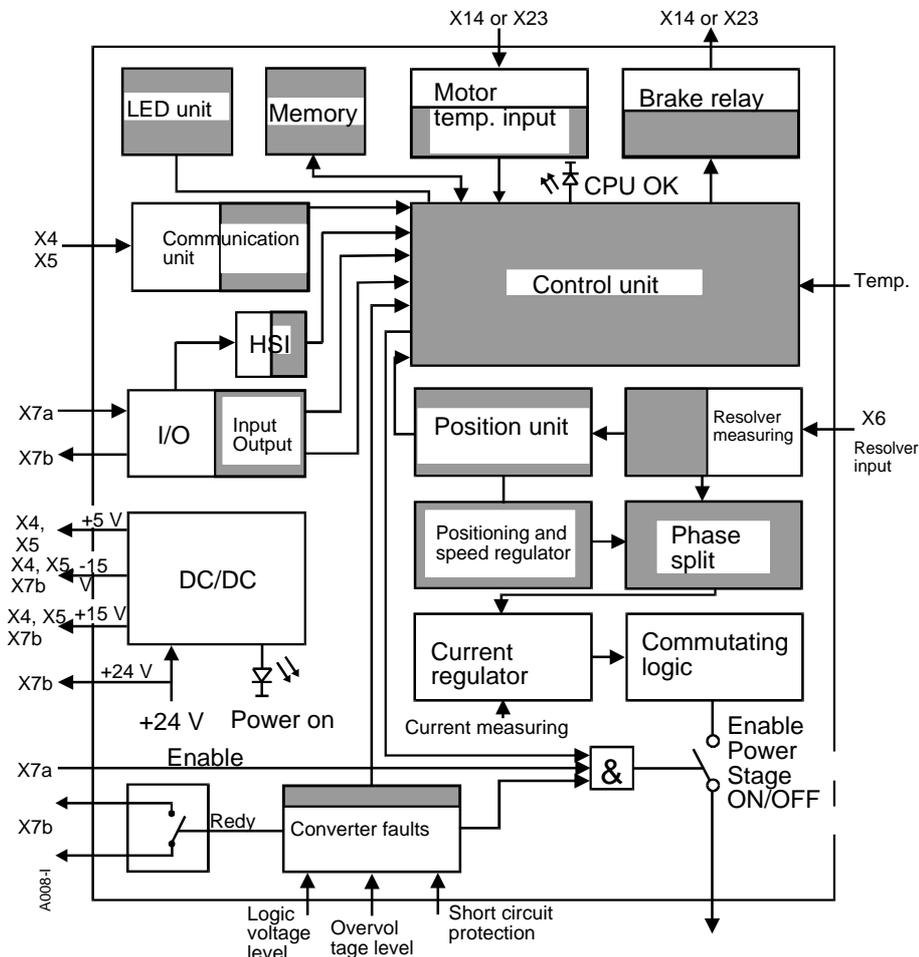


*Figure 10. Control Section Block diagram. (Shaded blocks handled by software).*

### READY RELAY

A relay contact set that closes when no converter faults are indicated and the DMC$^2$ is ready for use. The ready relay will be open after power up until a reset pulse has been sent to the power stage in the converter section.
If one of these faults is indicated, the ready relay contact will open:

- Short circuit protection active in converter section.
- Over voltage level in converter section.
- Too low logic voltage level in converter section.
- Too low logic voltage level in control section
- OUT.Fault have been set from the software.

Any software fault can be programmed to set OUT.Fault and open the read relay contact.

## POSITION AND SPEED REGULATOR

Combined position and speed PID regulator with different feed forward functions and programmable limit settings.

## POSITIONING UNIT (CONTROLLER)

Includes Profile Generator, Electronic Gear Box, Pdata Array, Position Counter and Timers.

## COMMUNICATION UNIT

Contains serial communication interface for RS-232, RS-422, Daisy chain, Sync signal (and CAN bus connection).

## PROGRAM MEMORY

Contains memory for Firmware and application program and a non-volatile EEProm memory for parameter storage.

## MOTOR TEMP INPUT

For connection of the temperature sensor device in the motor. When the motor temperature input is active (open or high impedance), an internal variable (`Motor Temp.High`) is set. The variable `Motor Temp.High` can, in the application program, is used for shutting down the power output stage.

## BRAKE RELAY

Software controlled relay that could be used for control of a brake in the motor.

## CONVERTER FAULTS

Disables the power output stage and de-energizes the Ready relay upon recognition of a fault signal from the Converter section.

## COMMUTATING LOGIC

Turns on and off the switches (IGBT's) in the output power stage depending on motor angle and magnitude of torque (current) command.

## LED UNIT

A group of ten fronts panel LEDs. (Power On, CPU OK and LED 1 thru LED 8) and associated drive electronics.

| LEDs controlled by hardware. | |
|---|---|
| Power On | Green, lit when +5 V are available in controller section. |
| CPU OK | Green, lit when CPU has started up and runs. |
| **LEDs controlled by software.** | |
| LD 1 | Green, Software defined. |
| LD 2 | Yellow, Software defined. |
| LD 3 | Yellow, Software defined. |
| LD 4 | Yellow, Software defined. |
| LD 5 | Red, Software defined. |
| LD 6 | Red, Software defined. |

## DMC2 unit

LD 7          Red, Software defined.

LD 8          Red, Software defined.

### DC/DC (CONVERTER)

Reduces the +24VDC to +15VDC, -15VDC and +5VDC supply voltage for the logic in the controller section.

### POWER SUPPLY SECTION

The power supply section converts three phase AC power to DC power which is used by the Converter section as a source of motor current. Figure 11. illustrates the power supply section of a AC supplied DMC$^2$ and Figure 12. illustrates the power
supply section of a stand-alone power supply. The principal differences between the two configurations are:

- The stand-alone power supply does not include integral inrush current protection components.
- The regeneration resistor is integral to the AC supplied DMC$^2$. A separate external regeneration resistor must be provided for the stand-alone power supply.
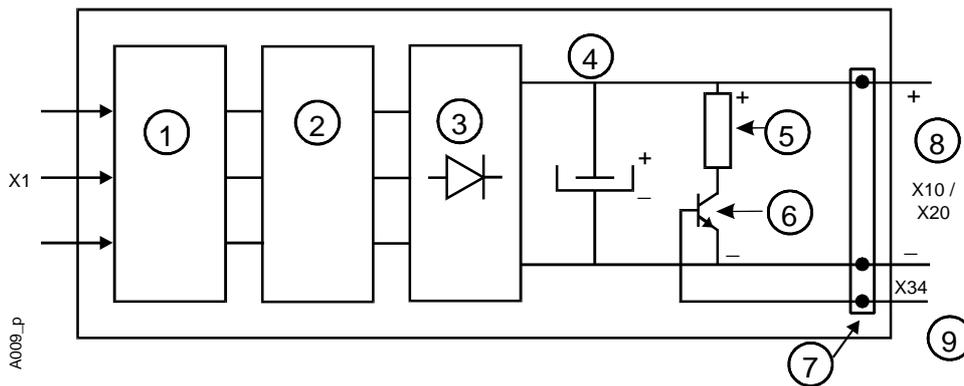


*Figure 11. Block diagram of power supply section of AC supplied DMC$^2$.*

1. Internal EMC filter.          2. Inrush current protection.
3. Rectifier.                        4. Storage capacitator.
5. Dynamic brake resistance.
6. Dynamic brake switch.      7. Internal connection to converter section.
8. DC Bus.                          9. To dynamic brake control.
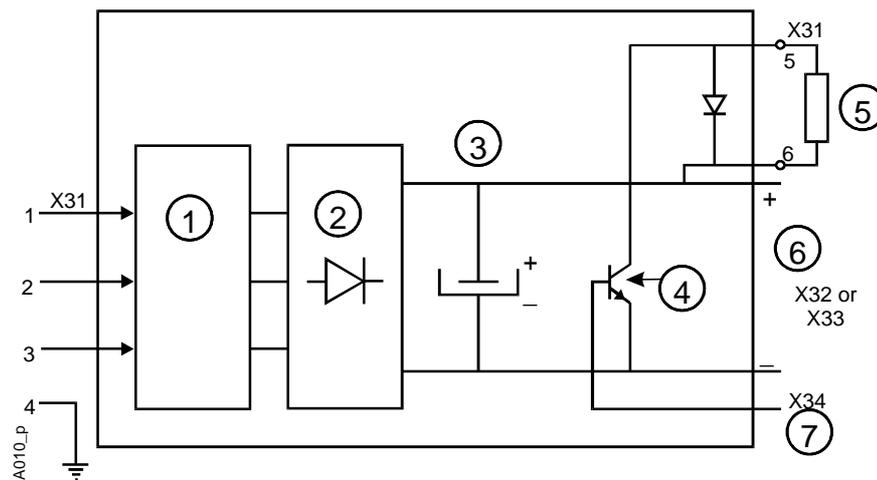
*Figure 12. Block diagram of power supply section of stand-alone power supply.*

1. Internal EMC filter      2. Rectifier.
3.Storage capacitor.      4. Dynamic brake switch.
5. Dynamic brake resistance.
6. DC Bus.      7. From dynamic brake control.

## INTERNAL EMC FILTER

Attenuates conducted electrical noise into and out of power supply section.

## INRUSH CURRENT PROTECTION

Limits the inrush current for protection of the rectifier diodes internally. This includes Contactors and switches externally.

## RECTIFIER

Six-pulse rectification of the three-phase input power.

## STORAGE CAPACITOR

Storages energy and filters the six pulse rectified voltage on the DC bus.

## DYNAMIC BRAKE (REGENERATION, BLEEDER OR SHUNT CIRCUIT)

When Bus voltage rises to a pre-set level due to regeneration by the motor, the dynamic brake transistor is turned on allowing excess energy to be dissipated in the dynamic brake resistor.

## DMC2 unit

### CONVERTER SECTION
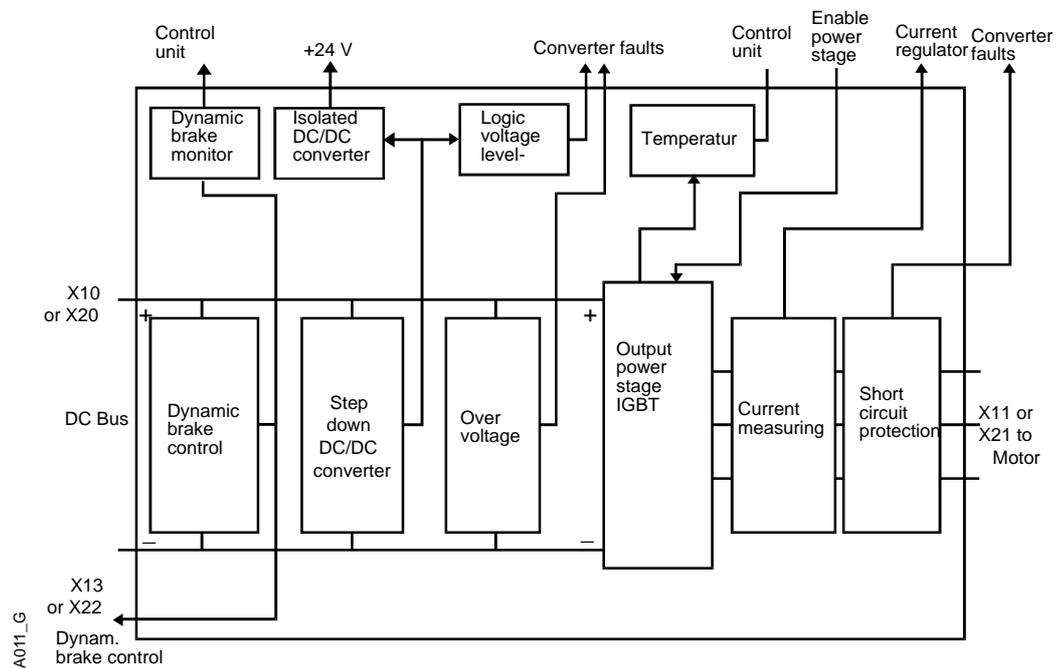


*Figure 13. Converter Section, Block diagram.*

### SHORT CIRCUIT PROTECTION

Detects short circuits between motor windings and shorts to ground. Whenever current exceeds 300 % of the DMC[2]'s peak current rating for 10 ms, a short circuit protection fault occurs, immediately shutting down the output power stage. The short circuit detection is independent of the current measuring circuit.

### TEMPERATURE (DRIVE OVER-TEMPERATURE PROTECTION)

Temperature sensor located in the output power stage, which sets an internal variable (Drive Temp High) whenever a drive over-temperature condition exists. The variable Drive Temp High can, in the application program, be used to shut down the output power stage.

### OVER VOLTAGE LEVEL

Monitors the DC-bus voltage level. When the DC-bus voltage level is too high a over voltage level fault occurs, immediately shutting down the power stage.

### LOGIC VOLTAGE LEVEL

Monitors the logic supply voltage level. When the logic voltage level is too low a logic voltage level fault occurs, immediately shutting down the power stage.

### STEP DOWN DC/DC CONVERTER

Reduces the DC bus voltage to +24 V DC supply voltage for the logic.

### ISOLATED DC/DC CONVERTER

Transform the +24 V DC supply voltage in the converter section to + 24 V DC supply voltage in the controller section with safe isolation.

### CURRENT MEASURING

The current measurements are done in two motor phases with isolated current sensors able to measure AC, DC and impulse currents.

### DYNAMIC BRAKE CONTROL (REGENERATION BLEEDER OR SHUNT CONTROL)

Controls the dynamic brake in the power supply section. When the DC bus voltage rises too high it will turn on the dynamic brake and turn it off when the voltage has reduced.

### DYNAMIC BRAKE MONITOR

Measure the time the dynamic brake have been active and present it as a analog voltage that can be read from the software and used for overload detection.

# SELECTING A DMC$^2$ FOR THE APPLICATION

## PERFORMANCE SUMMARY AC SUPPLIED DMC$^2$

Table 3. summarizes the principal performance characteristics of the available DMC$^2$ models with an integral AC power supply.

## PERFORMANCE SUMMARY DC SUPPLIED DMC$^2$

Table 4. summarizes the principal performance characteristics of the available DMC$^2$ models without an integral AC power supply.

## STAND-ALONE POWER SUPPLIES, PS UNITS

When configuring a PDS with multiple DMC$^2$s the optimum configuration is frequently a stand-alone power supply with DC supplied DMC$^2$s. Table 5 summarizes the principal performance characteristics for the available models of stand-alone power supply.

## CONNECTOR KIT FOR DMC$^2$

Input power, DC Bus power, motor, Dynamoc brake, Termistor/brake, Temperature switch, +24 V DC and I/O connections to the DMC$^2$ are made using transition connectors who mate with header type connectors on the DMC$^2$. Table 6. lists part numbers for these transition connectors along with mating DMC$^2$ connector kit designed for each model of the DMC$^2$.

# CABLING

## POWER CABLE

Power cables shall be chosen so that national electrical regulations are fulfilled in the country where the system is to be used. We recommend that the power cable be sized for 2 times the fused current or at least 1.5 mm$^2$.

## MOTOR CABLE

Motor cables shall be chosen so that national electrical and EMC regulations are fulfilled in the country where the system is to be used. We recommend that the motor cable be sized for 2 times the continuos motor current or at least 1mm$^2$. Table 7. and Table 8. lists some motor cables available from us. A complete motor cable installation requires a threaded strain relief to be mounted on the motor junction box.
Table 9. lists strain relief's for the motor cable types listed in Table 7. and Table 8.

## RESOLVER CABLE

Resolver cables shall be chosen so that national electrical and EMC regulations are fulfilled in the country where the system is to be used. We recommend resolver cables with shielded pair twisted conductors with an external common shield and an area of at least 0.25 mm$^2$.
If cables recommended by us are used, electrical and EMC regulations within EC and USA are fulfilled. We supplies completed resolver cable assemblies in various lengths as well as un-terminated cable, which may be ordered in custom lengths. Table 10.- Table 13. lists available resolver cable selections. Table 14. and Table 20. lists available resolver cable accessories.
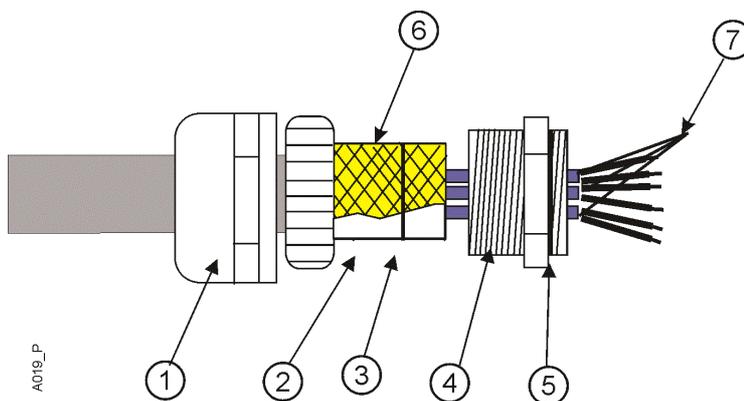


*Figure 14. EMC shield with Hummel strain relief.*

1. Cap.
4. Connecting nut.
7. Shield.

2. Insert.
5. Sealing.

3. O-Ring .
6. EMC shield.

*Figure 15. EMC shield with Pflitsch strain relief.*

| | | |
|---|---|---|
| 1. Cap. | 2. Insert. | 3. Clamping sleev. |
| 4. Connecting nut. | 5. Sealing. | 6. EMC shield. |
| 7. Shield. | | |

## COMMUNICATION CABLE

Cable assemblies for $DMC^2$ to PC and $DMC^2$ to $DMC^2$ interconnection are listed in Table 15. and Table 16. The $DMC^2$ to PC cables use a F 9 pin DSUB and 9 pol metal housing on the PC end. Cable assemblies for $DMC^2$ to Terminal PC are listed in Table 17.

