INSTRUCTION MANUAL
MFC – MFD COD: 16496-EN-2023/08

CE

DC current injection electronic braking group

The solution to brake an AC motor while preventing mechanical stress

Integrated connection contactor **MFC**
External connection contactor **MFD**

WESTCAR S.r.l.
Via MONTE ROSA, 14
20149 Milano (MI
www.westcar.it

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1 Overview

1.1 Safety

The following instructions imply that this product has to be set up by a technician aware of the installation, working and servicing procedures of electric machines in general. Knowledge of the laws in force about security and of all the good senses to avoid accidents is mandatory to operate on the machines.

WARNING: The working cycle of the device provides for the braking and slow down, not the control of the still motor.
For security applications combine the braking module circuit with a device for still motor control suited to the required class of security.

The following instructions are only referred to the use and servicing of the braking modules with MFC - MFD microprocessor control.

1.2 Warnings

Electrical equipment can be a source of security risk. It is therefore necessary to know deeply the regulations and the control and working devices of the installation before operating on the machine.
The setting of the braking module must be made by a qualified technician, who must know the installation rules to follow in compliance with safety and protection standards necessary.

- Some unforeseeable stops and reboots could occur in case of a parameter variation during the setting phase with working machine
- The MFC - MFD module is not provided with fuses for short circuit protection. These have to be assembled by the installer following the instructions on the chart on **page 10**

Emissions
The MF series is compliant with EMC regulation, CE mark.
During the current injection cycle, being a power control with phase control regulation, interferences are given out at radio frequency level due to the quick thyristors' commutation, that usually are not relevant as interferences.
However, if electrical measurement devices or low frequency receivers are placed near the MF module, it is necessary to include line filters or shielded wiring in the installation.
In case of need, please contact our offices.

1.3 Warranty

The only valid warranty conditions are those stipulated at the purchase.

- The device has been designed to control the braking and cut-off cycle of an asynchronous three-phase motor and as such must be used
- Possible re-phasing groups have to be installed upstream of the starter system and never on the motor side

We do not take responsibility for damage due to use, installation or working conditions not conforming to what advised in this handbook.
The braking module dimensioning must be given based on the real needs of the motor braking torque (and consequently on the current) necessary for the device cut-off.
No responsibility due to the wrong dimensioning can be attributed us.
Possible tampering will definitely cause the decay of every guarantee and can cause great damage and/or accidents.
For all possible applications it's necessary to consider that the motor braking is made by injecting a current on the stator and therefore is of a dissipative kind.

We disclaim all responsibility concerning accidental and consequential damages.

- The information contained in this handbook are correct at the moment of printing. We reserve ourselves the right to modify the content and the product's technical data without notice

No part of this handbook can be copied without written authorization from **Westcar S.r.l.**

1.4 General description

The MFC - MFD braking control group is a DC converter for the control of an asynchronous three-phase motor's braking cycle. The circuits to manage the working / cut-off cycle with the interlocks necessary to a correct running are integrated in the product.
The MFC model offers a complete version, which includes the on-board power insertion contactor, the concerning control circuits, and the cycle interlock relay.
The MFD expects the assembly of the power contactor externally, although it provides for the control and auxiliary supply circuits of the contactor on board.
The working parameters can be set by the front control trimmers with analogical regulation; this allows to adjust immediately and intuitively both the starting functions and the different parameters of the working conditions.
The diagnostics and the monitoring of the working status are made by led display.
Two relay outputs are included to manage the working cycle and the interface towards the system.

1.5 Features

1.5.1 Electrical

Supply voltage	Single phase 230 - 400 V -15% / +10% (optional 440V - 500V)
Service voltage	Derived from supply voltage (separated on request)
Frequency	50 / 60 Hz +/- 2 Hz
Nominal current	20 - 500 A in 10 sizes
Output voltage	DC with supply shuttering phase regulation
Braking control	Voltage program with max value limit Imax
Cut-off control	Automatic or non-stop (time-limited)
Protections	Thermal pad on the heat sink set on 85 °C for all sizes RC and VDR suppressors on the thyristors

Motor power 400V [kW]	Motor nominal current [A]	Motor power 230V [kW]	Motor nominal current [A]	Suggested MF size	
~~7,5~~	~~14,8~~	4	~~14,5~~	~~MF~~	~~20~~
~~15~~	~~28,5~~	~~7,5~~	~~28~~	~~MF~~	~~30~~
22	42	11	42	MF	50
37	69	18,5	68	MF	75
55	100	22	80	MF	100
75	131	37	130	MF	150
110	195	55	192	MF	200
160	285	75	248	MF	300
200	370	100	356	MF	400
250	460	132	425	MF	500

NB: Sizes MF20 and MF30 have been discontinued

1.5.2 General

Protection degree	IP20
Electrostatic discharges	IEC 1000-4-2 /3
Noise	IEC 1000-4-3 /3
Bursts	IEC 1000-4-4 /4
Stocking temperature	-10 / +70°C
Working temperature	+5 / +40°C*
Relative humidity	90% without condensation
Altitude	1000 m above sea level
Installation position	Vertical +/- 15°

*The MFC - MFD module can supply nominal values of braking current up to 50 °C inside the panel; above this temperature performance degrades by 2% for every 1 °C rise. Maximum temperature of 55 °C.

