1.1 MM424

1.1.1 General Information

The MM424 motor module is used for digital control of up to four DC motors with a nominal voltage of 24 VDC at a nominal current of max. 2 A. Unlike the MM432 motor bridge module, the MM424 motor module can only digitally switch the 24 VDC supply voltage to the respective motor. The following possibilities are available for the motor:

Control	Motor Status
Switch through 24 VDC	Motor is running
Change polarity of plus and minus	Motor changes direction
Plus and minus open	Motor freewheeling or spins out
Plus and minus connected	Motor brakes itself

Table 1: MM424 control options for motor

To increase the nominal current, outputs can be switched in parallel.

The module is controlled digitally, comparable with a DM435.

1.1.2 Order Data

Model Number	Short Description	Image
7MM424.70-1	2003 motor module, four motor digital output levels, 24 VDC, 3 A at 50 °C, max. starting current 10 A (max. 50 ms), electronic over-current and over-temperature protection, status LEDs. Order TB710 terminal block separately.	
7TB710.9	Terminal block, 10-pin, screw clamps	
7TB710.91	Terminal block, 10-pin, cage clamps	
7TB710:90-01	Terminal block, 10-pin, 30 pcs., screw clamps	
7TB710:91-01	Terminal block, 10-pin, 30 pcs., cage clamps	
Terminal block is not included in delivery.		

Table 2: MM424 order data

1.1.3 Technical Data

Model Number	MM424
General information	
C-UL-US listed	In preparation
B&R ID Code	$F3
Module Type	B&R 2003 I/O module
Number CP430, EX270 CP470, CP770, CP474, CP476, CP774 EX470, EX770, EX477, EX777	 4 8
Status Display	LEDs
Power Consumption Internal 24 VDC Supply	 Max. 0.5 W Max. 6.1 W
Environmental Temperature during Operation	0 - 50 °C
Static Characteristics	
Number of Motor Bridges	4
Type	4 push-pull outputs
Electrical Isolation Bridge - PLC Bridge - Bridge	 Yes No
Diagnostics Status Voltage Monitoring	 Motor supply voltage >18 V
Switching Voltage/Supply Minimum Nominal Maximum	 18 VDC 24 VDC 30 VDC
Continuous Current per Output Module	 Max. 3 A Max. 8 A[1)] To increase the output current, bridges can be switched in parallel.
Peak Current	5 A @ ≤200 ms
Starting Current	10 A @ ≤50 ms
Switching On after Overload Cutoff	Automatic within seconds (depends on the module temperature)
Protection	Thermal cutoff Over-current cutoff
Dynamic Characteristics	
Switching Delay Log. 0 - Log. 1 Log. 1 - Log. 0	 Max. 400 µs Max. 400 µs
Mechanical Characteristics	
Dimensions	B&R 2003 single-width

Table 3: MM424 technical data

1) Simultaneous factor = 66.7%

1.1.4 Status LEDs

Status LEDs	
	
LED	**Description**
DCOK	Lit as long as the supply voltage for the motors is in the defined range (>18 VDC).
LED yellow (R, L)	Control status of the corresponding output.
LED green (Mx)	When one of the motor control outputs is set, then the corresponding LED is lit. If an error occurs on the motor bridge the LED goes out. Possible Error: • Over-temperature • Short circuit motor • Short circuited to ground (GND)

Table 4: MM424 status LEDs

1.1.5 Pin Assignments

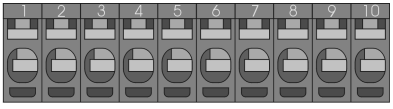
Terminal Block X1		
Terminal	**Assignment**	
1	GND	X1  TB710
2	+24 VDC supply for inputs for motors	
3	Motor 1 (-)	
4	Motor 1 (+)	
5	Motor 2 (-)	
6	Motor 2 (+)	
7	Motor 3 (-)	
8	Motor 3 (+)	
9	Motor 4 (-)	
10	Motor 4 (+)	

