Drive System Application

applications
& TOOLS

MICROMASTER 4

Application Description

SIEMENS

Operating several motors from one MICROMASTER 4

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2 Description

For many applications - e.g. for roller table drives or traversing gear drives – it makes sense to operate several motors connected in parallel to one frequency inverter. A description is provided in the following as to which details must be taken into account when engineering such drive systems.

2.1 Principle structure

In the simplest case, the motors are directly connected to the frequency inverter. If the motors are to be individually protected or selectively powered-up and powered-down, then circuit-breakers must be provided for each motor – and possibly also contactors.

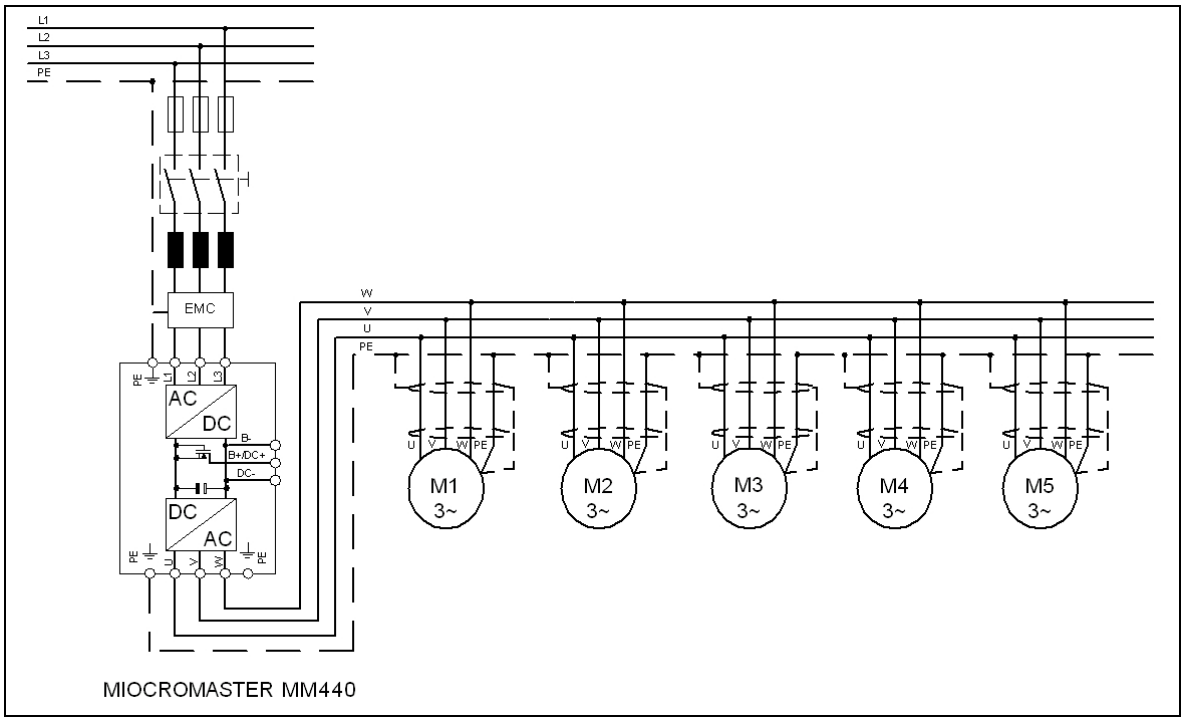

Fig. 1: Principle structure of a multi-motor drive

3 Dimensioning the frequency inverter

When dimensioning the frequency inverter a differentiation must be made as to how the motors are to be operated.

- All of the motors must be simultaneously started
- Motors must be selectively powered-up and powered-down

3.1.1 All of the motors are to be simultaneously powered-up

When all of the motors are to be simultaneously powered-up this has the advantages that all of the motors are powered-up at the same instant in time at zero frequency – and are ramped-up to the operating frequency using the frequency inverter. This means that high starting currents do not occur – and the frequency inverter only has to be dimensioned for the sum of the motor currents.