## CONTROL CIRCUIT CABLE

Shall be chosen so that national electrical regulations are fulfilled in the country where the system is to be used. We recommend that the control circuit cable having a cross-section of at least 0.5 $mm^2$ (AWG20).

# FUSES

## REQUIREMENTS

Fuses shall be chosen so that national electrical regulations are fulfilled in the country where the system is to be used. We recommend time delay fuse with a delayed opening of approximately 1 min total delay for 1.5 to 2 times rated current. Table 2 below lists the fuse ratings for the various $DMC^2$ models.

If a circuit breaker is used, it must have a current interrupting capacity 6000 A and a delayed opening of approximately 1 min total delay for 1.5 to 2 times rated current of the $DMC^2$. If a circuit breaker is used, it should be used in conjunction with 100 amp fuses.

EMC filters

| DMC² Type | Time Delay Fuse Rating | Circuit Breaker Rating |
|---|---|---|
| DMC² 50412P | 6-8 A | 6-8 A |
| DMC² 50720P | 6-8 A | 6-8 A |
| DMC² 51540P | 10-16 A | 10-16 A |
| PS380160 | 10-50 A | 10-50 A |
| PS580160 | 10-50 A | 10-50 A |

*Table 2 Fuse/circuit breaker ratings for DMC² models.*

# EMC FILTERS

## REQUIREMENTS

EMC filters shall be chosen so that national electrical regulations are fulfilled in the country where the system is to be used. The filters used shall be tested to comply with the EMC regulations. We recommend the filters listed in Table 21. which have been tested together with the DMC² unit. For filter dimensions, see part C.

## CONTACTORS

One or two different types of contactors may be required depending on the system configuration:

- All system configurations use a main contactor. Paragraph "Main contactor selection" provides guidelines for main contactor selection. Table 22.
- Systems utilizing a stand-alone power supply require an additional contactor, which inserts inrush current limiting resistance into the in feed circuit for the first 50 ms. after power-up. Paragraph "Inrush current contactor selection" provides guidelines for inrush current contactor selection. Table 23.
- For Inrush Resistor, See Table 24.

## MAIN CONTACTOR SELECTION

- Use 4-pole contactors.
- The contactor's working current for AC1-operation at 40°C ambient temperature shall be equal or greater than 125 % of rated rms current for the input power fuses.
- The make current shall be lower than the contactors rated make current capacity.
- Operating rated voltage shall be +24 V DC or the voltage that are used for the auxiliaries' circuit.

## INRUSH CURRENT CONTACTOR SELECTION.

- The contactor shall have a time delay on make of at least 10 ms.
- The contactor's working current for AC1-operation at 40°C ambient temperature shall be equal or greater than 125 % of rated rms current for the input power fuses.

- The make current shall be lower than the contactor's rated make current capacity.
- Operating rated voltage (50 or 60 Hz) shall be not less than the line-to-line voltage of the AC input voltage.

# EXTERNAL DYNAMIC BRAKE RESISTORS

Select a power wire wound resistor type Dale HL or similar that are rated 1.5 TIMES the continuous dynamic brake power that are needed. This type of resistor is enabling to handle a peak power 50 TIMES its rated power in 1 second.

- Calculate needed power rating on the resistor.
- Calculate the peak power for 1 second.
- Calculate the max peak current for 700 V at the DC-bus.
- Calculate the resistance value.
- Check that maximum peak current and continuous current for the dynamic brake in the PS unit not are exceed.
- If the peak current is to low, select a resistor with higher power rating and calculate again.

## EXAMPLE 1. CONTINUOUS POWER, 130W AND PEAK POWER 8KW.

Calculate needed power rating on the power resistor:
*1,5x130W = 200 W*
Calculate peak power for 1 second:
*200x50 = 10 kW*
Calculate max peak current for 400 V DC-bus:
*10 kW/700V = 14.3 A*
Calculate resitance value: *700V/14.3A = 49 Ω*
another way to calculate the external dynamic brake resistor is to go the opposite way.
First select the resistance as close as possible to the minimum resistans that is allowed for the shunt regulator. This will give the maximum dynamic brake peak power for the dynamic brake in the PS unit.

- Calculate the max peak current for 700 V at the DC-bus.
- Calculate the peak power for 1 second.
- Calculate the power rating for the resistor that could handle the peak power.
- Calculate the minimum continuous power that could be handled by the resistors.
- Check that the continuous power is sufficient for the application. If the calculated continuous power is much larger then what is needed in the application, try to reduce the peak power it will save cost on the power resistors.

## EXAMPLE 2. FOR PS580160 MINIMUM RESISTANS 10Ω.

Calculate the max peak current for 700 V at the DC-bus:
*700V/10 Ω = 70 A*
Calculate the peak power for 1 second:
*700V x 70 A = 49 kW*
Calculate the power rating for the resistor that could handle the peak power:
*49 kW/50 = 980 W*
Calculate the minimum continuous power that could be handle by the resistor:
*980W/1,5 = 653W*

| i | **Peak power for 1 second in Watt is the same as pulse energy in Joule, J = W/s** |
|---|---|

# TRANSFORMER SELECTION

In some application it is a need for transformer to convert the input voltage or for safety reasons.

Requirements on the transformer for a typical servo application with acceleration and deceleration peak torque of 2-3 times the continues torque:

- The output voltage should be 400 V AC.
- The transformers that have a continuous power rating equal our higher than the total continuous output power needed for the application.
- The transformer shall have a maximum of 5 % voltage drop at two times the continuous output power needed for the application.

# EXAMPLE OF SYSTEM CONFIGURATIONS

## DRIVE COMBINATION

To give good performance in dynamic applications should the drive-motor combination be able to give 2 to 3 times the rated torque at rated speed. The drive applications that are listed in Table 25 and Table 26 shows the components that are essential for an application.

They are optimized to take out the maximum of performance of drive and motor in a dynamic application.

# SIZING COMPONENTS OF THE DMC$^2$ SYSTEM

- Calculate torque, power requirement and regeneration power requirement for the application.
- Choose motor, which satisfies torque, peak torque, and speed requirements.
- Choose DMC$^2$ unit with required continuous current, peak current and regeneration energy dissipation capacity.
- Choose cables and accessories, which satisfy voltage and current requirements and national electrical regulations.
- Overload Protection of the DMC$^2$ System.
- Use a motor that can handle a specified overload current and an overload protection device that activates before the specified overload is exceeded.
- Use a motor cable that can handle a current higher than the specified overload current for the motor.
- Connect the over-temperature protection device in the motor to the motor temperature input on the DMC$^2$ unit.
- Set the current limiting parameter `Reg.TorqLim` in the DMC$^2$ unit to the specified overload current for the motor. Use the internal variable for Current Regulator fault to shut down power stage in the DMC$^2$ unit if actual current measured in motor phases differs from command current.
- Use the internal variable for `Motor.TempHigh` to shut down the power stage in the DMC$^2$ unit if the motor overload protection device is activated.

# DMC$^2$ Tables

## PERFORMANCE SUMMARY AC SUPPLIED DMC$^2$.

*Table 3*

| Order No 9032 | AC Supply Models DMC$^2$ | Input voltage 50/60Hz VCA | Input current A$_{rms}$ | Output cont. current A$_{rms}$ | Output peak current A | Output cont. power kW | Power loss W$^{1)}$ | Max cont. DC-bus current A$^{2)}$ | Dynamic brake current A | Dynamic brake max. energy one pulse kJ | Dynamic brake cont. power W | Width mm | Weight kg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0121 28 | 50412P | 3x400 | 3 | 3 | 12 | 1.9 | 90 | 7 | 18.7 | 10 | 40 | 76 | 3.8 |
| 0121 42 | 50412P-CAN | | | | | | | | | | | | |
| 0121 30 | 50720P | 3x400 | 5 | 5 | 20 | 3.4 | 90 | 7 | 18.7 | 10 | 40 | 76 | 3.8 |
| 0121 44 | 50720P-CAN | | | | | | | | | | | | |
| 0121 32 | 51540P | 3x400 | 11 | 11 | 40 | 7.4 | 155 | 14 | 18.7 | 20 | 80 | 160 | 6.8 |
| 0121 46 | 51540P-CAN | | | | | | | | | | | | |
| $^{1)}$ Not including dynamic breaking power loss | | | | | | | | | | | | | |
| $^{2)}$ Including internal current to output power | | | | | | | | | | | | | |

## PERFORMANCE SUMMARY DC SUPPLIED DMC$^2$.

*Table 4*

| Order No 9032 | DC Supply Models DMC$^2$ | Input voltage V DC | Cont. current A DC | Cont. current A$_{rms}$ | Peak current A | Cont. output power kW | Power loss W | Width mm | Weight kg |
|---|---|---|---|---|---|---|---|---|---|
| 0121 20 | 50412 | 570 | 3.5 | 3 | 12 | 1.9 | 60 | 46 | 2.7 |
| 0121 34 | 50412-CAN | | | | | | | | |
| 0121 22 | 50720 | 570 | 6 | 5 | 20 | 3.4 | 60 | 46 | 2.7 |
| 0121 36 | 50720-CAN | | | | | | | | |
| 0121 24 | 51540 | 570 | 13 | 11 | 40 | 7.4 | 115 | 122 | 5.1 |
| 0121 38 | 51540-CAN | | | | | | | | |
| 0121 26 | 53080 | 570 | 25.5 | 21 | 80 | 14.5 | 190 | 173 | 7.5 |
| 0121 40 | 53080-CAN | | | | | | | | |

# PERFORMANCE SUMMARY STAND-ALONE POWER SUPPLIES, PS UNITS.

*Table 5*

| Order No 9032 | Power Supply Models PS | Input voltage 50 / 60 Hz V AC | Input current A$_{rms}$ | Output cont. current A DC | Output peak current A DC | Output cont. power kW | Power loss W [1] | Dynamic brake peak current A | Dynamic brake cont. current A | Dynamic brake max energy one pulse kJ | Dynamic brake cont. power W | Width mm | Weight kg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0101 01 | 580160 | 3x400 | 65 | 80 | 160 | 45.5 | 180 | 70 | 35 | note 1 | note 1 | 173 | 7.2 |
| [1] Depends on rating for the external dynamic brake resistor. | | | | | | | | | | | | | |

# CONNECTOR KIT FOR DMC$^2$

*Table 6*

| Order No / Connection function | Name Phoenix | DMC$^2$ connector designation | DMC$^2$ 50412P 50720P | DMC$^2$ 50412P 50720P | DMC$^2$ 50412 50720 | DMC$^2$ 51540P | DMC$^2$ 51540P | DMC$^2$51540 53080 | PS 580160 |
|---|---|---|---|---|---|---|---|---|---|
| | | | Single | Master | Slave | Single | Master | Slave | |
| Power | | | | | | | | | |
| 20D604B [1] | GMSTB 2.5/4-ST-7.62 | X1 | 1 | 1 | | | | | |
| 20D504R | PC4 HV/4-ST-7.62 | X1 | 1 | 1 | | 1 | 1 | | |
| Motor | | | | | | | | | |
| 20D505Q | PC 4/5-ST-7.62 | X11 | 1 | 1 | 1 | | | | |
| 20D509Q | PC 4/9-ST-7.62 | X21 | | | | 1 | 1 | 1 | |
| DC Bus | | | | | | | | | |
| 20D503Q | PC 4/3-ST-7.62 | X10 | | 1 | 1 | | | | |
| 20D506Q | PC 4/6-ST-7.62 | X20, X32, X33 | | | | | 1 | 1 | 2 |
| Dynamic brake | | | | | | | | | |
| 20D503I | IC 2.5/3-ST-5.08 | X13, X22, X34 | | | | | | | 2 |
| Termistor / brake | | | | | | | | | |
| 20D505B | MSTBA 2.5/5-ST-5.08 | X14, X23 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Input and Output | | | | | | | | | |
| 20D516S | MC1.5/15-ST-3.81 | X7A | 1 | 1 | 1 | 1 | 1 | 1 | |
| 19N017A | MC1.5/15-ST-3.81 | X7B | 1 | 1 | 1 | 1 | 1 | 1 | |
| Temp. switch | | | | | | | | | |
| 20D502A | MSTBA 2.5/2-ST-5.08 | X35 | | | | | | | 1 |
| +24Volt Extenal DC | | | | | | | | | |
| 20D602B | GMSTB 2.5/2-ST-7.62 | X2 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Connector Kit No | | | 9032 0119 70 | 9032 0104 94 | 9032 0103 53 | 9032 0104 95 | 9032 0103 52 | 9032 0104 96 | 9032 0108 51 |

[1] 20D604B This connector is only for DMC delivered before Feb 2001.

# MOTOR CABLE, COMBI CY

*Table 7*

| Order No | Name | No of leads | Current rating EN60204 A | Voltage rating V | Temp-erature ºC | Motor leads area mm² | Bend radius mm | Strain reliefs | Diameter ∅ mm | DC resistance mΩ/m | Capacitance conductor to shield pF/m | Shield coverage |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 27M012A | MC-COMBICY-1,0 | 4x1+2(2x0,25) | 9.6/11.7 | 500 | -5 to +70 | 1 | 5x∅ | 19N308A | 12.7 | 19.5 | 200 | 82% |
| 27M010D | MC-COMBICY-2,5 | 4x2,5+2(2x0,75) | 16.5/21 | 500 | -5 to +70 | 2.5 | 15x∅ | 19N310A | 16 | 7.98 | 220 | 80% |
| 27M014A | MC-COMBICY-4,0 | 4x4+(2x1)+(2x0,75) | 23/28 | 500 | -5 to +70 | 4 | 15x∅ | 19N310A | 17 | 4.95 | 250 | 80% |
| 27M735A | MC-COMBICY-2x4,0 | 8x4+2x(2x1) | 2x23 / 2x28 | 500 | -5 to +70 | 2x4 | 15x∅ | 19N310A | 21.5 | 4.95 | 225 | 80% |

# HIGH FLEX MOTOR CABLE, EUROFLEX S 801 C

*Table 8*

| Order No | Name | No of leads | Current rating EN60204 A | Voltage rating V | Temp-erature ºC | Motor leads area mm² | Bend radius mm | Strain reliefs | Diameter ∅ mm | DC resistance mΩ/m | Capacitance conductor to shield pF/m | Shield coverage |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 27M720A | MC-S801C-1.0 | 4x1+2(2x0.25) | 9.6/11.7 | 750 | -40 to +70 | 1 | 12x∅ | 19N308A | 10.9 | | | |
| 27M721A | MC-S801C-2.5 | 4x2,5+2(2x0,75) | 16.5/21 | 750 | -40 to +70 | 2.5 | 12x∅ | 19N310A | 14 | | | |
| 27M722A | MC-S801C-4.0 | 4x4+(2x1)+(2x0,75) | 23/28 | 750 | -40 to +70 | 4 | 12x∅ | 19N310A | 16 | | | |
| 27M725A | MC-S801C-2x4.0 | 8x4+2x(2x1) | 2x23/2x28 | 750 | -40 to +70 | 2x4 | 12x∅ | 19N310A | 21.1 | | | |

# STRAIN RELIEFS FOR MOTOR CABLE

*Table 9*

| Order No | Name | Pg | Cable diameter mm ∅ | | L2 mm |
|---|---|---|---|---|---|
| 19N308A | HSK-M-EMV | 21 | 13-18 | Hummel | |
| 19N309A | HSK-M-EMV | 21 | 19-16 | Hummel | |
| 19N310A | HSK-M-EMV | 29 | 13-20 | Hummel | |
| 19N300A | MCC-EP-PG16/1.0 | 16 | 12-15 | Pflitsch | 6 |
| 19N301A | MCC-EP-PG16/1.0 | 16 | 14-17 | Pflitsch | 8 |
| 19N302A | MCC-EP-PG16/1.0 | 16/21 | 16-20 | Pflitsch | 8 |
| 19N303A | MCC-EP-PG16/1.0 | 21 | 16-20 | Pflitsch | 10 |

# RESOLVER CABLES WITH CONNECTORS FOR EP MOTORS

*Table 10*

| Order No | Name | Type of cable | Cable area mm² | Length m | Temp rating ºC | DMC contact | Motor contact | Bend radius | Diameter mm ⌀ |
|---|---|---|---|---|---|---|---|---|---|
| 27M017B | RC-DMC-EP-5 | Shielded with three twisted and shielded pairs | 0.25 | 5 | -5 to +70 | 19N117K | 19N117R + 19N304A | 7.5x⌀ | 9.9 |
| 27M017C | RC-DMC-EP-7.5 | | 0.25 | 7.5 | -5 to +70 | 19N117K | | 7.5x⌀ | 9.9 |
| 27M017D | RC-DMC-EP-10 | | 0.25 | 10 | -5 to +70 | 19N117K | | 7.5x⌀ | 9.9 |
| 27M017E | RC-DMC-EP-15 | | 0.25 | 15 | -5 to +70 | 19N117K | | 7.5x⌀ | 9.9 |

# RESOLVER CABLES WITH CONNECTORS FOR SEM MOTORS

*Table 11*

| Order No | Name | Type of cable | Cable area mm² | Length m | Temp rating ºC | DMC contact | Motor contact | Bend radius | Diameter mm ⌀ |
|---|---|---|---|---|---|---|---|---|---|
| 27M030B | RC-DMC-AHD-5 | Shielded with three twisted and shielded pairs | 0.25 | 5 | -5 to +70 | 19N117K | 19N410A + 20B231A (8 pcs) + 19N305A | 7.5x⌀ | 9.9 |
| 27M030C | RC-DMC-AHD-7.5 | | 0.25 | 7.5 | -5 to +70 | 19N117K | | 7.5x⌀ | 9.9 |
| 27M030D | RC-DMC-AHD-10 | | 0.25 | 10 | -5 to +70 | 19N117K | | 7.5x⌀ | 9.9 |
| 27M030E | RC-DMC-AHD-15 | | 0.25 | 15 | -5 to +70 | 19N117K | | 7.5x⌀ | 9.9 |