Table 5: MM424 pin assignments

1.1.6 Connection Example

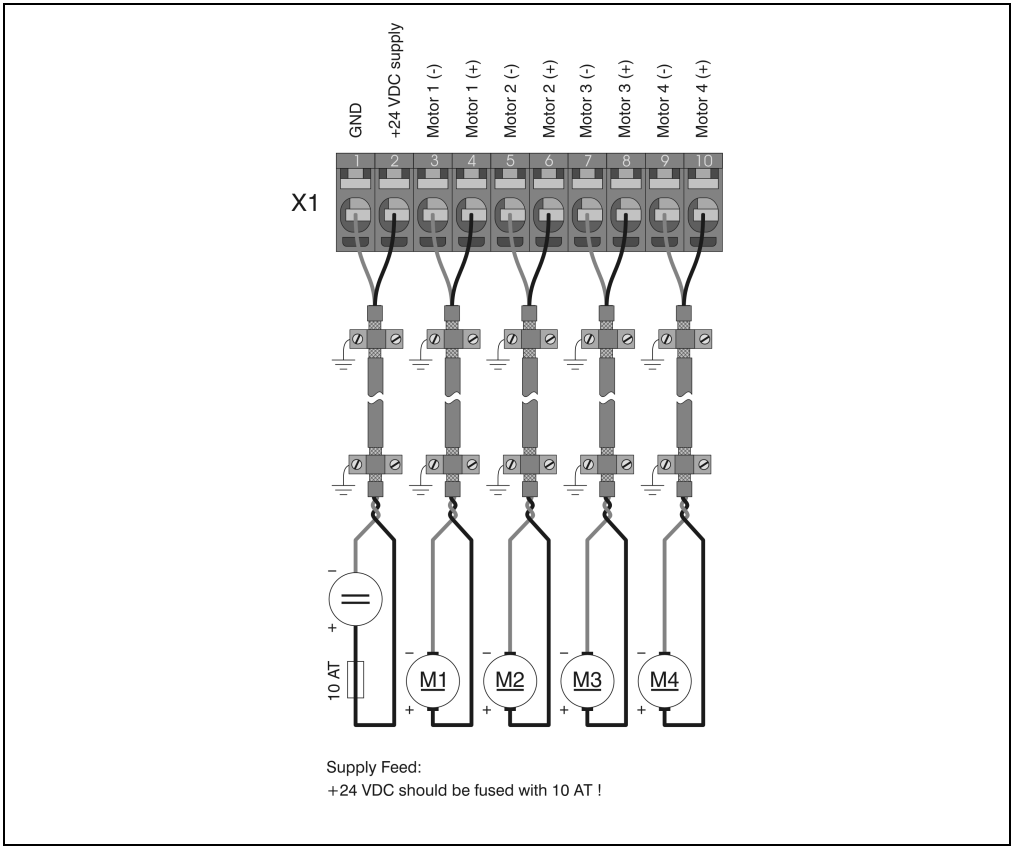


Figure 1: MM424 connection example

1.1.7 Output Circuit Diagram

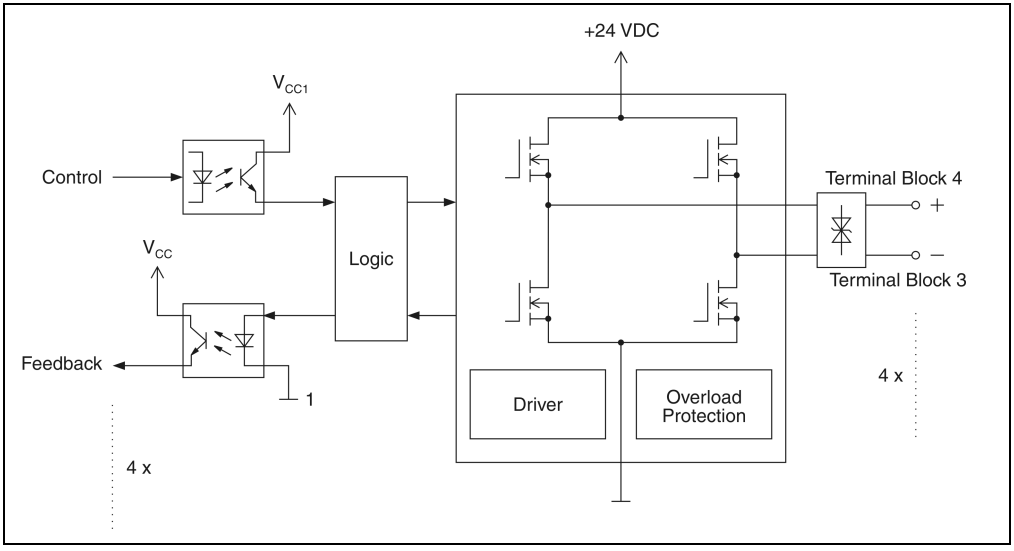


Figure 2: MM424 output circuit diagram

1.1.8 Area of Use

The motor module is mainly used for motor-drive combinations with or without a slip friction clutch. Any 24 VDC motor can be used if the current specifications are met.