Example:

Roller table drive with eight rolls, each roll is separately driven by a geared motor, 8 x 5.5 kW, IM

Motor data: 5.5 kW, 400 V star, 11.2 A, cos φ = 0.81, 1455 RPM

Dimensioning the frequency inverter:

Σ motor currents = 8 x 11.2 A = 89.6 A

Σ motor power = 8 x 5.5 kW = 44 kW

A frequency inverter with the following data is required:

- 400 V power supply voltage
- I_{inv} > 89.6 A
- P_{inv} > 44 kW

The following frequency inverters are obtained:

MICROMASTER MM440

- 45 kW
- I_{inv} = 90 A
- V_N = 380 – 480 V
- OrderNo.: = 6SE6440 – 2UE34 – 5FA1

3.1.2 The motors are selectively powered-up

In this case, several motors are connected to the frequency inverter; however, one or also several motors can be simultaneously powered-up. It must first be defined as to how many motors are to be simultaneously powered-up. The frequency inverter must be dimensioned so that its output current is greater than / equal to the sum of the motors connected to the frequency inverter plus the starting currents of the motors to be started. If motors with different sizes are used, the motor with the highest starting current must be taken into account. It must be taken into consideration that the starting currents (inrush currents) depending on the motor size, lie between 200% and 800% of the rated motor current (refer to Catalog M11).

Example:

Motor data: 5.5 kW, 400V Y, 11.2 A, cos phi = 0.81, 1455 RPM, starting current I_{start} = 6.3 * I_{rated}, one motor should be powered-up in operation

Dimensioning the frequency inverter:

Σ motor currents = 7 x 11.2 A = 78.4 A

Σ starting currents = 6.3 x 11.2 A = 70.56 A

A frequency inverter with the following data is required:

- 400 V supply voltage
- I_{inv} > 89.6 A
- I_{peak} > 149 A

If starting is carried-out within 60 seconds, then the overload capacity of the frequency inverter can be used. The following inverters are then obtained:

MICROMASTER MM440

- 55 kW
- I_{inv} = 110 A
- Vn = 380 – 480 V
- OrderNo.: = 6SE6440 – 2UD35 – 5FA1

4 Motor cable lengths

The sum of the individual motor cable lengths must be less than or equal to the maximum permissible motor cable length of the frequency inverter (refer to Catalog DA51.2).

In order to reduce the cable length, a cable can be routed close to the motor, and from there shorter cables are distributed to the individual motors.