# RESOLVER CABLES, BY THE METER

*Table 12*

| Order No | Name | Type of cable | Cable area mm² | Length m | Temp rating ºC | Bend radius | Diameter mm ⌀ |
|---|---|---|---|---|---|---|---|
| 27M013A | RC-LIYCY-0.25 | Shielded with three twisted and shielded pairs | 0.25 | By the meter | -5 to +70 | 7.5x⌀ | 9.9 |

# HIGH FLEX RESOLVER CABLES

*Table 13*

| Order No | Name | Type of cable | Cable area mm² | Length m | Temp rating ºC | Bend radius | Diameter mm⌀ |
|---|---|---|---|---|---|---|---|
| 27M015A | RC-LY12Y11Y-0.25 | Shielded with three twisted and shielded pairs | 0.25 | By the meter | -40 to +70 | 7.5x⌀ | 10 |

# STRAIN RELIEFS FOR RESOLVER CABLE

*Table 14*

| Order No | Name | Pg | Cable diameter mm ∅ | | L2 mm |
|---|---|---|---|---|---|
| 19N305A | HSK-M-EMV | 11 | 5-10 | Hummel | |
| 19N304A | MCC-EP-PG11 | 11 | 6-10 | Pflitsch | 10 |

# COMMUNICATIONS CABLES DMC$^2$ - PC

*Table 15*

| Order No | Name | Length m | No of leads | Cable area mm² | Shield |
|---|---|---|---|---|---|
| 27M117A | CC-DMC-RS232-2 | 2 | 3 | 0.25 | Yes |
| 27M117B | CC-DMC-RS232-4 | 4 | 3 | 0.25 | Yes |

# COMMUNICATIONS CABLES DMC$^2$ - DMC$^2$

*Table 16*

| Order No | Name | Length m | No of leads | Cable area mm² | Shield |
|---|---|---|---|---|---|
| 27M217A | CC-DMC-DMC-0.2 | 0.2 | 9 | 0.25 | Yes |
| 27M217B | CC-DMC-DMC-0.3 | 0.3 | 9 | 0.25 | Yes |

# COMMUNICATIONS CABLES DMC$^2$ – TERMINAL PC

*Table 17*

| Order No | Name | Length m | No of leads | Cable area mm² | Shield |
|---|---|---|---|---|---|
| 27M127A | CC-PC-DMC-3 | 3 | 9 | 0.25 | Yes |
| 27M127B | CC-PC-DMC-5 | 5 | 9 | 0.25 | Yes |
| 27M127D | CC-PC-DMC-1.5 Angle | 1.5 | 9 | 0.25 | Yes |

# SYNC CABLE

*Table 18*

| Order No | Name | Length m | No of leads | Cable area mm² | Shield |
|---|---|---|---|---|---|
| 27M425A | Syncbox Cable | 0,7 | 12 | 0.25 | Yes |

# DMC² SYNCBOX

*Table 19*

| Order No | Name | No of connectors | | |
|---|---|---|---|---|
| 27M425B | DMC Syncbox External resolver | 3 | EP MOTOR | |
| 27M425C | DMC Syncbox Master / Slave | 4 | EP MOTOR | |
| 27M425D | DMC Syncbox Master / Slave | 8 | EP MOTOR | |
| 27M425E | DMC Syncbox External resolver | 7 | EP MOTOR | |
| 9032 0108 80 | DMC Syncbox External resolver | 3 | SEM MOTOR | 2 pol resolver |
| 9032 0108 81 | DMC Syncbox External resolver | 3 | SEM MOTOR | 6 pol resolver |

# CONNECTOR.

*Table 20*

| Order No | Name | Remark | No of pin | | | Connector |
|---|---|---|---|---|---|---|
| 9032 0103 17 | Connector, female | D-SUB incl. hood | 9 | For external rotary | | |
| 9032 0103 18 | Connector, male | D-SUB incl. hood | 9 | For external rotary | | |
| 9032 0103 14 | CAN termination | | | | FBU and CAN communication | X4/X5 |
| 9032 0103 15 | CAN termination | | | With external connection | FBU and CAN communication | X4/X5 |
| 19N117K | Connector, male | D-SUB incl. hood | 15 | For resolver cable at DMC | | X6A |
| 19N117R | Connector, Burndy | | 8 | For resolver cable at EP motor | | |
| 19N410A | Connector, AMP | Contact 20B231A (8pcs) | 8 | For resolver cable at SEM motor | | |
| 19N117A | Connector kit | 4-10A incl. D-subs | 9 pcs. | | | |
| 19N117B | Connector kit | 15-20A incl. D-subs | 9 pcs. | | | |

# RECOMMENDED EMC FILTERS

*Table 21*

| Order No | Name | Rated current (50_C) A$_{rms}$ | Leakage current (230V/50Hz) mA | Power loss W | Weight Kg | Input connection | Output connection | Recommended for DMC[2] |
|---|---|---|---|---|---|---|---|---|
| 56S117A [1] | FN251-8-07 | 8 | 1.31 | 7 | 0.75 | Cable AWG16 | Cable AWG16 | 50412P + 50720P |
| 9032 0118 31 | FN258-7/07 | 7 | 71 | 4.5 | 1.1 | Cable AWG16 | Cable AWG16 | 50412P + 50720P |
| 56S117B [1] | FN251-16-07 | 16 | 1.31 | 14 | 1.8 | Cable AWG14 | Cable AWG14 | 51540P |
| 9032 0118 32 | FN258-16/07 | 16 | 84 | 9 | 1.7 | Cable AWG16 | Cable AWG16 | 51540P |
| 56S117C | FN351-50-33 | 50 | 190 | 13 | 3.1 | Cable AWG6 | Cable AWG6 | 53080+PS580160 |
| 56S117F | FN258-30/07 | 30 | 104 | 14 | 1.8 | Cable AWG10 | Cable AWG10 | PS580160 |
| 56S117G | FN258-75/34 | 75 | 113 | 20 | 4 | Cable AWG3 | Cable AWG3 | PS580160 |
| [1] 56S117A, 56S117B is second hand choice. | | | | | | | | |

# RECOMMENDED MAIN CONTACTORS

*Table 22*

| Name | Current rating, AC1 operating A | Supply voltage V DC | Fuses A | Recommended for 400 V AC application with maximum rated cont. output power kW |
|---|---|---|---|---|
| Type Telemecanique  LP1-D25004BD | 25 | 24 | 16 | 11 |
| Type Telemecanique  LP1-D25004BD | 40 | 24 | 32 | 22 |

# RECOMMENDED INRUSH CURRENT CONTACTORS

*Table 23*

| Name | Current rating, AC1 operating A | Supply voltage V AC | Fuses A | Recommended for application with maximum rated cont. output power kW | Recommended inrush resistor |
|---|---|---|---|---|---|
| Type Telemecanique LC1-D12004Q5 | 25 | 400 | 16 | 11 | 4.7Ω/50W |
| Type Telemecanique  LC1-D25004Q5 | 40 | 400 | 32 | 22 | 4.7Ω/50W |

# RECOMMENDED INRUSH RESISTORS

*Table 24*

| Name | Rating | Inrush Currrent limit at 400 V AC |
|------|--------|-----------------------------------|
| Type example (DALE HL 50) | 4.7Ω/50W | 120 A |

# SYSTEM CONFIGURATION DMC$^2$

## SYSTEM CONFIGURATIONS 400 VAC

*Table 25*

| Motor-Drive combination | Power Supply | Motor Cable 15m | Motor Cable strain relief | Resolver Cable with conn. 15 m | Filter | Fuse | Power Cable rating | Main Cont. curr. rating A | Inrush Curr. cont. | Inrush resistor | Dynamic brake resistor |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DMC$^2$ 50412P | inbuilt | 27M012A | 19N300A | 27M017E | 56S117A | 6 | 10 A → AWG16 | 10 | inbuilt | inbuilt | inbuilt |
| DMC$^2$ 50412P | inbuilt | 27M012A | 19N300A | 27M017E | 56S117A | 6 | 10 A → AWG16 | 10 | inbuilt | inbuilt | inbuilt |
| DMC$^2$ 50720P | inbuilt | 27M010D | 19N301A | 27M017E | 56S117A | 6 | 10 A → AWG16 | 10 | inbuilt | inbuilt | inbuilt |
| DMC$^2$ 51540P | inbuilt | 27M010D | 19N301A | 27M017E | 56S117B | 16 | 20A → AWG14 | 25 | inbuilt | inbuilt | inbuilt |
| DMC$^2$ 53080 | PS580160 | 27M014A | 19N303A | 27M017E | 56S117C | 25 | 40A → AWG8 | 40 | 40 | 4.7Ω/50W | 10Ω/1000W |

## RATING FOR SYSTEM CONFIGURATIONS 400 VAC

*Table 26*

| Motor / Drive combination | Rated torque Nm | Peak torque at rated speed Nm | Max. peak torque (at 150 rpm) Nm | Rated speed rpm | Rated power kW | Peak power at rated speed kW | Dynamic brake max. energy one pulse kJ | Dynamic brake cont. power W | Rotor inertia kgm$^2$ x $10^{-3}$ |
|---|---|---|---|---|---|---|---|---|---|
| EP075112-44T3B / DMC$^2$ 50412P | 1.7 | 5.5 | 8.5 | 3000 | 0.53 | 1.7 | 6.5 | 40 | 0.13 |
| EP115052-66T3B / DMC$^2$ 50412P | 2.1 | 5.5 | 9 | 3000 | 0.66 | 1.7 | 6.5 | 40 | 0.29 |
| EP115105-66T3B / DMC$^2$ 50720P | 3.8 | 13.5 | 15 | 3000 | 1.3 | 4.2 | 6.5 | 40 | 0.47 |
| EP165090-66T3B / DMC$^2$ 51540P | 9 | 25 | 26 | 3000 | 2.8 | 7.8 | 7.8 | 80 | 1.67 |
| EP165180-66T3B / DMC$^2$ 53080 | 16 | 59 | 65 | 3000 | 5 | 18.5 | 10.4 | 150 | 3.01 |

System configuration DMC2

# DMC$^2$ Connections

## GENERAL

This section provides details for connecting the DMC$^2$ to motor connections, power, dynamic brake, thermistor /brake, DC Bus, I/O, Daisy chain, LAN 2 and integral resolver.

| | |
|---|---|
| **STOP** | **The motor cable connector nomenclature and location is different for the various DMC$^2$ models.** |

| | WARNING |
|---|---|
| | ◆ **Failure in properly ground this equipment could result is serious or fatal injury to personnel who come into contact with the equipment. All earth grounds must be installed per the instructions in this chapter, and the equipment must be securely connected to a quality earth ground before power is applied for the first time. In addition, the panel or enclosure housing the equipment must be securely earth grounded.** |
| | ◆ **Local regulations may require additional grounding measures beyond those shown in this chapter.** |
| | ◆ **Failure to properly ground the equipment may result in damage to the equipment or damage to other devices connected to the equipment.** |

| | WARNING |
|---|---|
| | ◆ **This equipment uses high voltages, which can cause serious or fatal electrical shock.** |
| | ◆ **Can cause serious or fatal injury.** |
| | ◆ **Only qualified personnel should perform installation and wiring.** |

# X CONNECTOR'S

| Connector | Function | Interface | page |
|---|---|---|---|
| X1 | Input power | | 51 |
| X2 | + 24 V External DC | | 52 |
| X4 | Host | RS 232, RS 422, LAN 1, X5 | 52 |
| X5 | Next | RS 232, RS 422, LAN 1, X4 | 53 |
| X6A | Resolver Feedback | | 54 |
| X6B | Optional Position Sensor | Available only for DMC2 CAN | 56 |
| X7A | I/O | | 57 |
| X7B | I/O | | 57 |
| X8A | Measure connection | Available only for DMC2 CAN | 61 |
| X9 | LAN 2 | Available only for DMC2 CAN | 62 |
| X10 | DC Bus | X10P, X32, X33 | 62 |
| X11 | Motor | | 62 |
| X13 | Dynamic brake | X34 | 63 |
| X14 | Thermistor/brake | X35 | 63 |
| X20 | DC Bus | X20P, X32, X33 | 64 |
| X21 | Motor | | 64 |
| X22 | Dynamic brake | X34 | 65 |
| X23 | Thermistor/brake | X35 | 65 |
| X31 | Input power | | 66 |
| X32 | DC Bus | X10, X20 | 66 |
| X33 | DC Bus | X10, X20 | 66 |
| X34 | Dynamic brake | X13, X22 | 67 |
| X35 | Thermistor/brake Temperature switch | X14, X23 | 67 |

# DSUB CONNECTOR'S

| Connector | D-Sub miniature in Metal housing | Pin | Male | Female |
|---|---|---|---|---|
| X4 and X5 | High Density, VGA | 15 | | X |
| X6A | Standard | 15 | | X |
| X6B | Standard | 25 | | X |
| X8A | Standard | 9 | X | |
| X9 | Standard | 9 | X | |

# DMC² FRONT

S1  ID Switch
S2  ID Switch

1   NC
2   CiA CAN_L
3   CiA GND
4   NC
5   NC
6   GND
7   CiA CAN_H
8   NC
9   CiA V +7 - 26.5 V

**DMC²**

S2
S1

POWER ON
CPU OK
1
2
3
4
5
6
7
8

9  5
6  1

X9

LAN2

Power On  + 5 V on in controller section
CPU OK    CPU started up and running
LED 1  Software Defined
LED 2  Software Defined
LED 3  Software Defined
LED 4  Software Defined
LED 5  Software Defined
LED 6  Software Defined
LED 7  Software Defined
LED 8  Software Defined

1    Shield
2    RX
3    TX
4    Sync +
5    Sync -
6    NC
7    GND
8    + 15 V
9    Daisy Chain,  TX
10   Daisy Chain,  TX, Inv
11   Daisy Chain,  RX
12   Daisy Chain,  RX, Inv
13   LAN 1
14   LAN 1
15   - 15 VDC

X5      X4

NEXT  HOST

A203

1    Shield
2    RX
3    TX
4    Sync +
5    Sync -
6    NC
7    GND
8    + 15 V
9    Daisy Chain,  RX
10   Daisy Chain,  RX, Inv
11   Daisy Chain,  TX
12   Daisy Chain,  TX, Inv
13   LAN 1
14   LAN 1
15   - 15 VDC

15   5
     9
11   1
     6

*Figure 16. DMC² Front and Connections.*

DMC2 I/O Connections

# DMC$^2$ I/O CONNECTIONS

| 1 | Analog Input 2 + |
|---|---|
| 2 | Analog Input 2  - |
| 3 | Analog Input 1 + |
| 4 | Analog Input 1 - |
| 5 | Digital Ground |
| 6 | Digital Input Enable |
| 7 | Digital Input Di 10 |
| 8 | Digital Input Di  9 |
| 9 | Digital Input Di  8 |
| 10 | Digital Input Di  7 |
| 11 | Digital Input Di  6 |
| 12 | Digital Input Di  5 |
| 13 | Digital Input Di  4 |
| 14 | Digital Input Di  3 |
| 15 | Digital Input Di  2 |
| 16 | Digital Input Di  1 |

| 21 | Analog Ground |
|---|---|
| 22 | Analog Output 1 |
| 23 | Analog IOutput 2 |
| 24 | 0 V |
| 25 | + 24 V Input |
| 26 | + 24 V Output |
| 27 | + 15 V Output |
| 28 | - 15 V Output |
| 29 | Digital OutputDi  8 |
| 30 | Digital OutputDi  7 |
| 31 | Digital OutputDi  6 |
| 32 | Digital OutputDi  5 |
| 33 | Digital OutputDi  4 |
| 34 | Digital OutputDi  3 |
| 35 | Ready Relay Number |
| 36 | Ready Relay Number |

X7A   X7B

| 1 | Ground |
|---|---|
| 2 | |
| 3 | |
| 4 | Transducer Input + |
| 5 | Transducer Input - |
| 6 | Ground |
| 7 | - 5 V Supply |
| 8 | |
| 9 | + 5 V Supply |

X2

| 1 | 0 V Supply |
|---|---|
| 2 | + 24 V Supply |

X8A

X6B

X6A

| 1 | Shield |
|---|---|
| 2 | Rd1 Sin - |
| 3 | Rd 1 Sin + |
| 4 | Rd 1 Cos + |
| 5 | Rd 1 Cos - |
| 6 | + 15 V |
| 7 | Exitation 0 |
| 8 | - 15 V |
| 9 | Exitation Supply |
| 10 | Rd2 Sin - |
| 11 | Rd 2 Sin + |
| 12 | Rd 2 Cos + |
| 13 | Rd 2 Cos - |
| 14 | PTC Supply |
| 15 | PTC Ground |

| 1 | Endat Clock + |
|---|---|
| 2 | Endat Data + |
| 3 | Endat 0 V |
| 4 | +12 V |
| 5 | NC |
| 6 | Enc Cos - |
| 7 | Enc Sin - |
| 8 | Enc Ref - |
| 9 | Rd1 Cos- |
| 10 | Rd1 Sin - |
| 11 | Exitation Supply |
| 12 | NC |
| 13 | NC |
| 14 | Endat Clock - |
| 15 | Endat Data - |
| 16 | Endat Sense 0 V |
| 17 | Endat Sense 5 V |
| 18 | Endat 5 V Supply |
| 19 | Enc Cos + |
| 20 | Enc Sin+ |
| 21 | Enc Ref + |
| 22 | Rd1 Cos + |
| 23 | Rd1 Sin + |
| 24 | Exitation Ground |
| 25 | + 24 V |

