Sirius Digital Servo Drivers

Revision: 0.19

July 24, 2014

version	date	author	description	fw version
0.18		Marco Trentarossi	first deploy	DRV0-00.39
0.19		Francesco Trentarossi	FCC / Industry Canada Statements	DRV0-00.39

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Chapter 1

General information

1.1 Introduction

Motor control solution products:

- Sirius Digital Servo Drivers
- Fully configurable firmware to use
  - Brushless motors
  - Stepper motors
  - DC motors
- Winloader - Application updater
- Motor Control - Setup software

Chapter 2

Hardware MOH

2.1 Operational description

2.1.1 MOH

Sirius MOH is a compact servo driver. It can operate in position, speed or torque control mode, driving brushless DC or AC motors, stepper or brushed DC motors.

It can be used in network or stand alone environments. Standard feedback is provided by Hall sensors and incremental encoders. It can be configured, tested and be driven from a PC via serial TTL connection.

Our drivers communicate using CANOpen protocol and up to 127 drivers can be hooked up to the master in a CAN network. As a CAN node it can operate in position profile mode, speed mode and torque mode.

MOH can operate in conjunction with an external positioner in torque, speed or posizion mode. Speed reference input operates from 0 to 5 volts.

Four different hardware configurations are available.

2.2 Product images

2.2.1 MOH

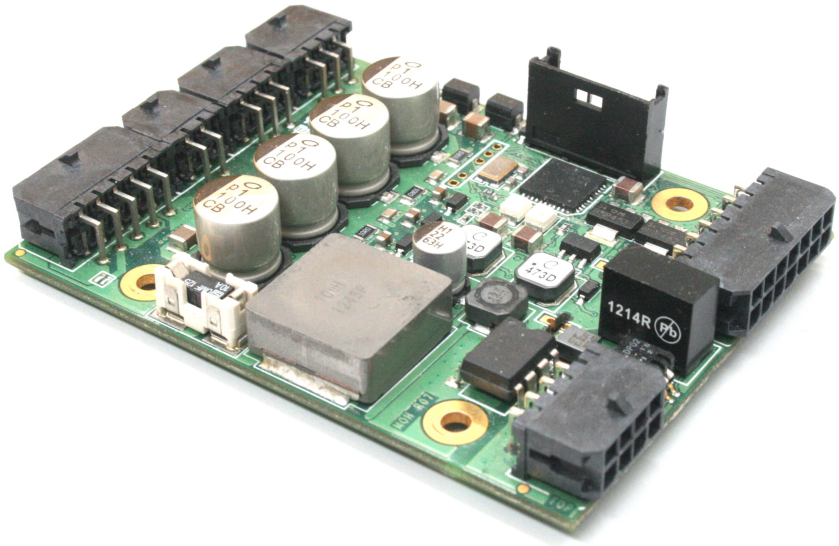


Figure 2.1: MOH-D

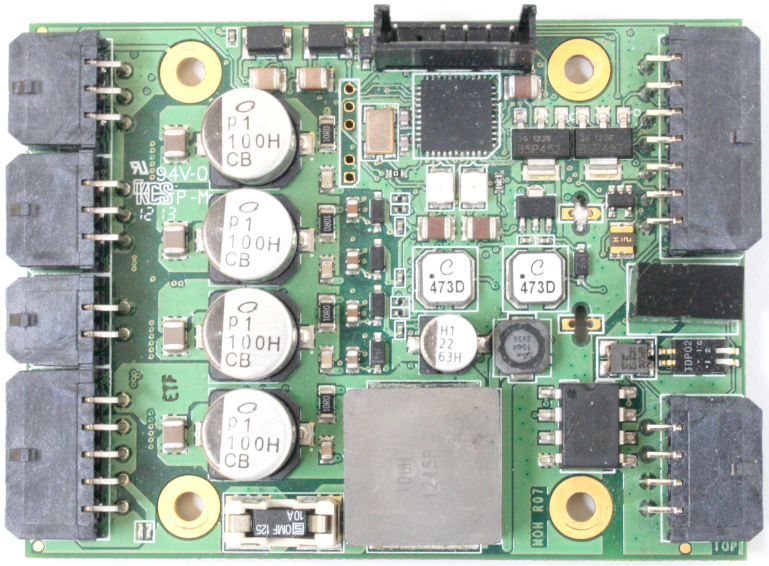


Figure 2.2: MOH-D

2.3 Configurations

	MOH-A	*MOH-B*	*MOH-C*	*MOH-D*	*U.M.*
CAN	-	-	√	√	-
ETHERNET					
MAXIMUM CURRENT	10	20	10	20	A
NOMINAL CURRENT	5	10	5	10	A
VDC	20-55	20-55	20-55	20-55	V