1.5.3 Dissipation

- In the power circuit: $P = I^{(1)} * \Delta V^{(2)} * \text{Duty cycle}^{(3)}$
- In the control circuit: Pmax = 7,5 VA
- In the contactor circuit: Pmax = 15 VA

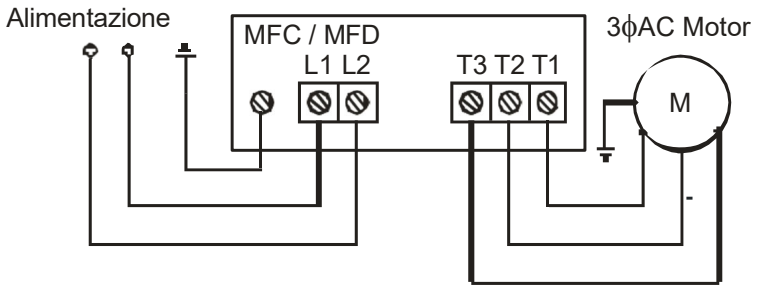
(1) I = Phase current (starting effective value about 4 x In)
(2) ΔV = Equivalent voltage drop (typically 1,5V)
(3) Consider the braking phase only because at full speed it is not active

Maximum allowed cycles:
120 per hour with 1/3 intermittence between braking cycle and the next one (=0,025)

1.6 I/O Connections

1.6.1 Power terminal blocks

The power supply and services inputs are in the lower part.
The power supply connection is on the L1 and L2 lugs for the supply, the power output connection towards the motor is on the T1 and T2 lugs while T3 is a signal only connection.
The Pe earth connection is on the side.
To guarantee the certified protection, the cables have to be made passed through the proper pre-cut holes.



1.6.2 Control terminal blocks

The control terminal board is made to be wire connected (max. section 1,5 mm^2).
Here's the analysis of the function of every single connection:

1	2	3	4	5

Modello MFC

6	7	8	9	/	1	2	3	4	5	T3	A1	A2

Modello MFD

Fig 1.6.2 Auxiliary terminal blocks

		Control terminal lug		FUNCTION
MFD	MFC	1 2 3	RL1 RL2 RLC	Internal contact for motor restart management after braking cycle
		4 5	WORK WORK	Braking module enable (**clean contact**)
		6 7	DIAG DIAG	Contactor diagnostics (**clean contact**)
		8 9	CONT CONT	External contactor control
		T3		Motor signal return
		A1 A2		Auxiliary supply (on request)

2 Controls and settings

2.1 Operator panel

The setting panel shown in figure 2.1.1 is how it appears to the operator.
There are two different sections concerning the **setting** of the braking module and its **signaling**.

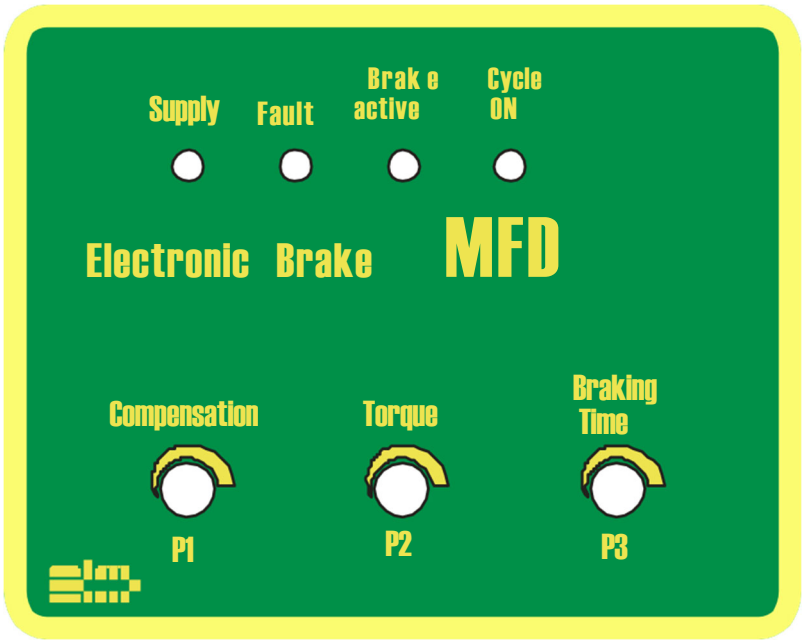


Fig. 2.1.1 - Operator panel

2.2 Settings

In the lower part there are the P1, P2, P3 parameter regulation potentiometers, with the functions:

P1 = Compensation
Allows to set the correction or compensation of the torque during the braking time according to the selected torque function
Turned clockwise increases the correction amount
Default pre adjustment at 25%
Regulate on the field 0 ÷ 50%

P2 = Torque
Allows to set the base torque amount that will be applied during the braking phase
Turned clockwise increases the torque
Default pre adjustment at 50%
Regulate on the field 0 ÷ 100%

P3 = Time
Fix the length of cut-off cycle
Turned clockwise increases the slope time
Default pre adjustment at 50%
Regulates on the field 1 ÷ 20” when **SW1 OFF**
Regulates on the field 10 ÷ 100” when **SW1 ON**

2.3 Signaling

For signaling, the **DL1, DL2, DL3, DL4** LEDs visible on the operator panel have the following functions:

DL1 = Supply **Green** Front
Signals the presence of the auxiliary supply and of the relative internal service voltages

DL2 = Fault **Red** Front
Signals a function block due to:
Overtemperature
Signals the exceeding of the maximum temperature
Active = Fixed red
Event memorization = Slow blinking led
Overcurrent
Signals the intervention of max current protection
Active = Quick blinking led
Cycle fault
Signals a fault in the activation / interlocks sequence
Active = blinks every 2 seconds
The recovery after the fault takes place only with a reset order or resetting the power supply.