A202

*Figure 17. I/O Connections for all DMC$^2$ units, bottom view.*

# DMC$^2$ 50412/P, DMC$^2$ 50720/P



3  NC
2  Output Dynamic brake regulator, - DC
1  Output Dynamic brake regulator, driver

3  - DC Bus Voltage
2  + DC Bus Voltage
1  PE

5  Motor Phase W
4  Motor Phase V
3  Motor Phase U
2  PE
1  Shield

5  Thermistor in
4  Thermistor out
3  NC
   Connection point for motor brake
2  Motor brake
1  Motor brake

Power

1  PE
2  L1
3  L2
4  L3

*Figure 18. DMC$^2$ unit connectors on the topside, Motor, Power, Thermistor, DC Bus for 50412/P and 50720/P.*

DMC2 51540/P, DMC2 53080

# DMC² 51540/P, DMC² 53080
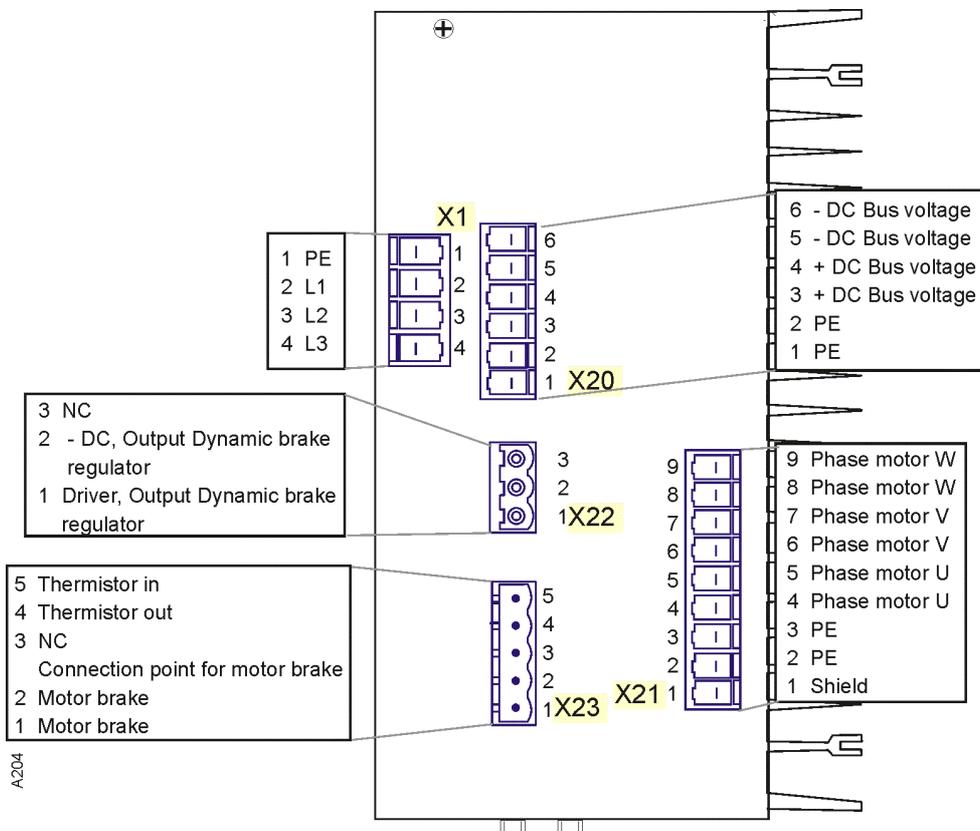


*Figure 19. DMC² unit connectors on the topside, Motor, Power, Thermistor, DC Bus for 51540/P and 53080.*

# POWER SUPPLY 580160
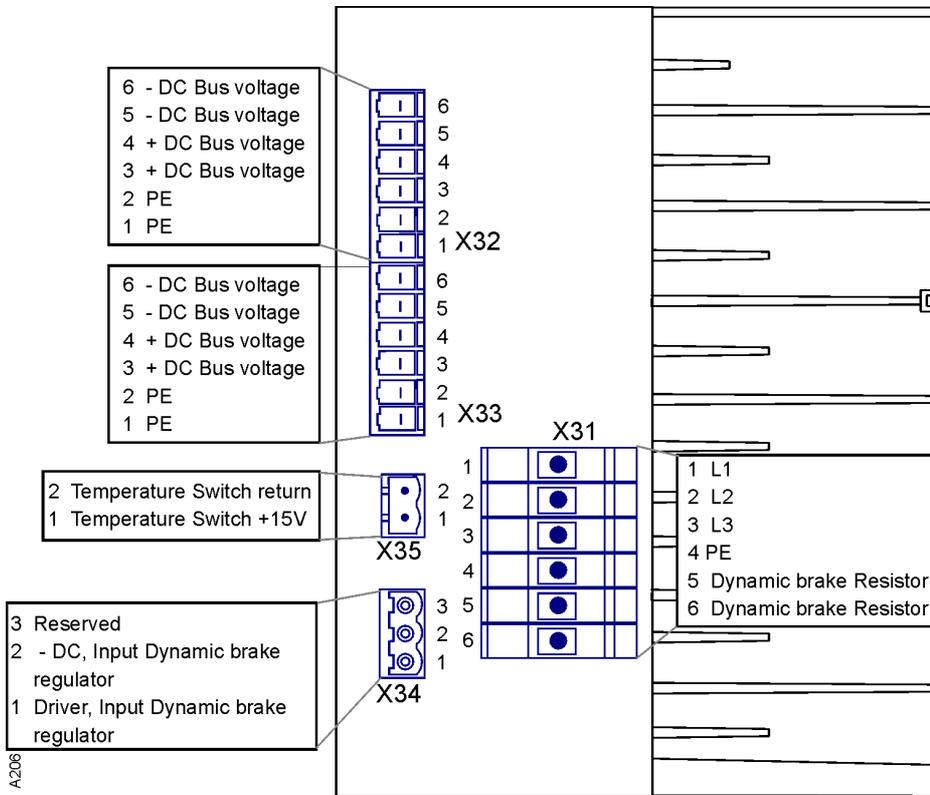


*Figure 20. PS 580160 unit connectors on top side, Power, Dynamic brake and Thermistor.*

# X1

| DMC$^2$ P | 50412 | 50720 | 51540 | |
|---|---|---|---|---|
| DMC$^2$ | 50412 | 50720 | 51540 | 53080 |
| Connector | See page | | | |

Input power is connected to X1 Figure 18 or Figure 19 on top of the DMC$^2$ unit as shown in Figure 29 for a Single and Figure 30 for a Master/Follower application.

Connect DMC$^2$5xxxxP models to 400 VAC mains.

| DMC$^2$ X1 | Function |
|---|---|
| 1 | PE |
| 2 | Phase L1 |
| 3 | Phase L2 |
| 4 | Phase L3 |

*Table 27. Connection Mains to DMC$^2$.*

X2

# X2

| DMC$^2$ P | 50412 | 50720 | 51540 | |
| DMC$^2$ | 50412 | 50720 | 51540 | 53080 |
| Connector | See page | 35 | | |

Connections for 24V-logic **external** supply voltage. When connected, it supplies the internal control circuit, feedback sensors, communication and I/O ports.

The 24V logic supply shall always be connected before the main supply voltage is connected to the input power port. External fuse shall be used rated max 1.5A T (slow).

| DMC$^2$ X2 | Function | Remark |
| --- | --- | --- |
| 1 | 0 V Supply | Internal connected to X7A,pin 5 |
| 2 | + 24 V Supply, +20%: -20%, maximum supply current 0.7A (not including load on digital outputs) | Internal connected to X7B, pin 25 |

*Table 28. External +24 V Connection to DMC$^2$.*

# X4 (HOST)

| DMC$^2$ P | 50412 | 50720 | 51540 | |
| DMC$^2$ | 50412 | 50720 | 51540 | 53080 |
| Connector | See page | 46 | | |

X4 is used for connections between external PC and other DMC$^2$ units.

> **i** **The maximum length for this cable is 15 m.**

| DMC$^2$ X4 (Host) | Function |
| --- | --- |
| 1 | Shield |
| 2 | RX |
| 3 | TX |
| 4 | Sync+ |
| 5 | Sync- |
| 6 | NC |
| 7 | GND |
| 8 | +15 V |
| 9 | Daisy Chain, RX |
| 10 | Daisy Chain, RX inv |
| 11 | Daisy Chain, TX |
| 12 | Daisy Chain, TX inv |
| 13 | LAN 1 |
| 14 | LAN 1 |
| 15 | -15 VDC |

# X5 (NEXT)

| DMC$^2$ P | 50412 | 50720 | 51540 | |
|-----------|-------|-------|-------|-------|
| DMC$^2$ | 50412 | 50720 | 51540 | 53080 |
| Connector | See page | 46 | | |

X5 is used for communication between two or more DMC$^2$ and for LAN1 communication.

| DMC$^2$ X5 (Next) | Function |
|-------------------|----------|
| 1 | Shield |
| 2 | RX |
| 3 | TX |
| 4 | Sync+ |
| 5 | Sync- |
| 6 | NC |
| 7 | GND |
| 8 | +15 V |
| 9 | Daisy Chain, TX |
| 10 | Daisy Chain, TX inv |
| 11 | Daisy Chain, RX |
| 12 | Daisy Chain, RX inv |
| 13 | LAN 1 |
| 14 | LAN 1 |
| 15 | -15 VDC |

# X4 AND X5 CONNECTION

## RS 232 INTERFACE

The RS-232 interface is used when connecting a PC to the DMC$^2$. Connect the serial communication cable from the computer to X4 (Figure 16.).

| DMC$^2$ X4 | Function | PC 9 Pin | PC 25 Pin |
|------------|----------|----------|-----------|
| 1 | Shield | | |
| 2 | RX | 3 | 2 |
| 3 | TX | 2 | 3 |
| 7 | GND | 5 | 7 |

*Table 29. Host (X4) Connection to RS 232 Interface.*

## COMMUNICATION BETWEEN DMC$^2$

Connect the Daisy Chain cable from X5 (Figure 16.) on the first DMC$^2$ unit to X4 on the second DMC$^2$ unit (Table 30.).

X6A

| DMC$^2$ X4 | Function | DMC$^2$ X5 |
|---|---|---|
| 1 | Shield | 1 |
| 4 | Sync + | 4 |
| 5 | Sync - | 5 |
| 7 | GND | 7 |
| 9 | Daisy chain Rx ↔ Tx | 9 |
| 10 | Daisy chain Rx Inv ↔ Tx Inv | 10 |
| 11 | Daisy chain Tx ↔ Rx | 11 |
| 12 | Daisy chain Tx Inv ↔ Rx Inv | 12 |
| 13 | LAN 1 High | 13 |
| 14 | LAN 1 Low | 14 |

*Table 30. Next (X5) Connection to Host (X4) on DMC$^2$.*

# LAN 1 COMMUNICATION

Connect the Daisy Chain cable from X5 on the first DMC$^2$ unit to X4 on the second DMC$^2$ unit (Figure 16.). Use the CAN termination 9032 0103 14 at the first DMC$^2$ in the application and a CAN termination with possibility to measure data 9032 0103 15 at the last DMC$^2$ in the application.
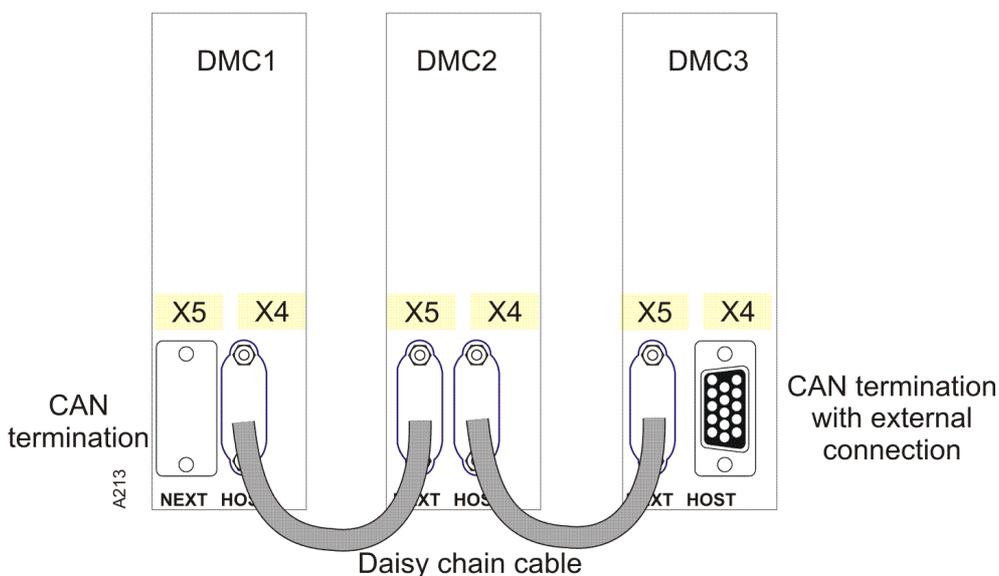


*Figure 21. Typicaly LAN connection.*

# X6A

| DMC$^2$ P | 50412 | 50720 | 51540 | |
|---|---|---|---|---|
| DMC$^2$ | 50412 | 50720 | 51540 | 53080 |
| Connector | See page | 46 | | |

This connector is used for resolver and external resolver connection. For location see Figure 17.

## RESOLVER AND EXTERNAL RESOLVER CONNECTION

### RESOLVER CONNECTION FROM MOTOR

On the DMC$^2$ end, connect the resolver cable to X6A.Use our connection set 19N117K. The connection on motor side is depending on the manufacturer of motor. It's therefore important to check the motor wiring diagram.

### EXTERNAL RESOLVER

For input from an external resolver is Rd2 used and is connected to X6A on the DMC$^2$. See Table 31.

| DMC$^2$ X6A | Function | Rd1 | Rd2 |
|---|---|---|---|
| 1 | Shield | X | |
| 2 | Rd1 Sin - | X | |
| 3 | Rd1 Sin + | X | |
| 4 | Rd1 Cos + | X | |
| 5 | Rd1 Cos - | X | |
| 6 | +15 V | | |
| 7 | Ground | X | X |
| 8 | -15 V | | |
| 9 | Excitation | X | X |
| 10 | Rd2 Sin - | | X |
| 11 | Rd2 Sin + | | X |
| 12 | Rd2 Cos + | | X |
| 13 | Rd2 Cos - | | X |
| 14 | PTC Supply | | |
| 15 | PTC Return | | |

*Table 31. External Resolver Connection.*

## SYNCBOX

At applications with more than one resolver is a syncbox necessary to use. Use a Syncbox cable to connect the DMC$^2$ with the Syncbox at X6A.

X6B

# X6B

| DMC[2] P-CAM | 50412 | 50720 | 51540 | |
| DMC[2-]CAM | 50412 | 50720 | 51540 | 53080 |
| Connector | See page | 46 | | |

This connector could be used for the following sensors:

| Sensor | Description |
|--------|-------------|
| S1 | Multiturn-Resolver with ENDAT serial interface. |
| S2 | SinCos Encoder and Absolute SinCos Encoders with ENDAT serial interface. |
| S3 | Incremental Encoder with index pulse, TTL interface and 5V supply. |
| S4 | Pulse input, max input frequency 30 kHz. |

| DMC[2] X6B | S1 | S2 | S3 | S4 | Function | Remark |
|-----|----|----|----|----|----------|--------|
| 1 | X | X | | | Endat Clock+ | ENDAT, RS485 |
| 2 | X | X | | | Endat Data+ | ENDAT, RS485 |
| 3 | X | X | X | | Endat 0 V | 0 V supply; ENDAT or Encoder |
| 4 | | | | | +12 V | (+12 V Supply, 150 mA, not standard opt.). |
| 5 | | | | | NC | |
| 6 | | X | X | | Enc Cos- | ENDAT 1 Vpp or Encoder 5V TTL,120 ohm. |
| 7 | | X | X | | Enc Sin- | ENDAT 1 Vpp or Encoder 5V TTL,120 ohm. |
| 8 | | X | X | X | Enc Ref- | ENDAT 1 Vpp or Encoder 5V TTL,120 ohm. |
| 9 | X | | | | Rd1 Cos- | Internal connected to X6A:5 |
| 10 | X | | | | Rd1 Sin- | Internal connected to X6A:2 |
| 11 | X | | | | Excitation Supply | Internal connected to X6A:9 |
| 12 | | | | | NC | |
| 13 | | | | | NC | |
| 14 | X | X | | | Endat Clock- | ENDAT, RS485 |
| 15 | X | X | | | Endat Data- | ENDAT, RS485 |
| 16 | X | X | | | Endat Sence 0 V | ENDAT, Voltage drop detection |
| 17 | X | X | | | Endat Sence 5 V | ENDAT, Voltage drop detection |
| 18 | X | X | X | | Endat 5 V Supply | ENDAT, Max 300mA |
| 19 | | X | X | | Enc Cos+ | ENDAT 1 Vpp or Encoder 5V TTL,120 ohm. |
| 20 | | X | X | | Enc Sin+ | ENDAT 1 Vpp or Encoder 5V TTL,120 ohm. |
| 21 | | X | X | X | Enc Ref+ | ENDAT 1 Vpp or Encoder 5V TTL,120 ohm. |
| 22 | X | | | | Rd1 Cos+ | Internal connected to X6A:4 |
| 23 | X | | | | Rd1 Sin+ | Internal connected to X6A:3 |
| 24 | X | | | | Excitation Ground | Internal connected to X6A:7 |
| 25 | | | | | +24 V | (+24 V Supply, 150 mA, not standard opt.). |

*Table 32. Connection on X6B. X indicates used pin.*

# X7A/B

| DMC² P | 50412 | 50720 | 51540 | |
|---|---|---|---|---|
| DMC² | 50412 | 50720 | 51540 | 53080 |
| Connector | See page | 35 | | |

All user connections to the DMC² I/O are made at X7A and X7B and Figure 17. illustrates the location.