2.4 Specifications

2.4.1 Output power

	MOH-A,C	*MOH-B,D*	*U.M.*
Peak current *	10	20	A
Constant current	5	10	A
Peak power *	480	960	W

* these limits are due to Molex Microfit connectors

2.4.2 Input power

	MOH-A,C	*MOH-B,D*	*U.M.*
Input voltage	20-55	20-55	V
Peak current	10	20	A
Constant current	5	10	A

2.4.3 Digital Control

	MOH-A,B,C,D
Control loops	Current, speed, position. 100% digital control loops
Sampling frequency	Speed and current loops at 20 kHz (50us), position loop 1kHz (1ms), stepper/brush DC 40kHz
Commutation	FOC (field-oriented control) sinusoidal, step/microstepping
Modulation	Center-weighted PWM with space-vector modulation, full bridge
Minimum load inductance	200 uH line-line

2.4.4 PWM output

	Brushless	*Stepper/Brush DC*	*U.M.*
Type	3-phase mosfet inverter centered 20 kHz PWM	double H bridge 40kHz PWM microstepping	-
PWM frequency	20k	40k	Hz

PWM CONFIGURATION

The possible configurations are shown below.

In fig. 2.3 two coils are controlled independently so it is possible to control individual bipolar stepper motors.

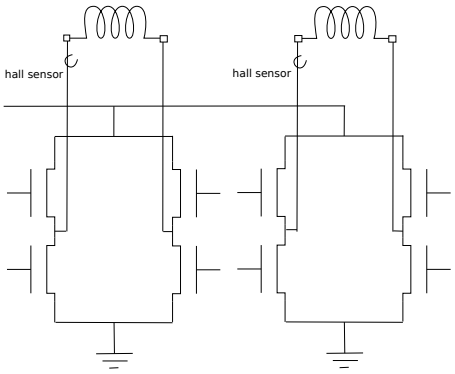


Figure 2.3: Double H bridge

In fig. 2.4 are driven the coils of a three-phase motor and a braking resistor. This configuration allows control of brushless motors. The third current is calculated by difference from the other two.

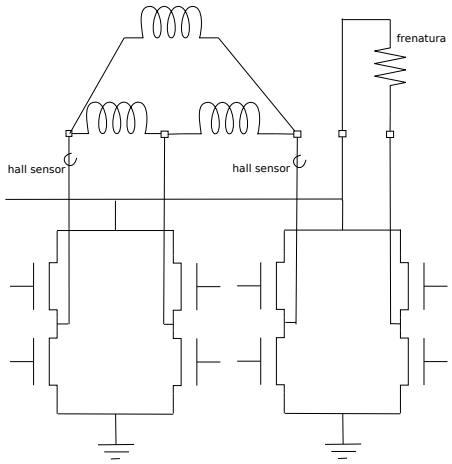


Figure 2.4: Three-phase bridge

2.4.5 Inputs

	MOH-A,B	*MOH-C,D*
CANopen	-	Position and homing profiles
Speed	0-5V	
TTL serial	Position, speed, torque, and homing profiles	