The module does not have an integrated brake resistor, which means that generator operation of a motor can cause the supply voltage to increase excessively. Therefore, this type of operation must be prevented mechanically.

The module is optimally suited for use as a very compact alternative to four reversing motor starter combinations in this performance range, especially for decentralized operation.

1.1.9 Control

Movement direction is directly controlled by the corresponding "digital output".

Movement Direction	Output
Movement in Right Direction	
Motor 1	1
Motor 2	3
Motor 3	5
Motor 4	7

Table 6: MM424 relationship between output and movement direction

Movement Direction	Output
Movement in Left Direction	
Motor 1	2
Motor 2	4
Motor 3	6
Motor 4	8

Table 6: MM424 relationship between output and movement direction (cont.)

The outputs can directly switch from left direction to right direction. The electronics of the MM424 protect the individual bridge legs from a short circuit.

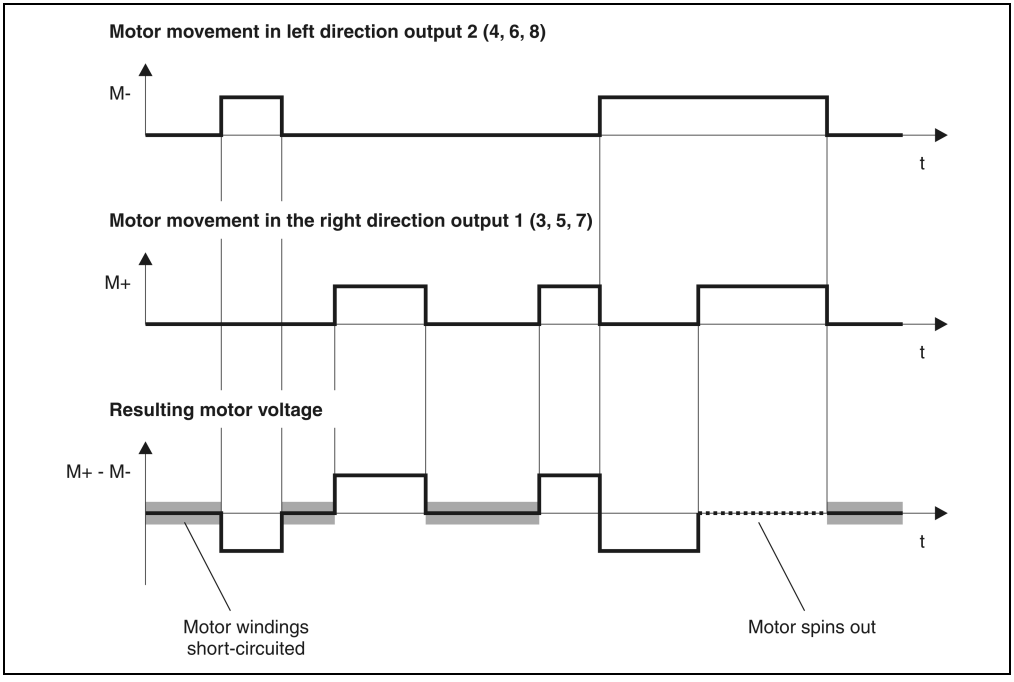


Figure 3: MM424 motor voltage

If both direction outputs are turned off, then the bridge short circuits the motor windings (minimal overtravel). The outputs are automatically turned off when the system has been switched on or when the controller is reset.

If both direction outputs are switched on at the same time, then none of the bridge transistors are switched through. A running motor spins out in this operating mode.

MM424 bridge controlling allows the direction to be switched directly. In the application, you must be sure that the motor will not be damaged because of an increase in voltage, and that the resulting bridge current does not exceed the limit.

1.1.10 Protection for the Output Driver

The outputs have basic thermal protection, and switch off when overheated. The motor spins out. The critical chip temperature can be exceeded because of the following:

- Environmental temperature too high when insufficient cooling
- Long-lasting overload or short circuit

After an appropriate cooling down phase, which is determined from the degree of the overheating and the environment temperature, the output levels switch themselves on again. There are no manual or software acknowledgement measures that need to be taken.

On the basis of the returned bridge status, it is recommended however to react to error messages in the application program by switching off the outputs.

The motor bridges output driver is protected up to a voltage of<33 V. An operational voltage >33 V can cause damage to the entire module.