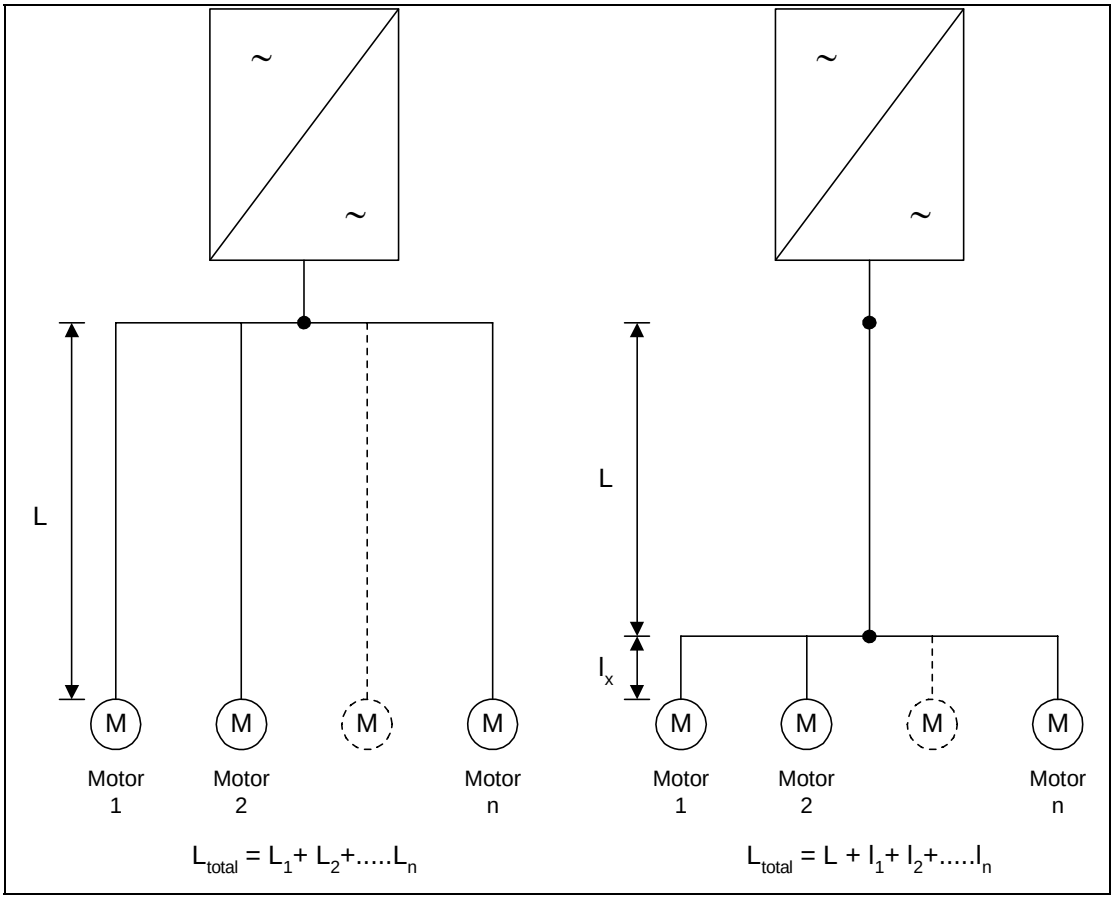

Fig. 2: Determining the complete cable lengths

5 Dimensioning switching devices

For multi-motor drive systems, switching devices (circuit-breakers, contactors, overload relays) are used both on the infeed side in front of the frequency inverter as well as at its output (output of the frequency inverter). The A&D CD Info “Using switching devices for frequency inverter systems” provides information on how to select/dimension circuit-breakers, contactors, overload relays”, Edition 01/2004. This information document is available through the following link:

https://workspace.automation.siemens.com/content/00000232/NewsArchiv/01/02/005/4_2%20%20Einsatz%20von%20Schaltgeräten%20im%20Umfeld%20von%20Frequenzumrichtern.doc

6 Closed-loop control versions

Multi-motor drives can be implemented with two different closed-loop control versions:

- V/f closed-loop control for drives that are not mechanically coupled

  The V/f closed-loop control is the classic version if several motors are to operate with the same frequency – however there may be no high demands placed on the speed accuracy. The frequency inverter enters the setpoint frequency; depending on the load situation, the motors operate with a certain slip.

- Closed-loop vector control with encoder for drives that are mechanically coupled with one another

  For closed-loop vector control with encoder, one motor is selected as master (leading) drive and is equipped with an encoder. The encoder feedback controls (closed-loop) the frequency inverter and the master (leading) drive. As a result of the mechanical coupling between the drives, the remaining motors participate in the total torque according to the gradient of their slip characteristic.

  Closed-loop vector control without encoder is not practical as the accuracy of the speed sensing depends on the parameterized motor data (refer to the frequency inverter setting) and this must be done together for all motors.

6.1 Frequency inverter setting

6.1.1 Closed-loop control parameters

The summed currents and summed power are parameterized as motor data. If motors with different sizes are connected, then the average value is used for the cos phi. A motor data identification routine should be executed for both V/f closed-loop control as well as for closed-loop vector control. The motor data identification routine must be carried-out with all of the motors connected.

6.1.2 Temperature evaluation

The frequency inverter cannot be used to directly monitor the temperature of several motors. This is the reason that a value of zero must be entered when selecting the temperature sensor P0601. The response to a possible overtemperature must be set to zero using parameter P0610 (alarm, no response,

no fault). In order to avoid an alarm message, parameter P0604 can be set so high that the alarm threshold is not reached.

If the motors are to be individually and thermally monitored, then they must be equipped with PTC thermistors. The PTC thermistors can be evaluated using separate evaluation units, e.g. 3RN10; the relay outputs are connected as external fault to a digital input of the frequency inverter.