DL3 = Current injection **Red** Front
Signals the condition of the braking current
The brightness is proportional to the motor braking current

DL4 = Braking required **Yellow** Front
Signals the condition of active cut-off cycle

2.4 DIP switch settings

SW1 (FS-T) OFF = Full scale cycle time = 20 sec
ON = Full scale cycle time = 100 sec

SW2 (A/M) OFF = Current injection automatically stops when the motor stops
ON = Current injection stops at the end of the set time

SW3 (C0) OFF **SW4** (C1) OFF Function: **Constant Torque**

The braking torque is set by the frontal potentiometer "**Torque**" (P2) on the filed 0-100%.
The "**Compensation**" (P1) adjustment is not active (Fig. 1 page 13)

SW3 (C0) OFF **SW4** (C1) ON Function: **Decreasing Torque**

The starting braking torque is set by the frontal potentiometer "**Torque**" (P2) on the range 0-100% and remains as such for half of the set braking time ("**Time**" P3).
After half time begins the function **Decreasing torque**. The decreased amount is set by "**Compensation**" (P1), which adjusts in the range 0-50%, that will be applied gradually till the end of braking time
(Fig. 2 page 13)

SW3 (C0) ON **SW4** (C1) OFF Function: **Increasing Torque**

The starting braking torque is set by the frontal potentiometer "**Torque**" (P2) in the range 0-100% and remains as such for half of the set braking time ("**Time**" P3).
After half time begins the function **Increasing torque.** The increased amount is set by "**Compensation**" (P1), which adjusts in the rage 0-50%, that will be applied gradually till the end of braking time
(Fig. 3 page 13)

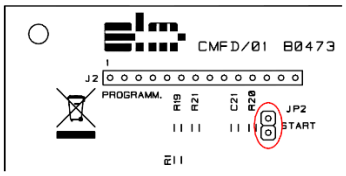
SW3 (C0) ON **SW4** (C1) ON Function: **Variable Torque**

The starting braking torque is set by the frontal potentiometer "**Torque**" (P2) in the range 0-100%, increases by the value set by "**Compensation**" (P1) for half of the set braking time ("**Time**" P3), then decreases until the end of braking time, returning to the starting value
(Fig. 4 page 13)

Power ON cycle setting

JP2 OFF = When power is supplied the cycle starts with the braking command ON

ON = When power is supplied the MF waits for a normal braking cycle to start the braking



Default: at shipment the cycle is active after the first normal cycle

3 Installation

3.1 Connections

In the installation schematics on pages **11**, **12**, **13** are indicated the connection schematics for typical applications of the MFC / MFD braking system

The following considerations for general connection apply:

Power supply mains 380/400V 2 phases

Connect to **L1, L2** on the power terminal block

Power supply mains 220/230V 1 phase + earth

Connect to **A1, A2** on the control terminal block (**in models with separated auxiliary power supply**)

Braking cycle control

It can be done by closing a clean contact on terminals **4, 5**

It can be obtained by NC contact of the **K1** power contactor or by a net potential signal

For PLC control use a return to obtain a clean contact

Protection conductor (⏚) Pe

The module is provided with anchorage for the **Pe** protection conductor connection

Make sure to make the connection properly

Shielding

Usually it's not necessary

Cycle agreements

On the terminal board are available some relay contacts, that run the agreement of the motor restart after a braking cycle on terminals **1**, **2**, **3**

3.2 General notes

The braking module fastening is foreseen with the proper stock brackets. These must be put on the lower part in the specific slots.

To enter the terminal boards, please refer to the following instructions.

To maintain the advised protection level, please use the specific pre-cut slit for the wires.

Install the device in vertical position. Avoid assembly near heat sources.

Leave around the device minimum 10 mm free area to the sides and below, to guarantee the necessary air circulation. Natural or forced ventilation is from the bottom to the top.

In case of box or cabinet assembly, please foresee a good air circulation with mouths or supported ventilation, that could guarantee the necessary change of air.

Arrange the air change so that an internal board temperature lower than 40°C or consider the derating values at page 4.

Connect the auxiliary circuit according to how indicated on the installation schematic, having care to keep the control wires path as separated as possible from the power ones.

WARNING: The working cycle of the device provides for the braking and slow down, not the control of the still motor.
For security applications combine the braking module circuit with a device for still motor control suited to the required class of security.

3.3 Protection fuses

The MFC / MFD module isn't supplied with fuses on board for the protection of power circuit.
Extra-rapid fuses or magneto-thermic switches can be used based on the expected protection coordination.
Please contact our office for any further information.

The size of the advised fuses for the 400Vac application is on the following chart:

MF size	Motor power [kW]	Nominal current [A]	Current max 10" [A]	aM fuse size [A]
~~MF 20~~	~~7,5~~	~~15~~	~~30~~	~~15~~
~~MF 30~~	~~15~~	~~30~~	~~60~~	~~30~~
MF 50	22	50	100	50
MF 75	37	75	150	75
MF 100	55	100	200	100
MF 150	75	150	300	150
MF 200	110	200	400	200
MF 300	160	300	600	300
MF 400	200	370	740	370
MF 500	250	460	920	460

NB: Sizes MF20 and MF30 have been discontinued

Fig. 3.3.1 – Protection fuses size

Note: The needs of security exercise require that the installation should be made by qualified workers, as foreseen by the laws in force.
Do not insert the re phasing group on the motor side output. If the re phasing group would be necessary, please always insert it **upstream the main working contactor.**
The re phasing group must be of fixed / without automatic regulation type.