## PINOUTS USER I/O

All user inputs and outputs are brought out to connectors X7A and X7B and are listed in Table 33 below.

| DMC² X7A | | DMC² X7B | |
|---|---|---|---|
| | Function | | Function |
| 1 | Analog input 2+ | 21 | Analog GND |
| 2 | Analog input 2- | 22 | Analog output 1 |
| 3 | Analog input 1+ | 23 | Analog output 2 |
| 4 | Analog Input 1- | 24 | Digital GND |
| 5 | GND | 25 | Input for +24 VDC external supply Parallel with X2:2 |
| 6 | Digital input, HW enable | 26 | +24 VDC out |
| 7 | Digital input 10 | 27 | +15 VDC out |
| 8 | Digital input 9 | 28 | -15 VDC out |
| 9 | Digital input 8 | 29 | Digital output 6 |
| 10 | Digital input 7 | 30 | Digital output 5 |
| 11 | Digital input 6 | 31 | Digital output 4 |
| 12 | Digital input 5 | 32 | Digital output 3 |
| 13 | Digital input 4 | 33 | Digital output 2 |
| 14 | Digital input 3 | 34 | Digital output 1 |
| 15 | Digital input 2 | 35 | Ready relay output, N.O. |
| 16 | Digital input 1 Used as other inputs and as HSI = High Speed Input | 36 | Ready relay output, N.O. |

*Table 33. I/O Connection (X7A and X7B) at DMC².*

# I/O CONNECTION EXAMPLES

## NPN TRANSDUCER, OPEN COLLECTOR TYPE

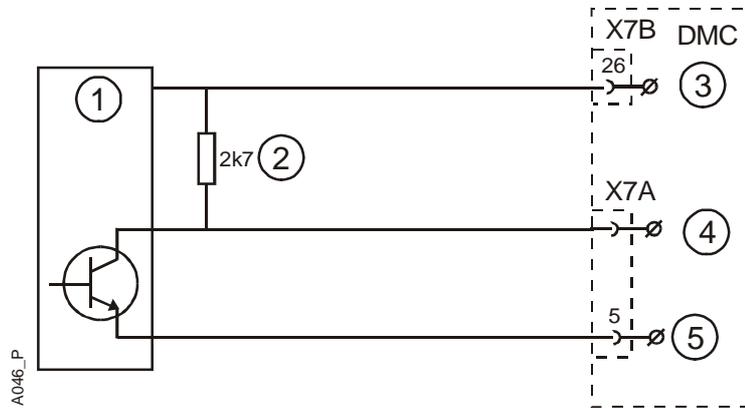Recommended min. conductor area: 0,5 mm$^2$ (AWG20).



*Figure 22. NPN open collector transistor interface to Digital input.*

1. NPN Transducer.      2. Pull up resistor.     3. 24V DC.
4. Digital input.     5. GND.

## PNP TRANSDUCER

Recommended min. conductor area: 0,5 mm$^2$ (AWG20).
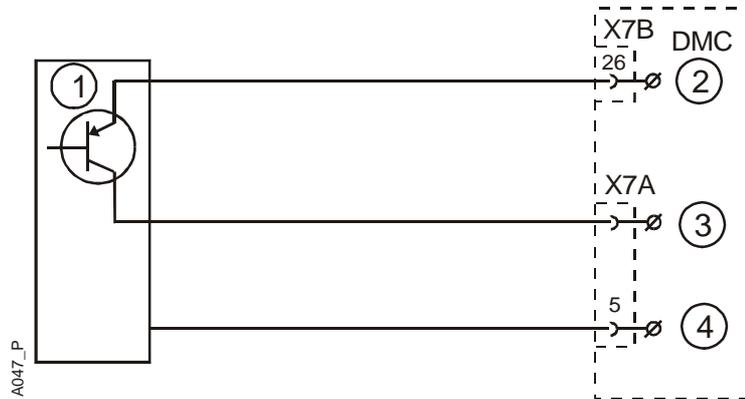


*Figure 23. PNP transistor interface to digital input.*

1. PNP Transducer.     2. 24V DC.     3. Digital Input.
4. GND.

## HIGH SPEED INPUT (DIGITAL INPUT1)

High speed: <1 micro second pulse.
Use shielded twisted pair cable.
Recommended min. conductor area: 0,5 mm$^2$ (AWG20).



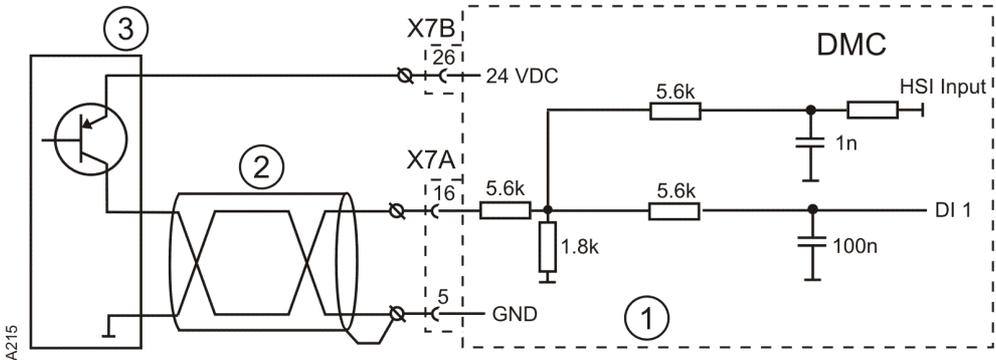*Figure 24. High speed input interface to digital input 1.*

1. Digital input.           2. Shield.           3. Puls generator.

## UNIPOLAR ANALOG INPUT
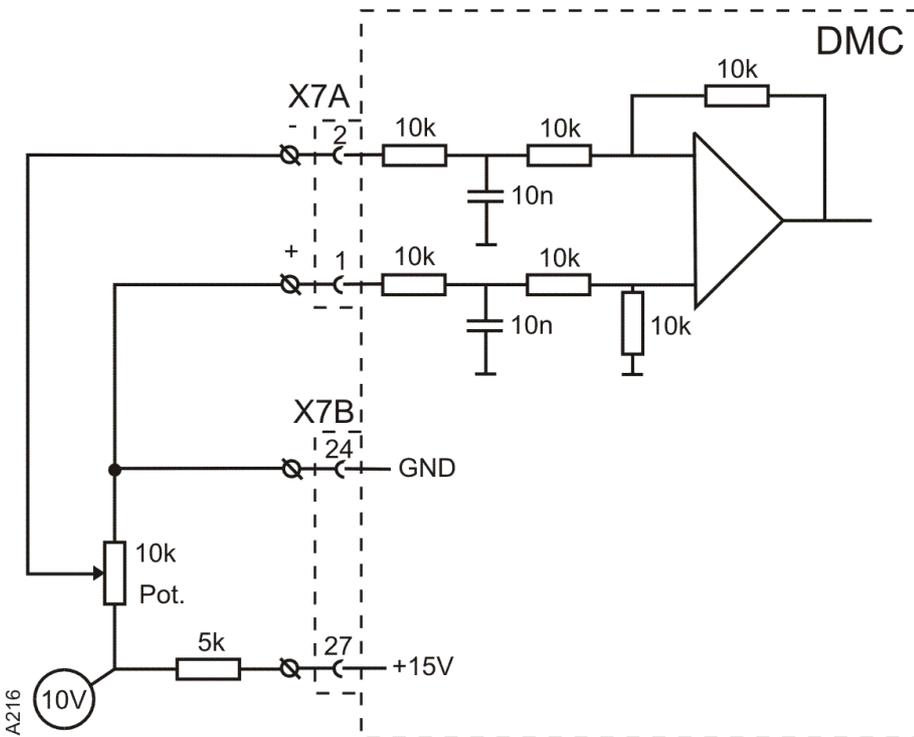
Recommended min. conductor area: 0,5 mm$^2$ (AWG20).



*Figure 25. Unipolar analog input.*

X7A/B

### BIPOLAR ANALOG INPUT

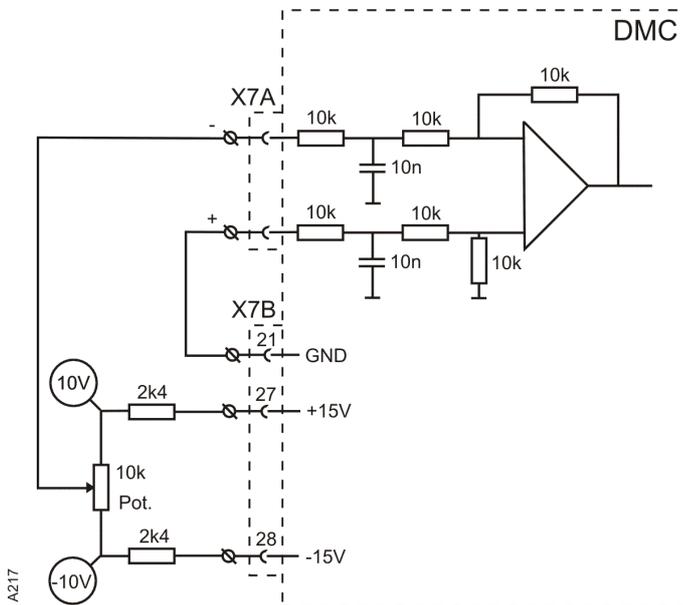Recommended min. conductor area: 0,5 mm$^2$ (AWG20).



*Figure 26. Bipolar analog input.*

### STANDARD DMC$^2$ OUTPUT

Recommended min. conductor area: 0,5 mm$^2$ (AWG20).
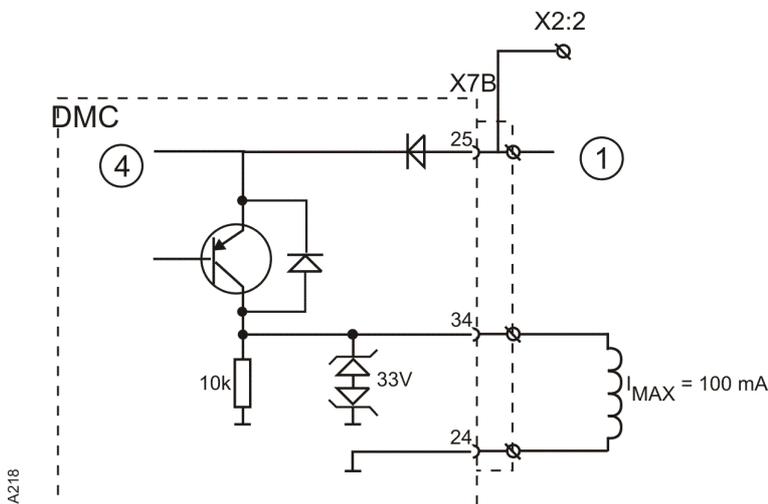


*Figure 27. Standard DMC digital output.*

1. User supplied power 24VDC for higher current output.
2. Output current $I_{MAX}$ = 100mA.                           3. To other outputs.
4. Internal +24 VDC.

## ANALOG OUTPUTS

Recommended min. conductor area: 0,5 mm$^2$ (AWG20).
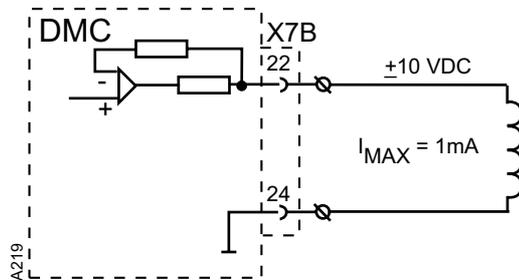


*Figure 28. Analog output.*

# X8A

| | | | | |
|---|---|---|---|---|
| DMC$^2$ P-CAN | 50412 | 50720 | 51540 | |
| DMC$^2$-CAN | 50412 | 50720 | 51540 | 53080 |
| Connector | See page | 46 | | |

For location, see Figure 17.

| DMC$^2$ X8A | Function | Comment |
|---|---|---|
| 1 | GND | |
| 2 | NC | |
| 3 | NC | |
| 4 | Measure bridge Input + | Measure bridge input ±50mV |
| 5 | Measure bridge Input - | Measure bridge input ±50mV |
| 6 | GND | |
| 7 | -5V Supply Output | Supply to measure bridge. Max 10mA. |
| 8 | NC | |
| 9 | +5V Supply Output | Supply to measure bridge. Max 10mA. |

*Table 34. Measure Connection (X8).*

# X9A

| DMC² P | 50412 | 50720 | 51540 | |
|---|---|---|---|---|
| DMC² | 50412 | 50720 | 51540 | 53080 |
| Connector | See page | 46 | | |

The CAN Bus is used for an external network. For location, see Figure 17

| DMC² X9A | Function | Comment |
|---|---|---|
| 1 | NC | |
| 2 | CiA CAN_L | |
| 3 | CiA GND | |
| 4 | NC | |
| 5 | NC | Shield |
| 6 | GND | Ground |
| 7 | CiA CAN_H | |
| 8 | NC | |
| 9 | CiA V+ 7-26.5 V | Supply |

*Table 35. LAN2 (X9) Connection.*

# X10

| DMC² P | 50412 | 50720 |
|---|---|---|
| DMC² | 50412 | 50720 |
| Connector | See page | 35 |

Table 36 illustrates the input power connections to a DC supplied unit from an AC (P version) supplied unit. Connect the DC bus voltage from X10 to X10. Figure 30 shows this application.

| DMC² P X10 | Function | DMC² X10 |
|---|---|---|
| 1 | PE | 1 |
| 2 | + DC bus voltage 570 VDC | 2 |
| 3 | - DC bus voltage 570 VDC | 3 |

*Table 36. DC Bus Connection.*

# X11

| DMC² P | 50412 | 50720 |
|---|---|---|
| DMC² | 50412 | 50720 |
| Connector | See page | 35 |

Figure 18 shows the connector X11. Table 37. describes the function. The motor connections are the same for AC and DC supplied DMC$^2$s.

Use the appropriate threaded strain relief with shield connection listed in Table 9 to secure the motor cable to the junction box at the motor:

The cable shield must make secure metallic contact with the strain relief.

| DMC$^2$ X11 | Function |
|---|---|
| 1 | Shield |
| 2 | PE |
| 3 | Motor U |
| 4 | Motor V |
| 5 | Motor W |

*Table 37. Motor Connection (X11) to DMC$^2$.*

# X13

| | | |
|---|---|---|
| DMC$^2$ P | 50412 | 50720 |
| DMC$^2$ | 50412 | 50720 |
| Connector | See page | 35 |

Make the following dynamic brake circuit connections (Table 38), from X13 Figure 18 on DMC$^2$ unit to X34 on PS unit. Figure 20

| DMC$^2$ X13 | Function | PS unit X34 |
|---|---|---|
| 1. | Output dynamic brake regulator, driver. | 1 |
| 2. | Output dynamic brake regulator, -DC. | 2 |
| 3. | NC. | 3 |

*Table 38. Dynamic brake (X13 and X34) Connection.*

# X14

| | | |
|---|---|---|
| DMC$^2$ P | 50412 | 50720 |
| DMC$^2$ | 50412 | 50720 |
| Connector | See page | 35 |

Make the following connections (Table 39) at the DMC$^2$ X14, (Figure 18 for placement) and the terminal block at the motor for thermistor and brake connections. See motor documentation for correct wiring.

X20

| DMC² X14 | Function |
|----------|----------|
| 1 | Motor brake, Contact NO. |
| 2 | Motor brake, Contact NO. |
| 3 | NC, used as connection point |
| 4 | Thermistor out +15 VDC |
| 5 | Thermistor return |

*Table 39. Thermisto/brake (X14) Connection to DMC².*

# X20

| DMC² P | | 51540 | |
|--------|--|-------|--|
| DMC² | | 51540 | 53080 |
| Connector | See page | 35 | |

Table 40. illustrates the input power connections to a DC supplied unit from an AC (P version) supplied unit. Connect the DC bus voltage from X20 (P) (Figure 19 for placement) to X20. Figure 32 show how X20 is connected.

| DMC² P  X20 | Function | DMC² X20 | DMC² X20 |
|-------------|----------|----------|----------|
| 1 | PE | 1 | 1 |
| 2 | PE | 2 | 2 |
| 3 | + DC bus voltage 570 VDC | 3 | |
| 4 | + DC bus voltage 570 VDC | | 4 |
| 5 | - DC bus voltage 570 VDC | 5 | |
| 6 | - DC bus voltage 570 VDC | | 6 |

*Table 40. DC Bus Connection (X20) between AC and DC.*

# X21

| DMC² P | | 51540 | |
|--------|--|-------|--|
| DMC² | | 51540 | 53080 |
| Connector | See page | 35 | |

Figure 19. shows the connector X21. Table 41 describes the function The motor connections are the same for AC and DC supplied DMC²s.

Use the appropriate threaded strain relief with shield connection listed in Table 9 to secure the motor cable to the motor.