1.1.11 Variable Declarations

The variable declaration is valid for the following controllers:

- CPU for the PLC 2003
- Remote I/O bus controllers
- CAN bus controller

B&R Automation Studio™ Support: See B&R Automation Studio™ Help starting with V 1.40

Variable Declaration with PLC 2003 CPU and Remote Slaves

Function	Variable Declarations				
	Scope	Data type	Length	Module Type	Channel
Single digital input (channel x)	tc_global	BIT	1	Digit. In	1, 3, 5, 7
Single digital output (channel x)	tc_global	BIT	1	Digit. Out	1 ... 8
Module status	tc_global	BYTE	1	Status In	0

Table 7: MM424 variable declaration using the CPU and remote slaves

Variable Declaration with CAN slaves

Function	Variable Declarations				
	Scope	Data type	Length	Module Type	Channel
Single digital Input (channel x)	tc_global	BIT	1	Digit. In	1, 3, 5, 7
Single digital output (channel x)	tc_global	BIT	1	Digit. Out	1 ... 8

Table 8: MM424 variable declaration with CAN slaves

Module Status

The module status for CAN slaves can only be read using command codes. The command codes are explained in Chapter 5 "CAN Bus Controller Functions", section "Command Codes and Parameters" . An example is provided inChapter 4 "Module Addressing".

1.1.12 Access using CAN Identifiers

Access via CAN identifiers is used if the slave is being controlled by a device from another manufacturer. Access via CAN identifiers is described in an example in Chapter 4 "Module Addressing" . The transfer modes are explained in Chapter 5, "CAN Bus Controller Functions".

Digital Inputs

A maximum of eight digital I/O modules can be operated in packed mode.

CAN ID 1)	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
286	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6	Module 7	Module 8

Table 9: MM424 access via CAN identifiers, digital inputs, packed

1) CAN-ID = 286 + (nn - 1) x 4
nn ... Node number of the CAN slave = 1

A maximum of four digital IO modules can be run in unpacked mode.

Module	CAN ID 1)	Byte
1	286	Inputs 1, 3, 5, 7
2	287	Inputs 1, 3, 5, 7
3	288	Inputs 1, 3, 5, 7
4	289	Inputs 1, 3, 5, 7

Table 10: MM424 access via CAN identifiers, digital inputs, unpacked

1) CAN ID = 286 + (nn - 1) x 4 + (ma - 1)
nn .... Node number of the CAN slave = 1
ma ... Module address of digital IO modules = 1 - 4

Digital Outputs

A maximum of eight digital I/O modules can be operated in packed mode.

CAN ID 1)	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
414	Module 1	Module 2	Module 3	Module 4	Module 5	Module 6	Module 7	Module 8

Table 11: MM424 access via CAN identifiers, digital outputs, packed

1) CAN ID = 414 + (nn - 1) x 4
nn ... Node number of the CAN slave = 1

A maximum of four digital IO modules can be run in unpacked mode.

Module	CAN ID 1)	Byte
1	414	Outputs 1 - 8
2	415	Outputs 1 - 8
3	416	Outputs 1 - 8
4	417	Outputs 1 - 8

Table 12: MM424 access via CAN identifiers, digital outputs, unpacked

1) CAN ID = 414 + (nn - 1) x 4 + (ma - 1)
nn .... Node number of the CAN slave = 1
ma ... Module address of digital IO modules = 1 - 4

For more information on ID allocation, see Chapter 5, "CAN Bus Controller Functions".

1.1.13 Digital Inputs

<table>
<tr><th>Input</th><th>Description</th></tr>
<tr><td rowspan="6">1, 3, 5, 7</td><td>0 ... Motor stalls or an error has occurred in the motor bridge
Possible Error:
• Over-temperature
• Short circuit motor
• Short circuited to ground (GND)
1 ... the corresponding motor control output is set</td></tr>
<tr><td><table>
<tr><th>Input</th><th>Assignment</th></tr>
<tr><td>1</td><td>Motor 1</td></tr>
<tr><td>3</td><td>Motor 2</td></tr>
<tr><td>5</td><td>Motor 3</td></tr>
<tr><td>7</td><td>Motor 4</td></tr>
</table></td></tr>
</table>

Table 13: MM424 assignment of digital inputs

1.1.14 Module Status

The evaluation of the module status is described in an example in Chapter 4 "Module Addressing" .

Bit	Description
0 - 4	Module code: $13
5	Not defined, masked out
6	Digital module: 0
7	0 ... No supply voltage or supply voltage too low for motors 1 ... Supply voltage for motors in the valid range