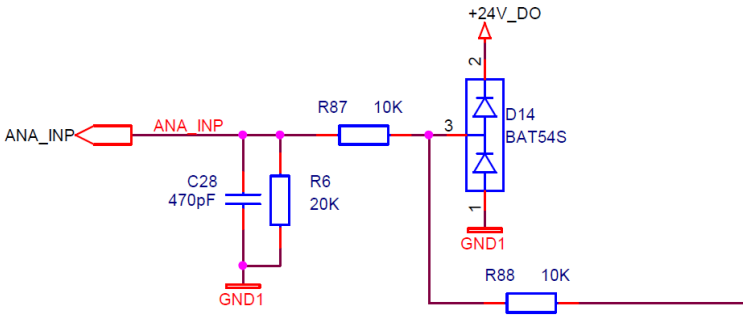


Figure 2.5: analog inputs

2.4.6 Digital inputs

	MOH-A,B,C,D
Number, type	3, not insulated, programmable
Inputs	active from 24V with RC filter
Logical levels	Vin-LO < 5.6V, Vin-HI > 13V
MS (IN1,2)	2 inputs @ 22us RC
MS (IN0)	1 input @ 22us RC with the possibility of reading through interrupt (homing)
Current consumption	10mA @ 24V

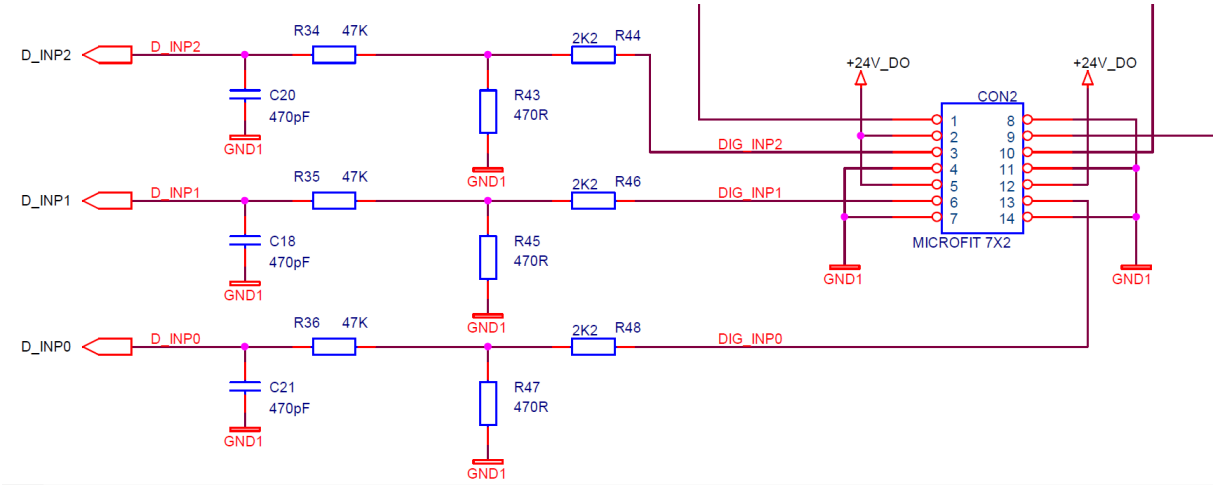


Figure 2.6: MS inputs

2.4.7 Digital outputs

	MOH-A,B,C,D
Number, type	2, not insulated, programmable
(OUT0,1)	Current-sourcing MOSFET at 24V (PNP)
Current consumption	200mA with PTC protection

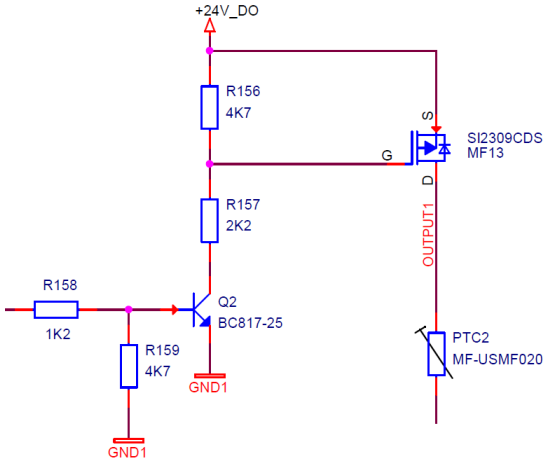


Figure 2.7: Outputs

2.4.8 UART port

	MOH-A,B,C,D
Signals	RX, TX, GND
Modes	full-duplex, serail port for motor control and setup, 115200 - 1250000 baud
Protocol	Binary