The cable shield must make secure metallic contact with the strain relief.

| DMC$^2$ X21 | Function |
|---|---|
| 1 | Shield |
| 2 | PE |
| 3 | PE |
| 4 | Motor U |
| 5 | Motor U |
| 6 | Motor V |
| 7 | Motor V |
| 8 | Motor W |
| 9 | Motor W |

*Table 41. Motor Connection (X21) to DMC$^2$.*

# X22

| DMC$^2$ P | 51540 | |
|---|---|---|
| DMC$^2$ | 51540 | 53080 |
| Connector | See page | 35 |

Make the following dynamic brake circuit connections (Table 42) from X22 Figure 19 on DMC$^2$ unit to X34 on PS unit

| DMC$^2$ X22 | Function | PS unit X34 |
|---|---|---|
| 1 | Output dynamic brake regulator, driver | 1 |
| 2 | Output dynamic brake regulator, -DC | 2 |
| 3 | Reserved | 3 |

*Table 42. Dynamic brake (X22 and X34) Connection.*

# X23

| DMC$^2$ P | 51540 | |
|---|---|---|
| DMC$^2$ | 51540 | 53080 |
| Connector | See page | 35 |

Make the following connections (Table 43) at the DMC$^2$, (Figure 19 for placement) X23 and the terminal block at the motor for thermistor and brake connections.

| DMC$^2$ X23 | Function |
|---|---|
| 1 | Motor brake, Contact NO |
| 2 | Motor brake, Contact NO |
| 3 | NC, used as connection point |
| 4 | Thermistor out +15 VDC |
| 5 | Thermistor return |

*Table 43. Thermistor/brake (X23) Connection to DMC$^2$.*

X31

# X31

| PS | 580160 |
|---|---|
| Connector | See page 35 |

At the power supply, make the following connections to X31 (see Figure 20 and Figure 31) Note that the model PS580160 power supply is for 400 VAC, 3 phase applications. Use a WAGO 284 (10 mm$^2$) Terminal block for interfacing to X31.

| PS X31 | Function |
|---|---|
| 1 | Phase L1, 400 VAC |
| 2 | Phase L2, 400 VAC |
| 3 | Phase L3, 400 VAC |
| 4 | PE |
| 5 | Dynamic brake resistor |
| 6 | Dynamic brake resistor |

*Table 44.Input Power at PS (X31).*

# X32 & X33

| PS | 580160 |
|---|---|
| Connector | See page 35 |

## DMC$^2$ 50412 OR DMC$^2$ 50720 DC BUS CONNECTION

The following information is applicable to DC supplied DMC$^2$s ONLY.
Make the connections listed in Table 45 below from X32 or X33 (Figure 20) on the stand-alone PS unit to X10 on the DMC$^2$ unit (see Figure 18.) Note that X32 and X33 have a maximum current ration of 20 amps per pin.

| PS unit X32 / X33 | Function | DMC$^2$ X10 | DMC$^2$ X10 |
|---|---|---|---|
| 1 | PE | 1 | |
| 2 | PE | | 1 |
| 3 | + DC bus voltage | 2 | |
| 4 | + DC bus voltage | | 2 |
| 5 | - DC bus voltage | 3 | |
| 6 | - DC bus voltage | | 3 |

*Table 45. DC Bus Connection from PS to DMC$^2$ 50412 and DMC$^2$ 50720.*

# DMC$^2$ 51540 OR DMC$^2$ 53080 DC BUS CONNECTION

Make the connections listed in Table 46 below from X32 or X33 (Figure 20) on the stand-alone PS unit to X20 on the DMC$^2$ unit (see Figure 19.).
Note that X32 and X33 have a maximum current rating of 20 amps per pin.

| PS unit X32 | Function | DMC$^2$ X20 | |
|---|---|---|---|
| (1.) | PE | 1 | |
| (2.) | PE | 2 | |
| 3. | + DC bus voltage | 3 | |
| 4. | + DC bus voltage | 4 | |
| 5. | - DC bus voltage | 5 | |
| 6. | - DC bus voltage | 6 | |
| PS unit X33 | Function | | DMC$^2$ X20 |
| (1.) | PE | | 1 |
| (2.) | PE | | 2 |
| 3. | + DC bus voltage | | 3 |
| 4. | + DC bus voltage | | 4 |
| 5. | - DC bus voltage | | 5 |
| 6. | - DC bus voltage | | 6 |

*Table 46. DC Bus Connection from PS to DMC$^2$ 51540 and DMC$^2$ 53080.*

# X34

| PS | 580160 |
|---|---|
| Connector | See page 35 |

Make the following dynamic brake circuit connections from X34 (Figure 20) on PS unit to X13 (Figure 18) or X22 (Figure 19) on DMC$^2$ unit.

| PS unit X34 | Function | DMC$^2$ X13 | DMC$^2$ X22 |
|---|---|---|---|
| 1. | Output dynamic brake regulator, driver. | 1 | 1 |
| 2. | Output dynamic brake regulator, -DC. | 2 | 2 |
| 3. | Reserved. | 3 | 3 |

*Table 47. Dynamic brake connection (X34).*

# X35

| PS | 580160 |
|---|---|
| Connector | See page 35 |

Make the following thermistor connections from X35 (Figure 20) on PS unit to X14 (Figure 18) or X23 (Figure 19) on DMC$^2$ unit.

Input wiring diagram

| PS unit X35 | Function | DMC² X14 | DMC² X23 |
|---|---|---|---|
| 1. | Temperature switch out +15 VDC. | 4 | 4 |
| 2. | Temperature switch return. | 5 | 5 |
| | NC, used as connection point. | 3 | 3 |

*Table 48. Thermistor connection (X35).*
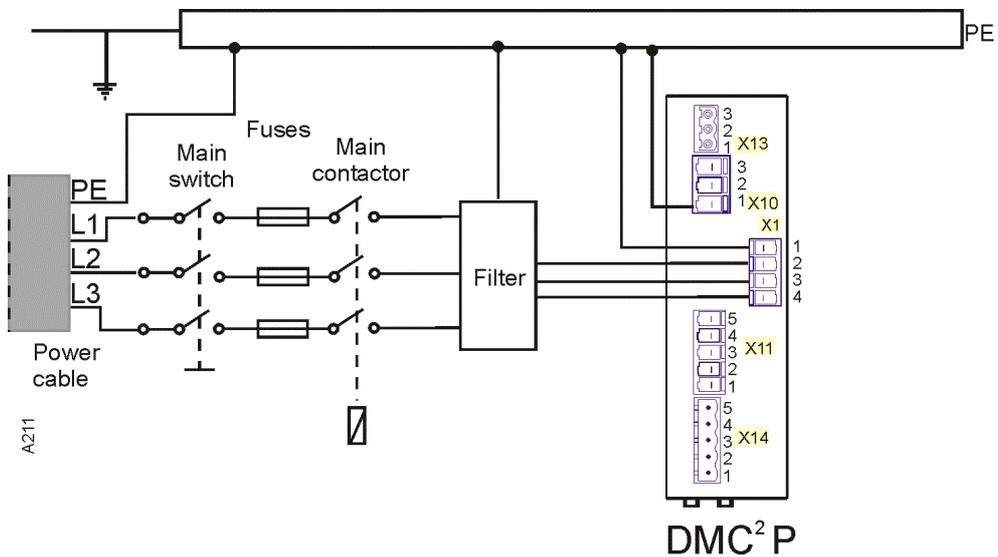
# INPUT WIRING DIAGRAM

## SINGLE INSTALLATION



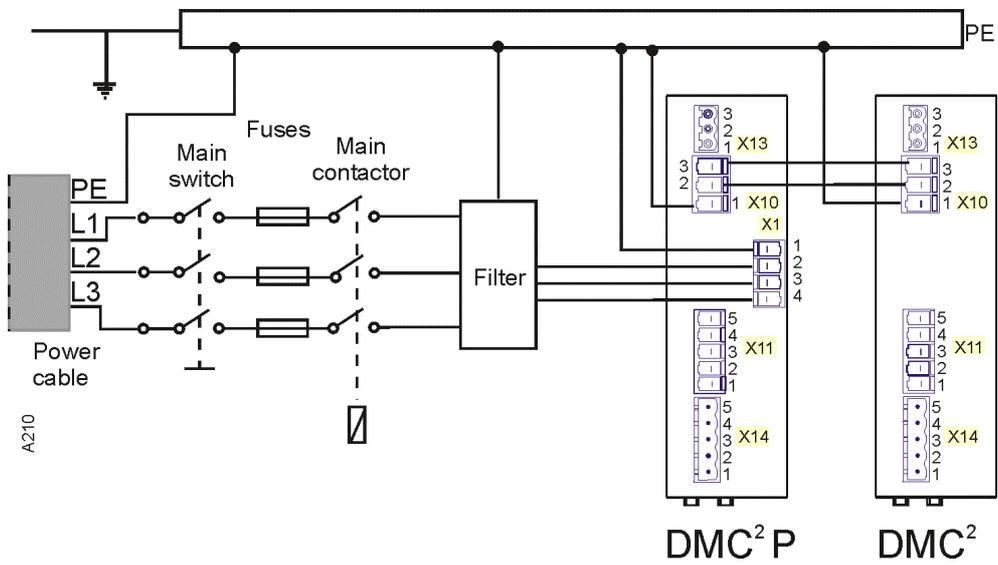*Figure 29. Input power connection to a single application.*

# DMC$^2$-P/DMC$^2$ INSTALLATION



*Figure 30. Input power connection to a Master/Follower application.*

Input wiring diagram
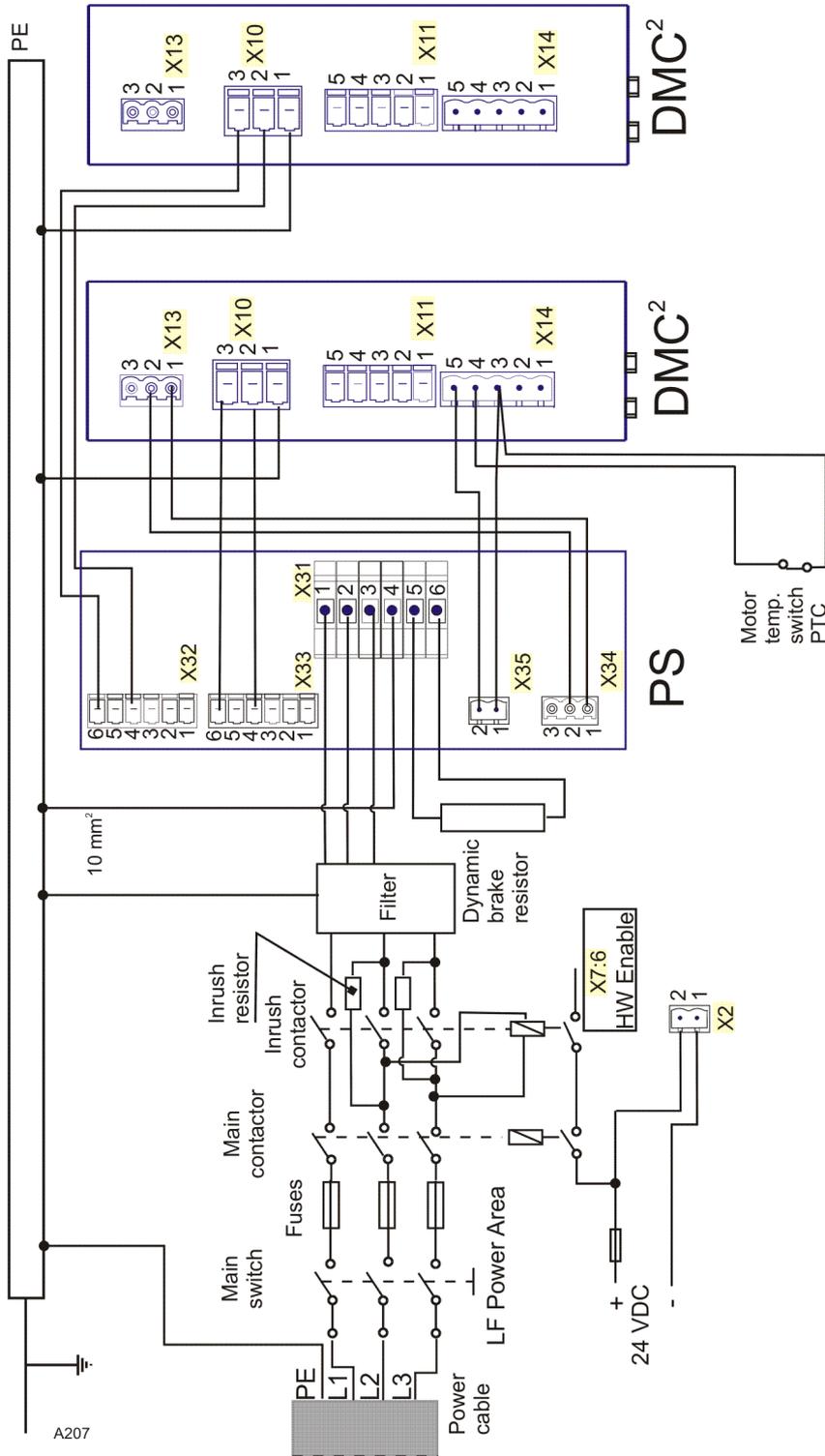
# POWER SUPPLY/DMC$^2$ 50412, 50720 INSTALLATION



*Figure 31. Input power connection to a Power Supply application.*

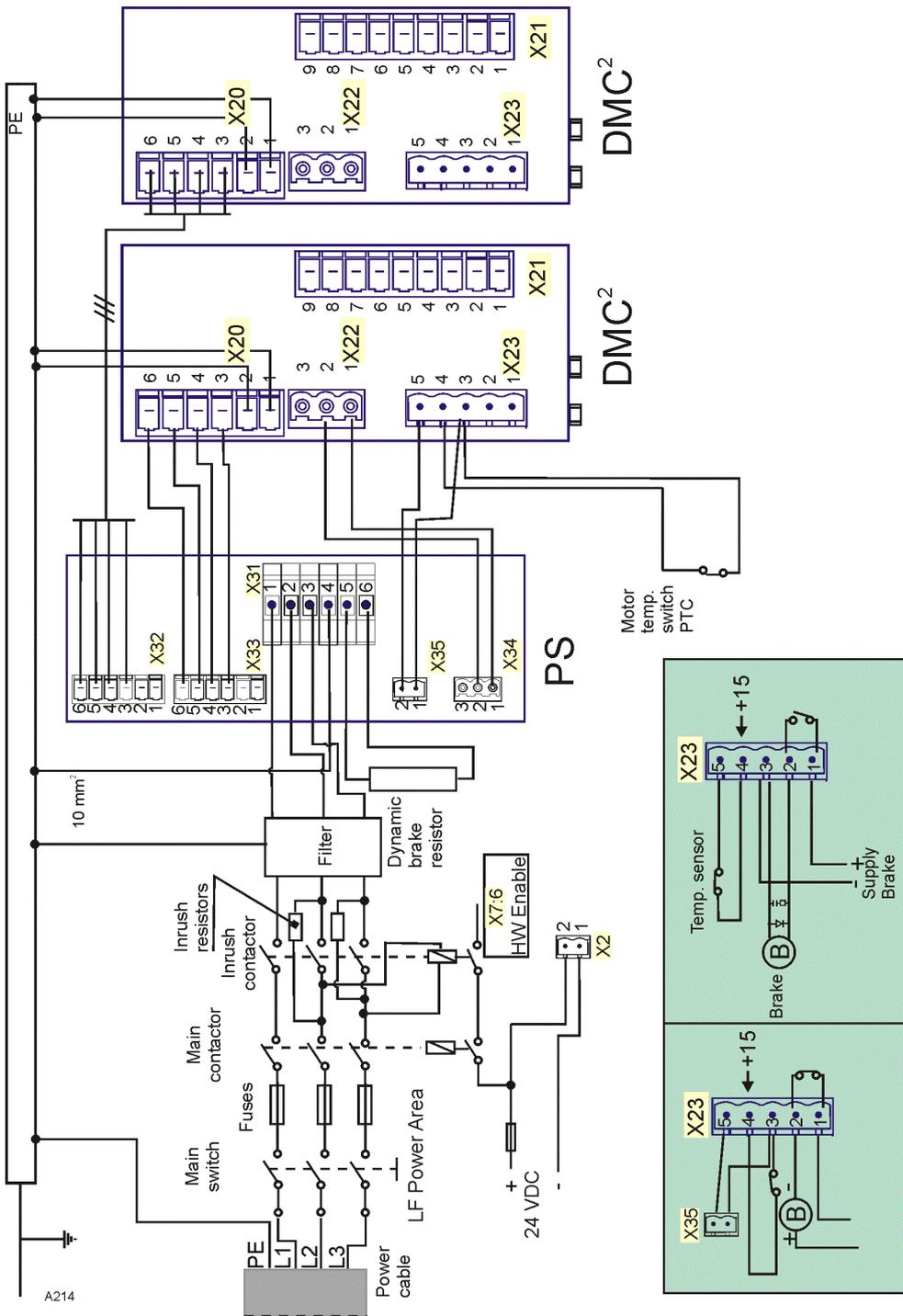## POWER SUPPLY/DMC$^2$ 51540, 53080 INSTALLATION



*Figure 32. Input power connection to a Power Supply application.*

# Installing the DMC$^2$ in a cabinet

## GENERAL

During mounting and installation of a DMC$^2$ unit in a cabinet beware of the following:

- Sufficient protective earth grounding.
- Thermal dimensioning of the cabinet and cooling of the DMC$^2$ unit.
- Placement of the DMC$^2$ unit in relation with other components in the cabinet.
- Installation performed in accordance with applicable regulations.