3.4 Supply voltage

MFC Versions 15 - 150
In the standard version the module is designed for 230 / 400 Vac, different values on request
The auxiliary voltage is derived internally and is 230 / 400 Vac settable with internal jumpers

MFD Versions 200 - 500 A
In the standard version the module is designed for 230 / 400 Vac, different values on request
An auxiliary voltage of 220 Vac must be supplied for the services (Ventilation 20VA)

At the moment of shipping the standard version is designed for 400 Vac supply

Please indicate the required voltage in the order or contact our office for the necessary instructions to make the 230 / 400 / 440 V variation

3.5 Typical installation schematics

MFC VERSION

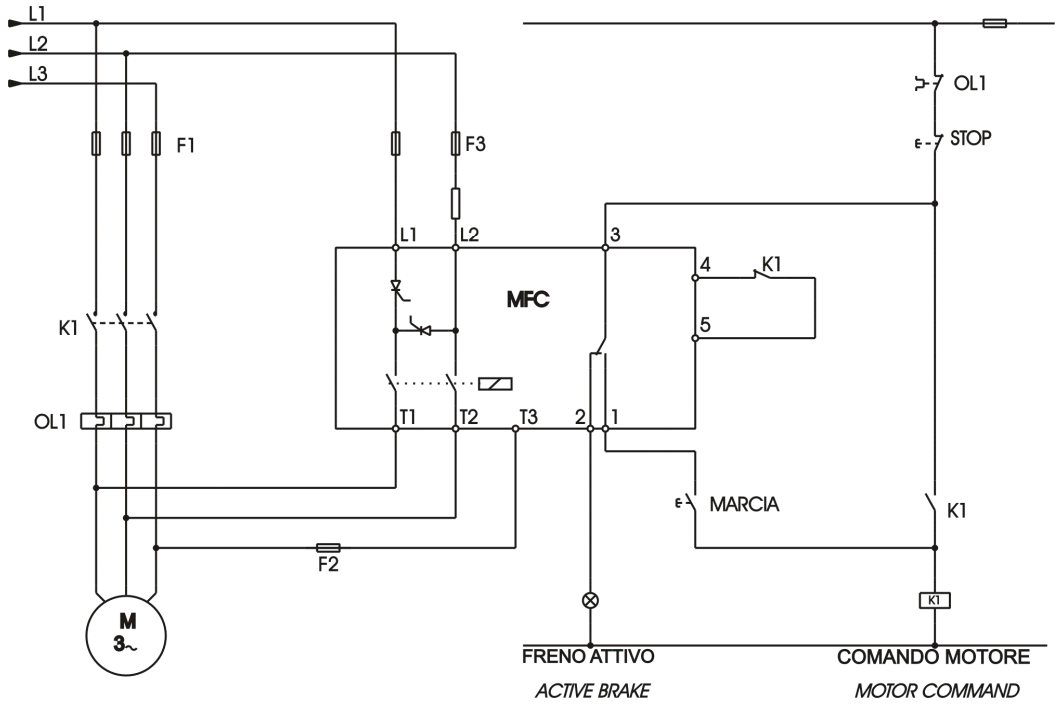


Fig. 3.5.1 - MFC base circuit

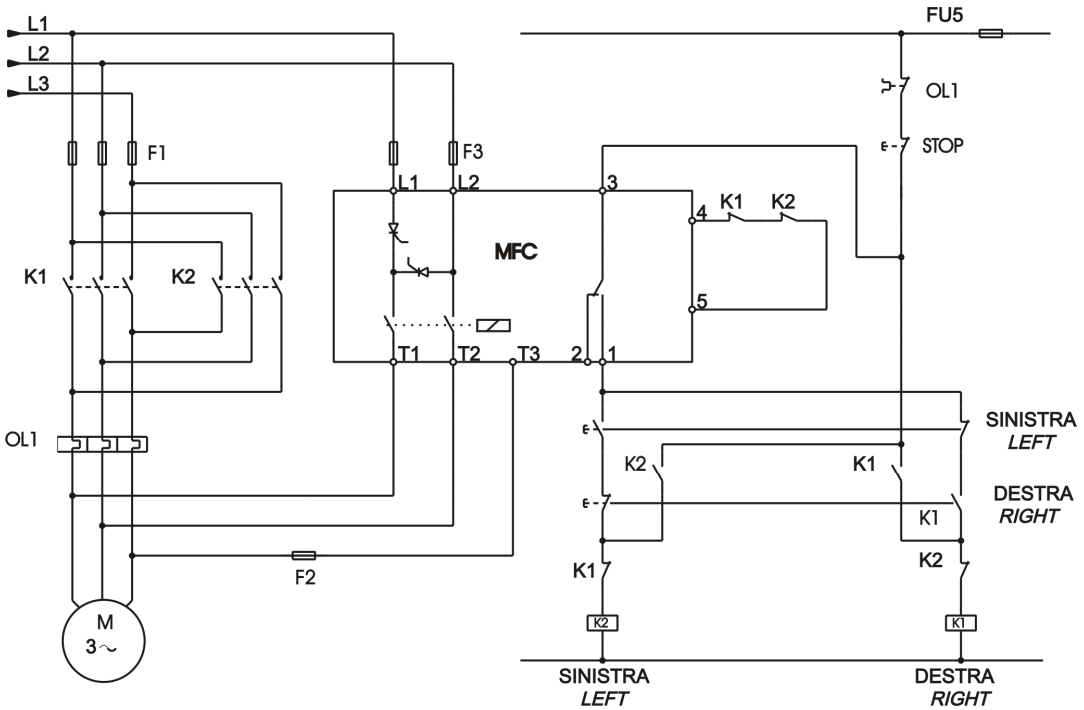


Fig. 3.5.2 - MFC Reverse direction