2.4.9 CAN port

	MOH-A,B	***MOH-C,D***
Signals	-	CANH, CANL, GND
Insulation	-	Optically insulated power and interface circuits +5 Vdc CAN
Format	-	conforming to the CAN V2.0b physical layer for high speed connections
Data	-	in accordance with CANopen CIA DS301
Address selection	-	dip-switch configurable
Stub	-	121 ohm selectable

2.4.10 Encoder port

	MOH-A,B	***MOH-C,D***
Signals	-	A, B, X
Levels	-	5V
Frequency	-	4MHz (post quadrature)
Power supply	-	5V @ 400mA

2.4.11 Digitall Halls

	MOH-A,B,C,D
Type	single ended digital, electrical phase-shifted by 120°
Levels	U, V, W
Frequency	10kHz
Power supply	5V @ 400mA

2.4.12 Motor connections

	MOH-A,B,C,D
U, V, W phases	three-phase PWM or 2 H bridges output, ungrounded.
Braking	dout(0).out can be configured as a brake without the needing of an external flyback diode.

2.4.13 Status Lights

	MOH-C,D
CAN status	Red and green lights, in accordance with CAN DR303-3

2.4.14 Protections

	MOH-A,B,C,D
I²T current limit	direct current
HV undervoltage	HV < 18V programmable

2.4.15 Mechanical and environmental

	MOH-A	*MOH-B*	*MOH-C*	*MOH-D*
Dimensions	75.7 x 54 mm			
Height	16.5 mm	16.5 mm	16.5 mm	16.5 mm
Weight	47 g	53 g	52 g	57 g
Temperature	Operativity from 0 to +45 ºC, Storage from -40 to +85 ºC			
Umidity	0 to 95%, non condensing			
Cooling	Heatsink or inducted airflow			

2.4.16 Conformance

	MOH-A,B,C,D
CE	CE compliant
61000_6_4	Generic standards - Emission Standard for industrial environments
61000_6_2	Generic standards - Immunity for industrial environments
ROHS	ROHS Compliant

2.5 Lights

There are two leds to indicate the status of the drivers.

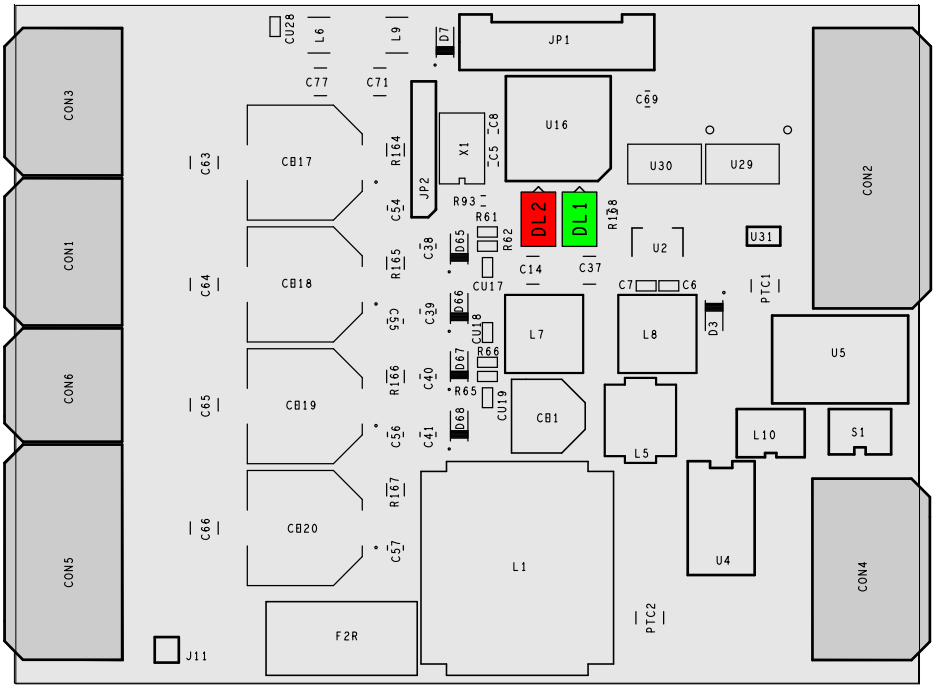
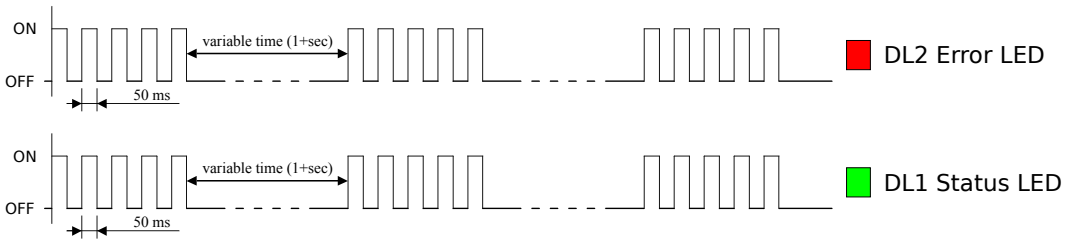