## SEPARATION OF CONTROL AND POWER AREAS

The cabinet should be separated into different zones with high power/high voltage components separated from low power/low voltage components where possible. Figure 33 shows an example of a typical installation in a cabinet. Note the separation of the input power section with dangerous voltages on the right and the terminal PC on the left. The DMC$^2$ units have been mounted in the upper half of the cabinet. This placement is suitable from several points of view. It prevents heat from the DMC$^2$ from heating other components in the cabinet. This arrangement also permits motor, power and ground cabling to be separated from other low level signal cabling (see Figure 34. and Figure 35.). Figure 36. illustrates the recommended general cabinet arrangement in which four different zones are created:

- HF Control area
- HF Power area
- LF Control area
- LF Power area

Between cables and components in the HF and LF zones there should be at least a 200-mm. separation. Cables from LF zones, which pass through the HF zones, shall be shielded. Cables and components in power areas shall be separated from components in control areas.
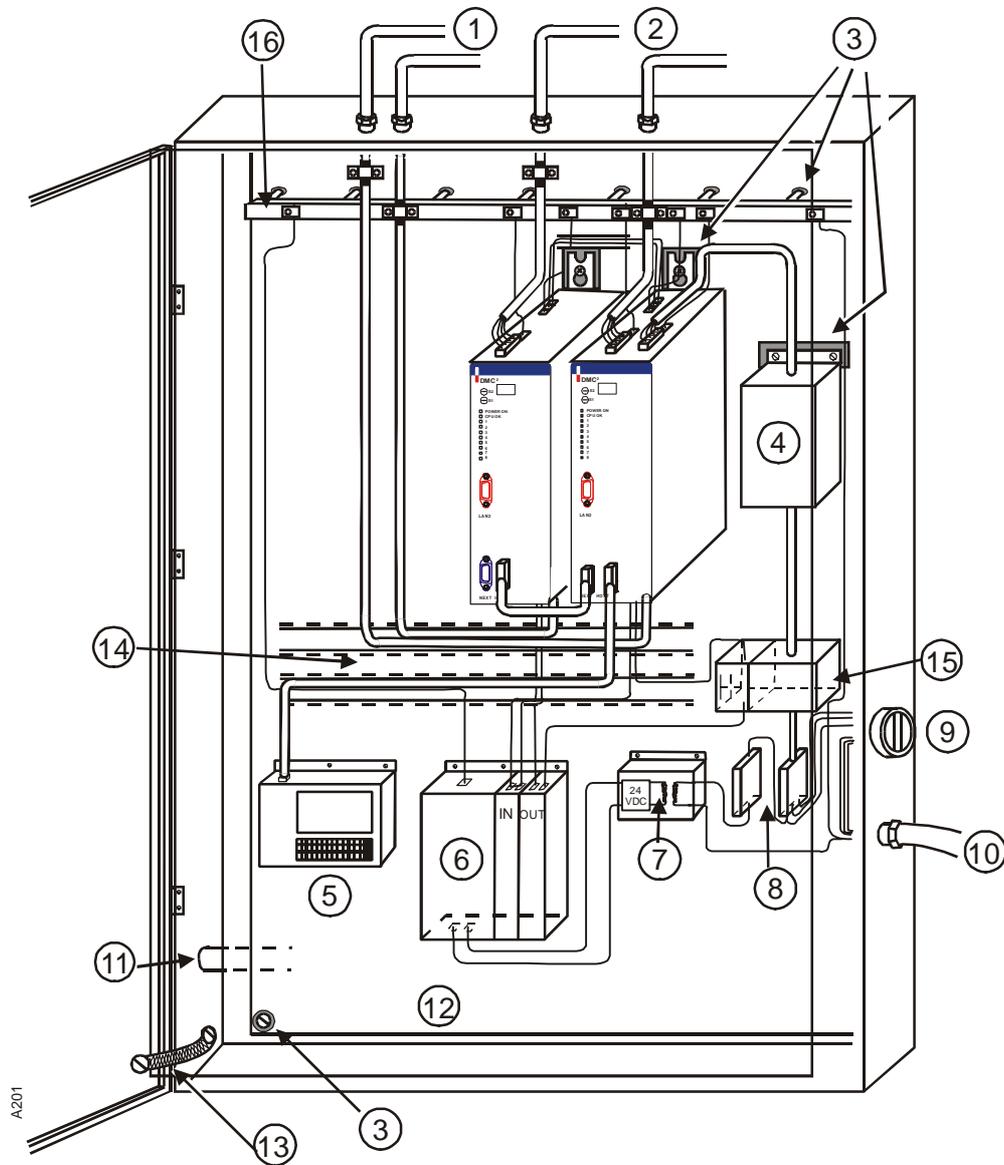
# INSTALLATION EXAMPLE



*Figure 33. Example of installation in a cabinet.*

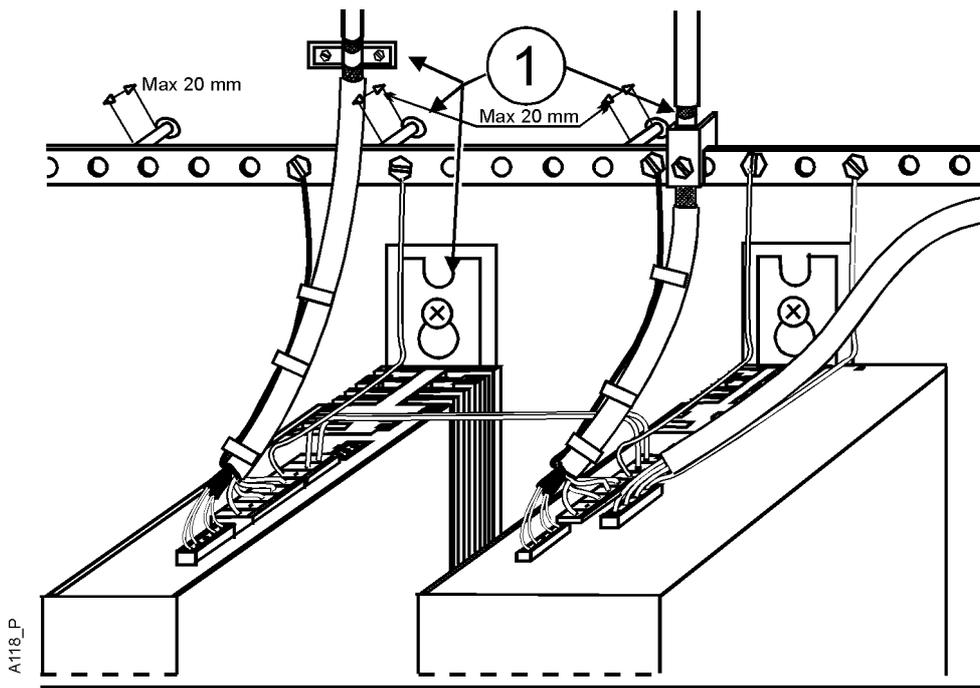| | | |
|---|---|---|
| 1. To resolver. | 2. To motor. | 3. Good electrical contact |
| 4. Filter. | 5. Terminale PC. | 6. PLC. |
| 7. Transformer. | 8. Fuses. | 9. Main switch. |
| 10. Power cable. | 11. I/O comunication. | 12. Mounting plate. |
| 13. Earth wire. | 14. Cable channel. | 15. Contactor. |
| 16. Protective earth rail. | | |

*Figure 34. Motor, power and ground connections.*
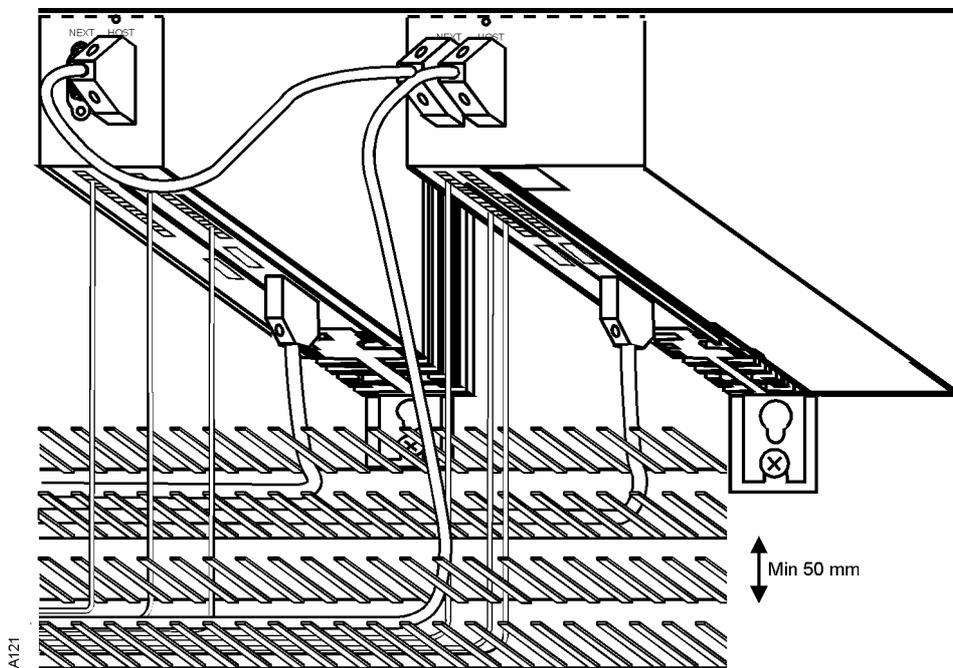
1. Good electrical contact here.



*Figure 35. I/O resolver and communications connections.*

Cabinet Space Requirements



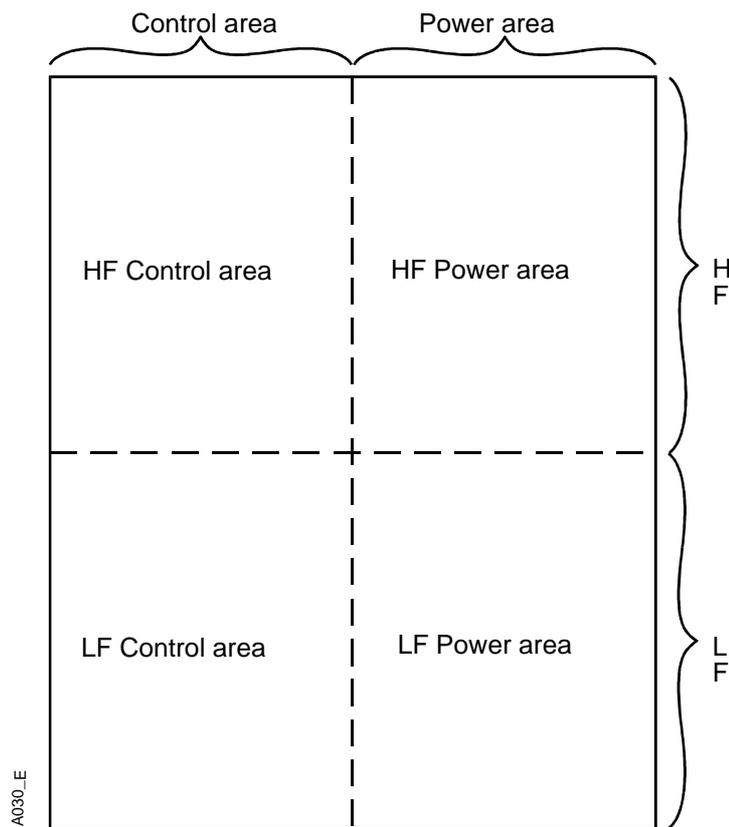*Figure 36. General cabinet layout recommendation.*

# CABINET SPACE REQUIREMENTS

## MOUNTING DIMENSIONS AND CLEARANCES

Figure 37. shows recommended minimum clearances for air flow, cable bends, etc. when mounting the DMC$^2$ unit. Mounting dimensions for various DMC$^2$ models are shown in Figure 38.
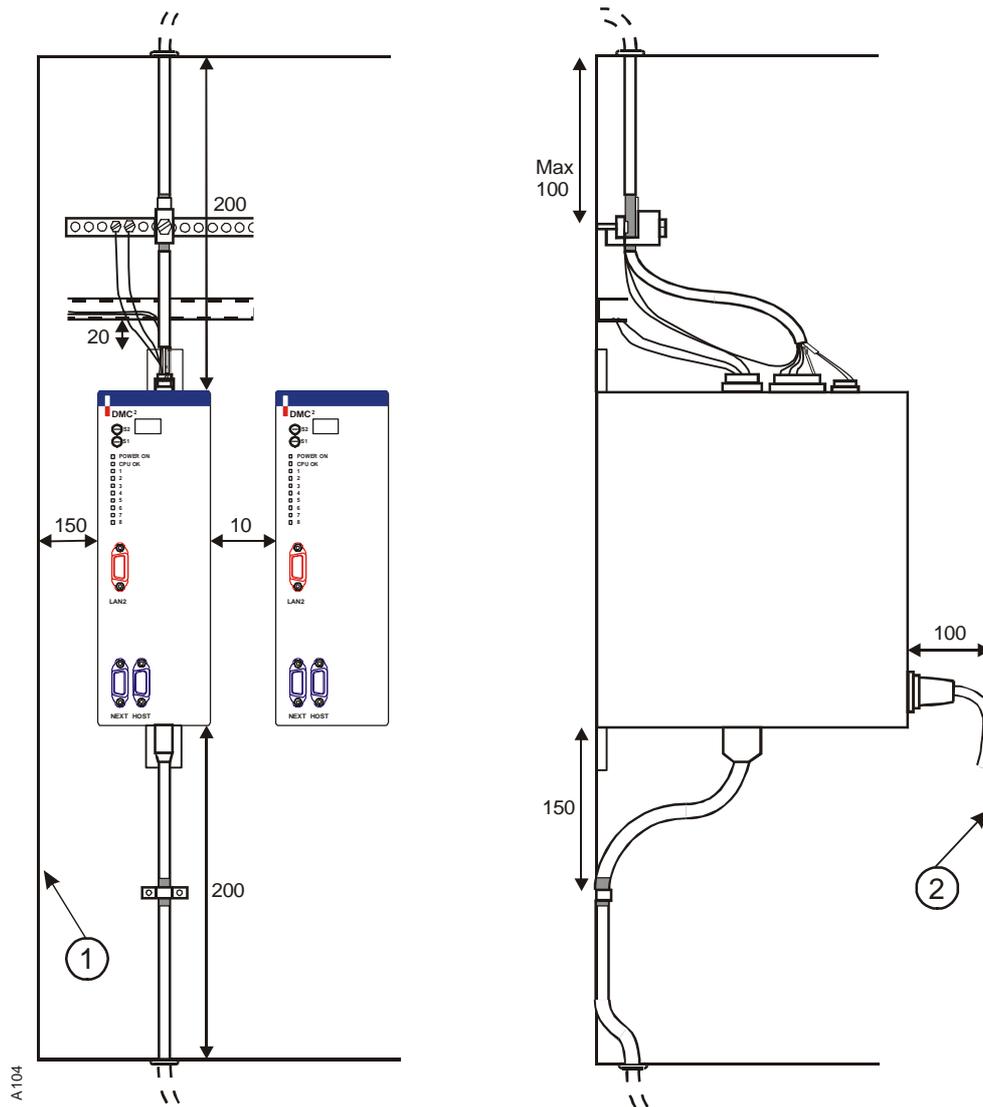
*Figure 37. Minumum clearances when mounting DMC²*.

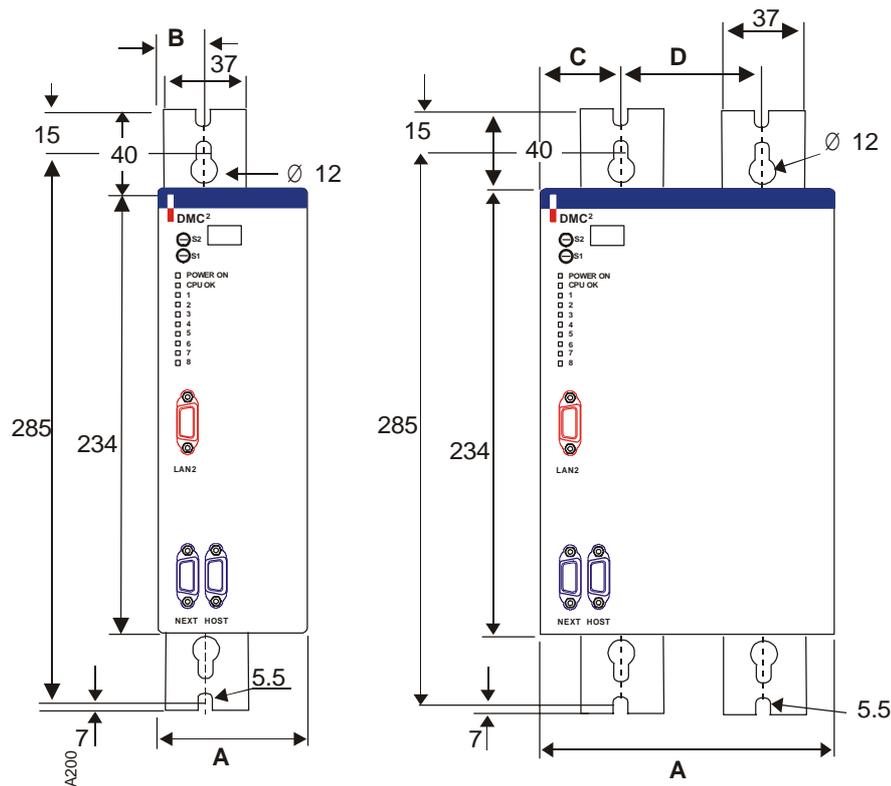1. Cabinet wall.             2. Cabinet door.

## Cabinet Space Requirements



*Figure 38. DMC$^2$ mounting dimensions (in mm). Depth for all units is 223 mm.*

|   | 50412<br>50720 | 50412P<br>50720P | 51540 | 51540P | 53080<br>PS580160 |
|---|---|---|---|---|---|
| A | 46 | 76 | 122 | 160 | 173 |
| B | 23.5 | 23.5 | 59 |  |  |
| C |  |  |  | 22 | 59 |
| D |  |  |  | 75.5 | 91.5 |

# ELECTROMAGNETIC COMPATIBILITY CONSIDERATIONS

The DMC$^2$ and other PDS components must be installed and operated in accordance with the instructions in this manual, to fulfill the EMC (Electromagnetic Compatibility) requirements.

# SCREENING

The purpose of screening (shielding) is to prevent unwanted electromagnetic radiation from entering or escaping the system. This means that screening applies to cabinets as well as cables. The motor cable, resolver cable and the serial communication cable must be screened. The screens shall be connected to both ends of the cable with metallic connector housings (see Figure 39.). The junction box on the motor (see Figure 41.) must be metallic, not plastic.

## STRAIN RELIEF

A complete cable installation, (Motor cable and Resolver cable Figure 41), require a strain relief to fulfil EMC regulations.