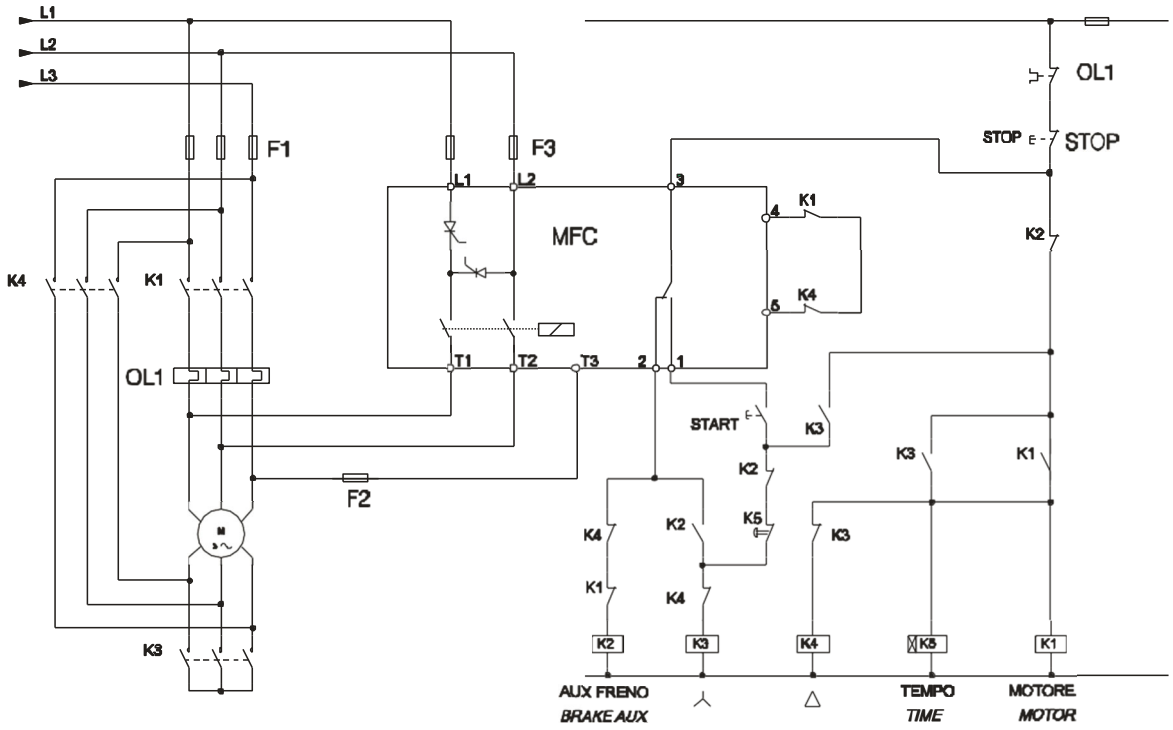


Fig. 3.5.3 - MFC Star-delta starting

MFD VERSION

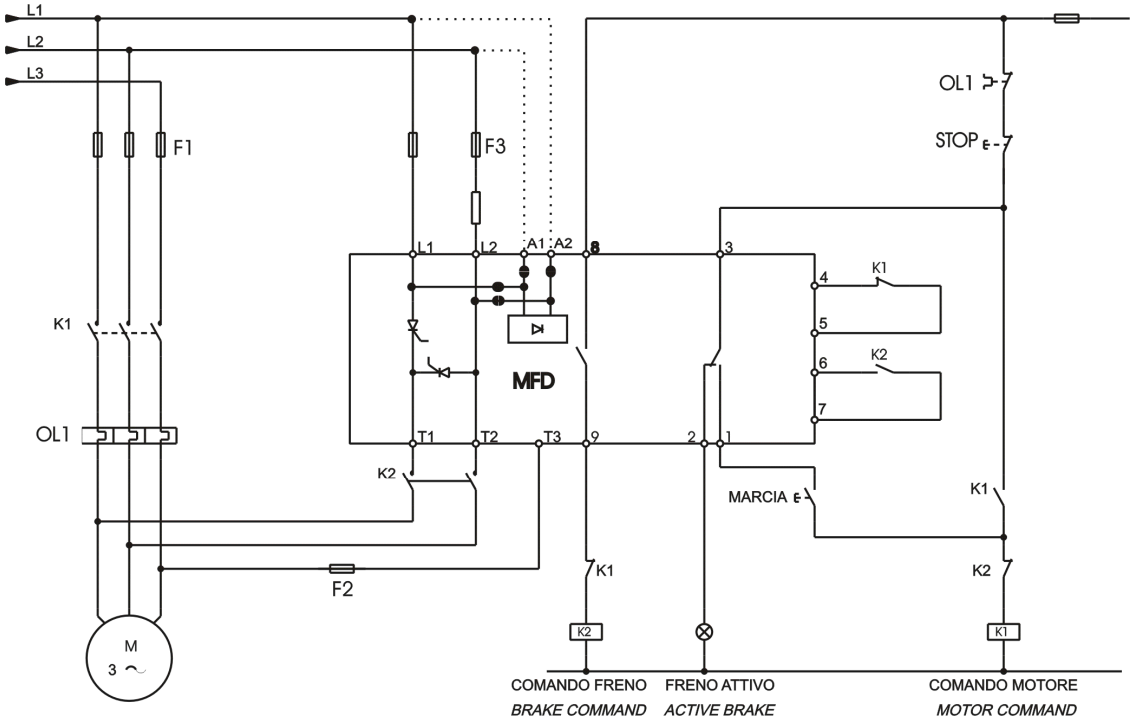


Fig. 3.5.4 - MFD Base circuit

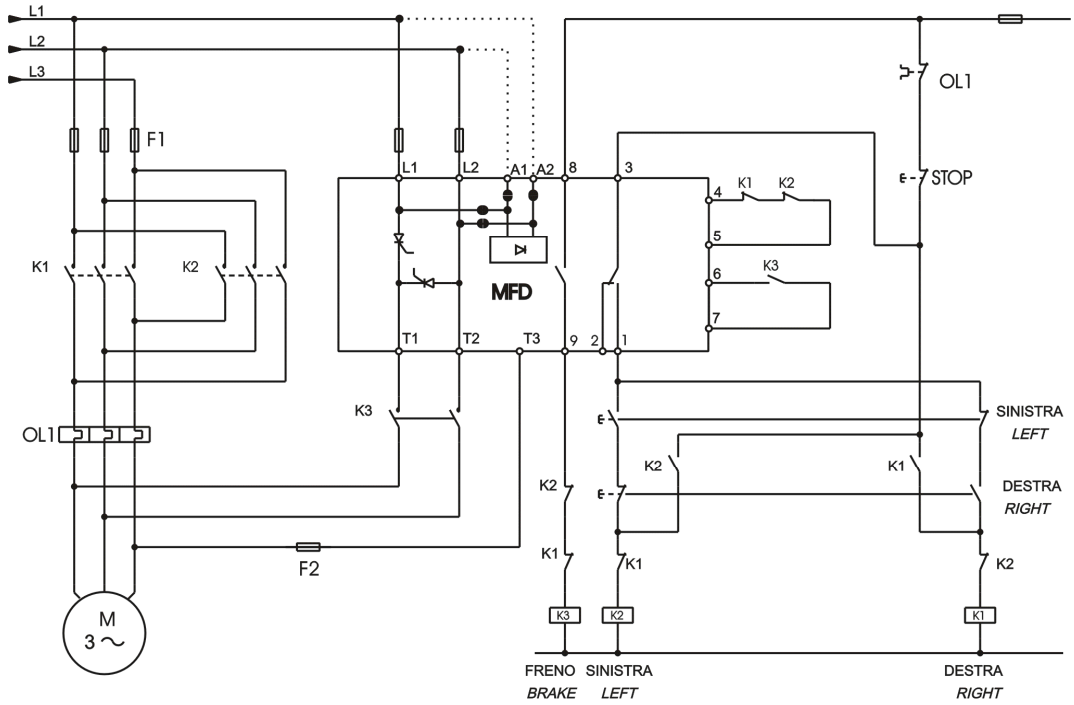


Fig. 3.5.5 - MFD Reverse direction

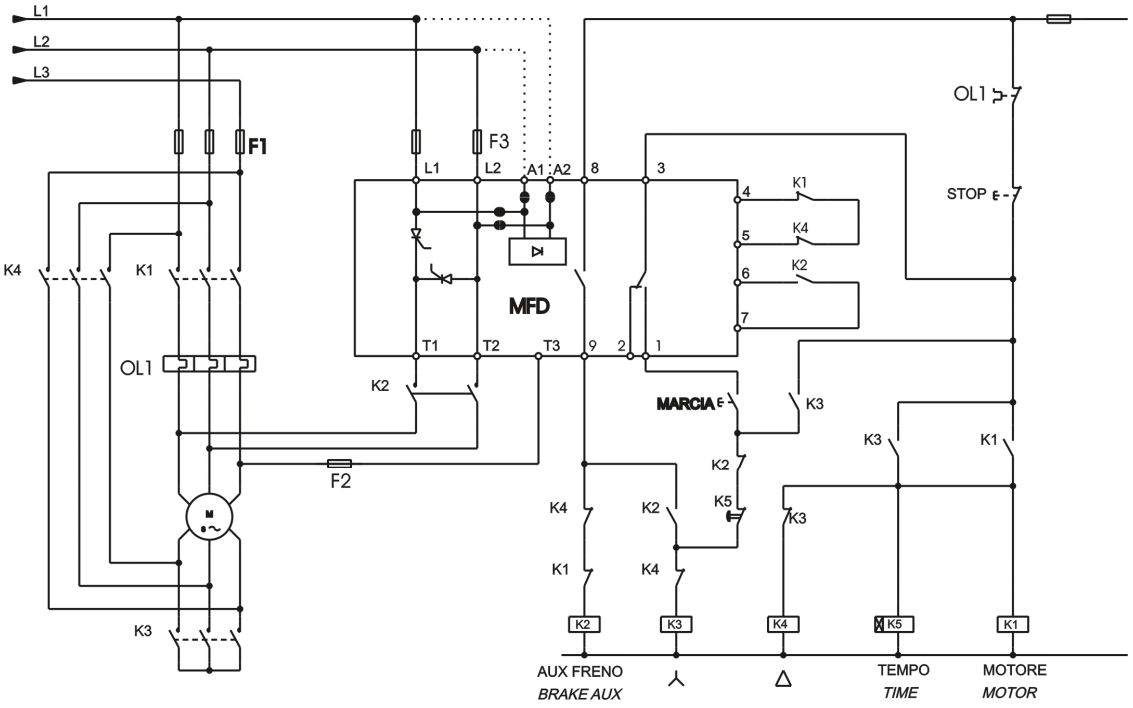


Fig. 3.5.6 - MFD Star-delta starting

4 Start-up

4.1 Working mode

Braking mode selection

It's possible to set 4 different braking modes:

Constant Torque **Fig. 1**

DIP switch **SW3** (C0) **OFF** **SW4** (C1) **OFF**

Linear braking torque set by "**Torque"** (P2)

Constant output current

Decreasing Torque **Fig. 2**

DIP switch **SW3** (C0) **OFF** **SW4** (C1) **ON**

The braking torque set by "**Torque**" (P2) is constant until 50% of the cycle time, then it decreases. The decreased amount is set by "**Compensation**" (P1)

Increasing Torque **Fig. 3**

DIP switch **SW3** (C0) **ON** **SW4** (C1) **OFF**

The braking torque starts from the value set by "**Torque**" (P2), it increases until 50% of the cycle time, then it stays constant until the end of the braking cycle. The increased amount is set by "**Compensation"** (P1)

Variable Torque **Fig. 4**

DIP switch **SW3** (C0) **ON** **SW4** (C1) **ON**

The braking torque starts from the value set by "**Torque**" (P2), it increases until 50% of the cycle time where it reaches the values set by "**Compensation**" (P1)

Then it decreases until it reaches the value set by "**Torque**" (P2)

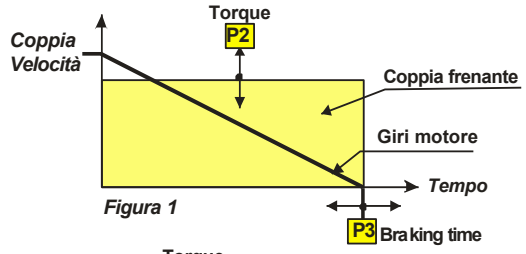


Figura 1

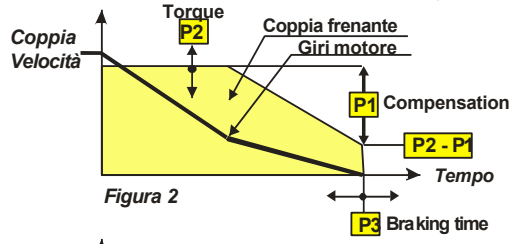


Figura 2

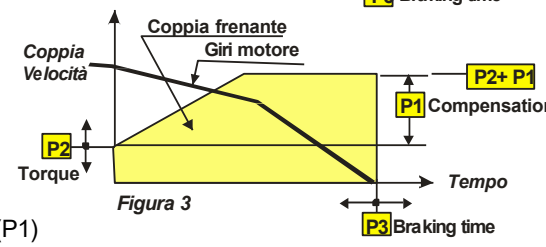


Figura 3

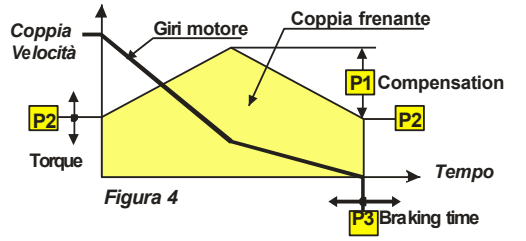


Figura 4

Current / torque profiles

Braking time selection

Two time ranges can be set by DIP Switch **SW1** (FS-T)

Position **OFF** With "**Braking time**" (P3) the range is between 1 and 20 sec

Position **ON** With "**Braking time**" (P3) the range is between 10 and 100 sec

Braking mode selection

Two cut-off modes can be set from DIP Switch **SW2** (A/M)

Position **OFF** **Automatic**

Braking ends when the motor becomes still, but the cycle is reset only at the end of the set time

Position **ON** **Manual**

Braking is active until the end of the set time

4.2 First start procedure

First start

- Check that the module size fulfils the grid voltage specifications and is adequate for the installed motor
- Set the configuration switches for the desired functionality, leaving **SW2** in manual **ON** position
- Set the "**Compensation**" (P1) and "**Torque**" (P2) to zero (anticlockwise)
- Open the motor fuses and test the **Working** and **Braking** cycle
- Regulate the desired braking time (in the phase following the cut-off) by acting on "**Braking time**" (P3) (during the cut-off cycle it will be visualized by LED **Cycle ON**). The cycle time can only be regulated when the cycle is not active, and is proportional to the potentiometer rotation angle. It's necessary to set a time, check it and correct it before starting a new cycle. **Corrections made during the cycle are active only for that cycle**
- Verify that the start command is inactive during the braking time
- Set "**Torque**" (P2) until it has a braking effect (20 - 30% of the trimmer's rotation). If a DC ammeter is available, measure the current on the **T1** wire and regulate the torque based on the measured current and the detected braking behavior
- Restore the motor fuses and execute the working cycle
- Readjust if necessary "**Torque**" (P2) and "**Braking time**" (P3) in order to have the desired cut-off time
- The braking time is intended as cycle time. If the motor stops before the end of the set time it's possible to activate the auto off function, which stops the braking current when the motor stops.
  In any case, even if the braking current is not active the cycle will end when the set time ends. The restart will only be possible at the end of the braking cycle (cycle time finished)
- To activate the automatic cut-off function set **SW2** to **Auto (OFF)**
- Repeat the working cycle if needed to further optimize the system's functionality