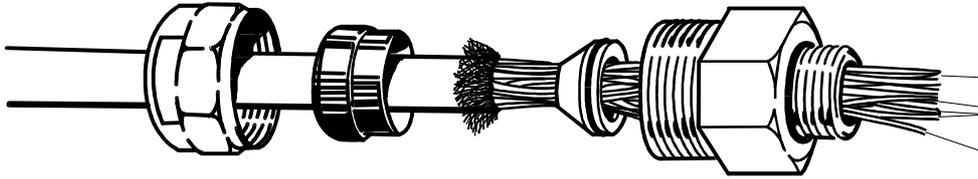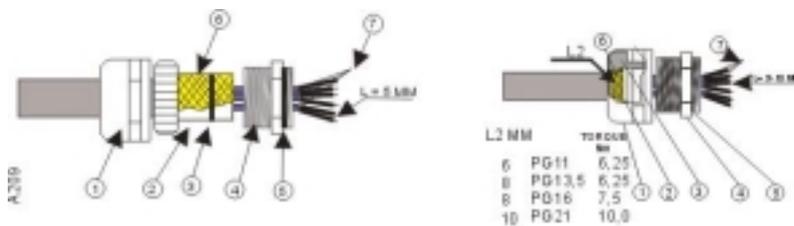*Figure 39. Screening of the cable.*



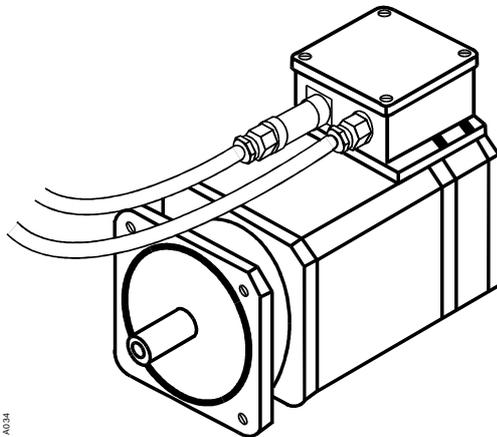*Figure 40. Hummel and Pflich strain relief.*



*Figure 41. Motor and resolver cable connections at metallic junction box on motor.*

## GROUNDING FOR HIGH FREQUENCIES

The inner areas of the cabinet and the mounting plate shall be galvanized and without paint. If paint is used, it must be removed at the component mounting surfaces for good high frequency grounding.

## Thermal Considerations

The cables shall be mounted along metallic surfaces. If possible, mount the cabinet and the machine with clean (no paint) surfaces against each other. (See Figure 42.)

All cables entering the cabinet shall be high frequency earth grounded at the point where the cable enters the cabinet.
There must be good electrical contact between the DMC$^2$ unit and the shield of the motor cable. If the motor cable shield is connected to the protective earth rail, the protective earth rail shall be high frequency grounded to the mounting plate at several places. (See Figure 34.)
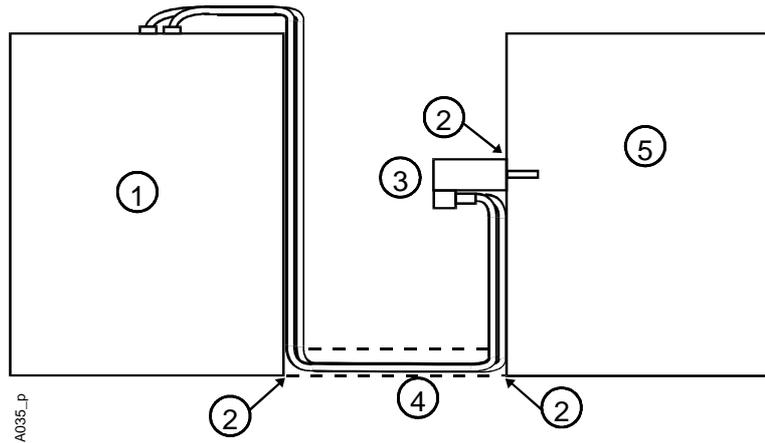


*Figure 42. Example of high frequency grounding techniques.*

1. Cabinet with DMC$^2$ unit.   2. Metal clean surface.        3. Servo motor.
4. Metal cable rail.              5. Machine to be driven.

# PROTECTIVE EARTH GROUNDING

Do not daisy chain earth ground connections. Run a separate wire between each component to be grounded and the ground point.
The ground wire (protective earth ground) in the motor cable shall not be connected to the DMC$^2$. Connect it directly to the protective earth rail (Figure 34.)
The earth ground for each DMC$^2$ shall be shall utilize two conductors, each having the same wire gauge as the input power cable.

# THERMAL CONSIDERATIONS

When DMC$^2$ units are mounted side by side (see Figure 37.), the cooling effect is decreased approximately 30 %. Using the cooling effect from the mounting plate on which the DMC$^2$ units are mounted can compensate this. The necessary area for compensation is 0,04 m$^2$/DMC$^2$.
At temperatures above 40°C, a fan is recommended because of the decrease of current rating above this temperature. The use of a fan will also compensate for the increased ambient temperature and thus avoid the reduced lifetime of the electronics. The fan can be mounted either on the DMC$^2$ unit or beside it.

# Technical Specifications

## 570 V DC Bus MODEL

| Model | DMC$^2$ 50412 | DMC$^2$ 50720 | DMC$^2$ 51540 | DMC$^2$ 53080 |
|---|---|---|---|---|
| Peak current (A) | 12 | 20 | 40 | 80 |
| Cont. current (A) at 40º C | 4 | 7 | 15 | 30 |
| Cont. current, RMS (A) at 40ºC | 2.2 | 4.5 | 10.5 | 21 |
| Cont. power (kW) at 40ºC | 1.4 | 3 | 6.3 | 13.8 |
| Min motor inductance (phase-phase) (mH) | 10 | 8 | 6 | 3 |
| Efficiency at cont. current | 95 % | | | |
| Speed linearity | < 1% | | | |
| Torque linearity | ±1 % of full scale plus ±2% command value | | | |
| Current open loop bandwidth | 2 kHz | | | |
| Speed loop bandwidth | Depending on motor and load | | | |
| Input voltage | 570 VDC + 10% : -20% | | | |
| DC bus voltage | 570 VDC + 10% : -20% | | | |
| Shunt regulation On | 670 - 700 VDC | | | |
| Shut down DC bus voltage | 700 - 725 VDC | | | |
| Speed range | 1:9000 | | | |
| Switching frequency | 4kHz | | | |
| Ambient temperature | 0ºC to 60ºC | | | |
| Storage temperature | -20ºC to 80ºC | | | |
| Humidity | 95 % | | | |
| Height (mm) | 234 | | | |
| Depth (mm) | 227 | | | |
| Width (mm) | 46 | 46 | 122 | 173 |
| Weight (kg) | 2.7 | 2.7 | 5.1 | 6.9 |
| Protection | IP 20 | | | |

# 400 V AC BUS MODELS

| Model | DMC$^2$ 50412P | DMC$^2$ 50720P | DMC$^2$ 51540P |
|---|---|---|---|
| Peak current (A). | 12 | 20 | 40 |
| Cont. current (A) at 40ºC. | 4 | 7 | 15 |
| Cont current, RMS (A) at 40ºC. | 2.2 | 4.5 | 10.5 |
| Cont. power (kW) at 40ºC. | 1.9 | 3.4 | 7.4 |
| Min motor ind. (phase-phase) (mH). | 10 | 8 | 6 |
| Efficiency at cont. current. | 95 % | | |
| Speed linearity. | < 1 % | | |
| Torque linearity. | ±1 % of full scale plus ±2% of command value | | |
| Current open loop bandwidth. | 2kHz | | |
| Speed loop bandwidth. | Depending on motor and load. | | |
| Input voltage. | 3 phase 400 VAC + 10% : -20% | | |
| DC bus voltage. | 570 VDC + 10% : -20% | | |
| Shunt regulation On. | 675 - 700 VDC | | |
| Shut down DC bus voltage. | 700 - 725 VDC | | |
| Speed range. | 1:9000 | | |
| Switching frequency. | 4 kHz | | |
| Ambient temperature. | 0ºC to 60ºC | | |
| Storage temperature. | -20ºC to 80ºC | | |
| Humidity. | 95 % | | |
| Height (mm). | 234 | | |
| Depth (mm). | 227 | | |
| Width (mm). | 76 | 76 | 160 |
| Weight (kg). | 3.8 | 3.8 | 6.8 |
| Protection. | IP 20 | | |

# STAND ALONE POWER SUPPLY

| Model | PS 580160 |
|---|---|
| Peak current (A). | 160 |
| Input Cont current, RMS (A) at 40ºC. | 65 |
| Cont. power (kW) at 40ºC. | 45.5 |
| Efficiency at cont. current. | |
| Input voltage. | 3 phase 400 VAC -20% - +10% |
| DC bus Cont. current CC (A) at 40ºC. | 80 |
| DC bus voltage. | 570VDC,+10%:-20% |
| Ambient temperature. | 0ºC to 60ºC |
| Storage temperature. | -20ºC to 80ºC |
| Humidity. | 95% |
| Height (mm). | 234 |
| Depth (mm). | 227 |
| Width (mm). | 173 |
| Weight (kg). | 7.2 |
| Protection. | IP 20 |
| Dynamic brake peak current (A). | 70 |
| Dynamic brake cont. current (A). | 35 |
| Dynamic brake max. energy on pulse. | Depends on rating for the external dynamic brake resistor. |
| Dynamic brake cont. power. | Depends on rating for the external dynamic brake resistor. |

# I/O

| Digital inputs: | |
|---|---|
| Number of inputs | 10 |
| Maximum voltage | 30 V |
| Input high | > 12.9 V, typical 10 V |
| Input low | <2 V, typical 5 V |
| Hysteres | >3 V, typical 5 V |
| Input impedance to ground | 6.8 kΩ |
| Filter time | 0.7 ms |

External Logic Supply

| Digital outputs: | |
|---|---|
| Number of outputs | 6 |
| Output high | +24 V |
| Output low | < 0.7 V |
| Max voltage | + 30 V DC |
| Max current | 100 mA, short circuits proof. |
| Max voltage drop | 3 V |
| **Analog inputs:** | |
| Number of inputs | 2 |
| Voltage range | ±10 V |
| Common mode voltage | ±10 V, Max. |
| Resolution | 14 bit |
| Linearity | 8 bit |
| Input impedance | 40 k$\Omega$ |
| Filter time | 0.1 ms |
| **Analog outputs:** | |
| Number of outputs | 2 |
| Resolution | 12 bit |
| Voltage swing | ±10 V |
| Max current | 0.5 mA |
| **Dedicated output for READY signal:** | |
| Controlled by | Software and hardware |
| Type | Relay, normally open |
| Max voltage | 24V DC |
| Max current | 0.2A |
| **Motor brake relay output:** | |
| Rating AC | 250 VAC / 2 A |
| Rating DC | 24 VDC / 2A |
| External freewheeling diode required | |

# EXTERNAL LOGIC SUPPLY

| Type | Specification |
|---|---|
| Voltage | +24 V ±20% |
| Max Supply Current | 0.7 A |
| External fuse | 1.5 A T (Slow) |

# OPTIONAL POSITION SENSORS

| Encoder | Function | Specification | Remark |
|---|---|---|---|
| Incremental Encoder | External movement sensor. | 5 V / RS422 | Only one could be used at same time. |
| SinCos Encoder | Motor shaft or external movement sensor | 1Vpp EnDat | |

# MEASURE CONNECTION

| Function | Specification |
|---|---|
| Low-level differential analog input for measurement bridge. | Input ± 50mV<br>± 5 V DC supply available. |

# LAN2

| Function | Specification |
|---|---|
| Second LAN interface in accordance with CANopen standard CiA 301. | Isolated<br>7-26.5 VDC external supply. |

# ENVIRONMENTAL DATA

| Environment | Specification |
|---|---|
| Pollution degree (IEC 664,A) | Degree 2 |
| Altitude | 1000 m |
| Protection class | IP 20, Nema 1 |
| EMC, Emission | EN 50081-2 |
| EMC, Immunity | EN 50082-2 |

# ENVIRONMENTAL TESTS

| Operating on average load: | |
|---|---|
| Cold (IEC 68-2-1) | ±0ºC, 2 h |
| Heat (IEC 68-2-2) | +40ºC, 2 h |
| **Operating on reduced load:** | |
| Cold (IEC 68-2-1) | ±0ºC, 2 h |
| Heat (IEC 68-2-2) | +60ºC, 2 h |

Resolver Specification

| Power turned off, storage: | |
|---|---|
| Cold (IEC 68-2-1) | -40ºC, 16 h |
| Heat (IEC 68-2-2) | +85ºC, 16 h |
| Change (IEC 68-2-14) | -40ºC to 85ºC, 2 cycle |
| Humidity (IEC 68-2-30) | 95%, +25ºC - +40ºC, 6 cycle |
| Bumps (IEC 68-2-29) | 100 m/s²s, 4 - 7 ms, 3x1000 cycle |
| Vibration (IEC 68-2-6) | 10-55 Hz, ±0.15mm 55-150 Hz, 20 m/s²s |

# RESOLVER SPECIFICATION

| | |
|---|---|
| Winding Configuration | 1-phase input / 2 phase output |
| Primary | Rotor |
| Pole Number | 2-pole or more |
| Operating Frequency | 4 kHz |
| Output Voltage | 2.25 $V_{rms}$ |
| Input Voltage | 2.25 - 8.5 $V_{rms}$ (depends on Transformation Ratio) |
| Transformation Ratio | 0.3-1.0  10% a 1kHz |
| Phase Shift | ±45º |
| Input Current | Max 150 mA (preferable max 75 mA) [1] |
| Electrical Error | <25 arc minute |
| [1] $DMC^2$ resolver output are able to drive 150 mA. If two resolvers are driven from one $DMC^2$, then each resolvers input current should be max 75 mA. | |

# Start up and Commissioning

<table>
<tr>
<td>⚠️☠️</td>
<td>

**WARNING**

♦ **The DMC$^2$ contains voltages, which may be as high as 575 volts. These high voltages can cause serious or fatal injury. Only qualified personnel familiar with this manual, software control of the DMC$^2$ and machinery driven by this equipment should attempt to start up or troubleshoot this equipment.**

♦ **DO NOT touch electrical components, power devices or connections without first insuring that high voltage is not present. Storage capacitors within the equipment require 20 seconds to discharge after AC power is removed.**

♦ **Incorrect programs, faulty equipment or faulty or incorrect connections may cause sudden, violent motion of the motor shaft and driven equipment. Peak torque of several times rated motor torque can occur under these conditions. Be certain that unexpected motor shaft movement will not cause injury to personnel or damage to the driven equipment.**

♦ **High voltages may be present at the motor whenever AC power is applied, even when the motor is not moving. Make certain that no motor connections are exposed.**

</td>
</tr>
</table>

## CHECKS PRIOR TO INITIAL POWER UP

### BEFORE POWER UP THE FIRSTS TIME

- Check the wiring of the DMC$^2$ installation.
- Check ground and shields connections of the installation.
- Check that the voltage for mains is correct.
- Make sure that there is a fast way to disconnect the main power to the DMC$^2$ with an emergency stop.
- The DMC$^2$ should have a BRAM or EPROM with application program that sets up motor parameters, regulator parameters, protection functions and the functionality of the application.
- Make sure that the enable signal to the DMC$^2$ is disabled until the installation have been completely power up and are ready to be used.
- Make sure that the motor shaft can run freely and that the temperature protection in the motor is connected to the DMC$^2$.

### BEFORE ENABLE THE POWER STAGE AFTER POWER UP

- If BRAM are used, down load an application program that sets up motor parameters, regulator parameters, protection functions and the functionality of the application.
- Set current limit to a low value so that the motor could handle the current without getting overheated.

Check that the resolver feedback and I/O functions in the application programs are working correctly.

## LOAD A NEW FIRMWARE RELEASE

The PL command 'BOOT' can be used to enter boot mode, when an existing copy of firmware already resides in the flash.

## Load a new firmware release

1. Turn power to the drive off.

2. Short pin 2 and pin3 on connector X5 or X4 (serial communication). (This will echo content sent by the drive back to the drive).

3. Apply power to the drive.

4. Remove short applied at step 2.

5. Without removing power to the drive connect to the ECT terminal emulator. Warning: Make sure that both the $DMC^2$ and the PC are earth grounded failure to do so may result in damage the $DMC^2$ unit and/or the PC!

6. The BOOT monitor should have been entered.
   First, the current program must be erased, to do that type,
   >EA
   or
   >EF
   EA - Erase all.
   EF - Erase firmware (currently same as EA).
   H  - Help.
   When command has finished then next step.

7. Select CONTROLLER:DOWNLOAD from the menu and select the new firmware file (firmware extension is *.hex).

8. Wait for download to finish

9. The new firmware should now be stored into the flash unless reported otherwise, turn the power off or type,
   >RF
   RF - Run firmware

10. Download the application program again.
    Note. Any stored PL program will have been erased from the flash. In a future release the EF command will erase only the firmware parts.

## BOOT MODE COMMAND

With the addition of the 'boot' command a user can enter the boot mode from the terminal. This simplifies the above procedure to,

1. Turn power to the drive on

2. Type 'boot' when the '>' prompt is seen.
   >boot<ENTER>

3. The unit has entered 'BOOT MODE'. Continue from step 6 in the above list.

## STARTUP MESSAGE

When power is applied to the $DMC^2$ the following startup message is displayed,

```
ACC DMC/ Inmotion Technology AB v05.00.00 Node#: 1 Baud: 9600
Mode: 0
```

This line is always sent using 9600 baud independent of the settings in the eeprom related to the COMM group or any programming of the COMM group. The line gives information about the content of the EEProm used for initialization of the serial communication (COMM group).
The assignments made to the COMM group by the firmware at startup, are:

| Node | COMM.Node = EEProm.6 and 15. |
|------|------------------------------|
| Baud | If `EEProm.4 = 0` then<br>`COMM.Baud = BaudTable`[EEProm.6 >> 8]<br>else<br>`COMM.Baud` = `EEProm.4` |
| Mode | `COMM.Mode = EEProm.7 and 15`<br>`COMM.TLines = EEProm.7 >> 8`<br>BaudTable is a table of 8 baudrate values, 50..9600 |

If there appears to be a problem communicating with the DMC[2], then check the startup message first to verify that the initial settings are correct.