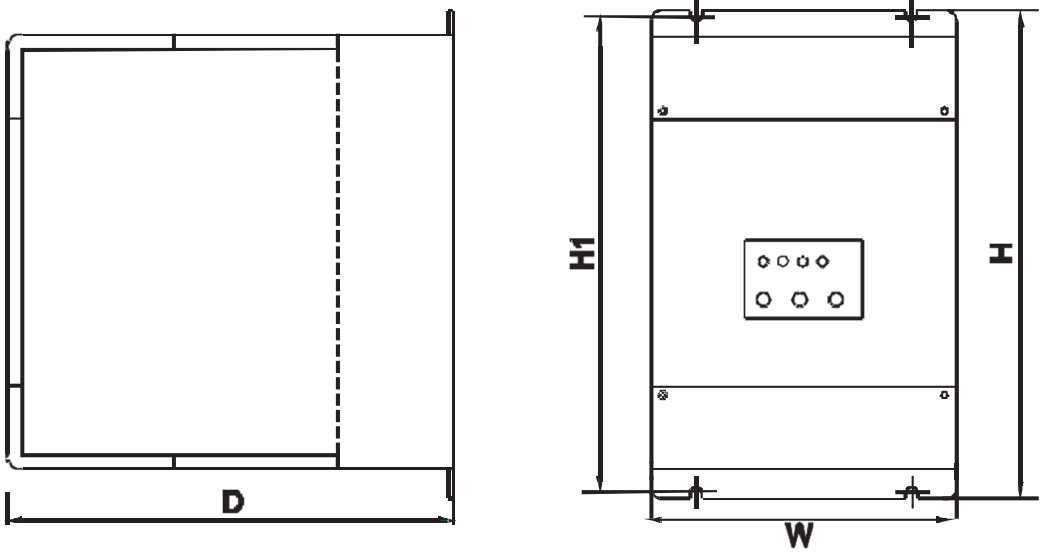
Compensation settings

To optimize the braking function in can be useful to compensate the braking action either in the first half of the braking phase when the motor's speed is highest to avoid abrupt braking, or in the second half when the speeds are low to avoid mechanical resonance.
To activate the compensation function, refer to the information in **page 14** to determine the required braking behavior.

- **Decreasing torque**
  Set the programming switches as explained in **page 14**
  Set "**Torque**" (P2) to have the desired initial braking torque, leaving "**Compensation**" (P1) at 20%
  Increase "**Compensation**" (P1) to soften the braking at the end of the cycle
  Compensation potentiometer at 0% = No braking compensation
  Compensation potentiometer at 100% = Braking reduction equal to 50% of the maximum torque

- **Increasing torque**
  Set the programming switches as explained in **page 14**
  Set "**Torque**" (P2) to have the desired initial braking torque, leaving "**Compensation**" (P1) at 20%
  Increase "**Compensation**" (P1) to increase the braking at the end of the cycle
  Compensation potentiometer at 0% = No braking compensation
  Compensation potentiometer at 100% = Braking increase equal to 50% of the maximum torque

5 Dimensions and weight



Suggested MF size		Dimensions [mm]					Weight [kg]
		W	H	D	W1	H1	
MFC	**20**	106	170	95	50	160	0,8
MFC	**30**	106	170	95	50	160	0,8
MFC	**50**	106	170	160	75	160	1,9
MFC	**75**	106	170	160	75	160	1,9
MFC	**100**	106	170	160	75	160	1,9
MFD	**50**	106	170	120	75	160	1,3
MFD	**75**	106	170	120	75	160	1,3
MFD	**100**	106	170	120	75	160	1,3
MFD	**150**	166	240	190	100	220	4
MFD	**200**	166	240	190	100	220	4
MFD	**300**	166	240	190	100	220	4
MFD	**400**	206	280	210	120	260	6
MFD	**500**	216	300	350	120	280	16

6 Troubleshooting

PROBLEM	CONDITION	SUGGESTED SOLUTION
The motor doesn't run and it doesn't accept the working command	LED **Cycle ON** is lit Cycle time too long	The module is executing a braking cycle Wait the end of the braking time and if necessary reduce it from "**Time**" (P3)
The motor doesn't run and it doesn't accept the working command	LED **Cycle ON** is off	Check that the motor start contact between terminals **1 - 3** is closed
The motor runs but doesn't brake at the cut-off command	LED **Cycle ON** doesn't turn on at the cut-off	Check that the braking command contact **4 - 5** is closed
The braking cycle stops just after the cut-off command	LED **Cycle ON** is lit Low braking torque	Set **SW2** to OFF to turn off the automatic brake cut-off Increase "**Torque**" (P2)
The braking cycle doesn't stop when the motor is still and continues until the end of the braking time	LED **Cycle ON** is lit	Set **SW2** to ON to turn on the automatic brake cut-off Increase "**Torque**" (P2)
The braking cycle is executed but the cut-off time is not enough	LED **Cycle ON** is lit	Increase "**Torque**" (P2) Increase "**Braking time**" (P3) Make sure that **SW3** and **SW4** are positioned correctly
During braking there are unwanted vibrations at low speeds	Light load with a lot of inertia from big flywheels	Select the **Decreasing Torque** working mode and regulate "**Compensation**" (P1) to reduce the braking action at the end of the cycle
At the beginning of the braking cycle there are unwanted vibrations and knocks	Load with significant play in the transmission	Choose the **Increasing Torque** working mode and regulate "**Compensation**" (P1) to increase the braking action at the end of the cycle