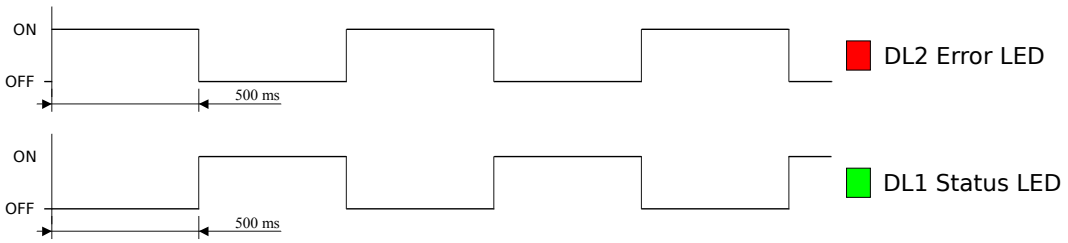
Figure 2.8: Lights position

The specifications of lights during operation of the device reflect what indicated in the document CiA DR 303-3 v1.2. In addition, two custom conditions have been defined

Corrupted or not installed application



Configuration parameters not found



2.6 Selectors

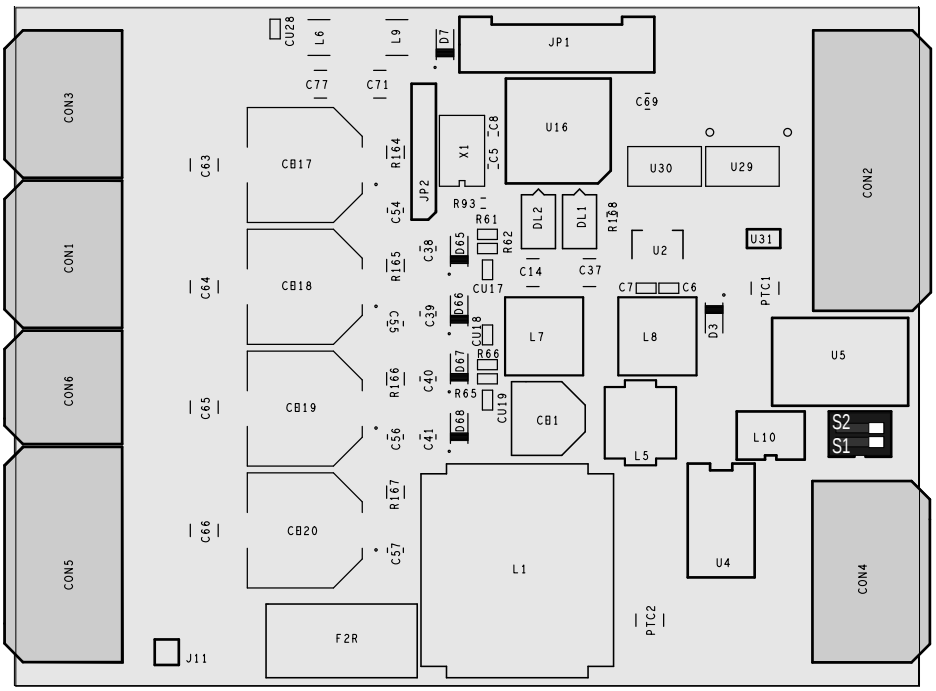


Figure 2.9: Position of selectors

Selector	*Description*
S1	Optional user defined function
S2	CAN terminating resistor

2.7 Connectors

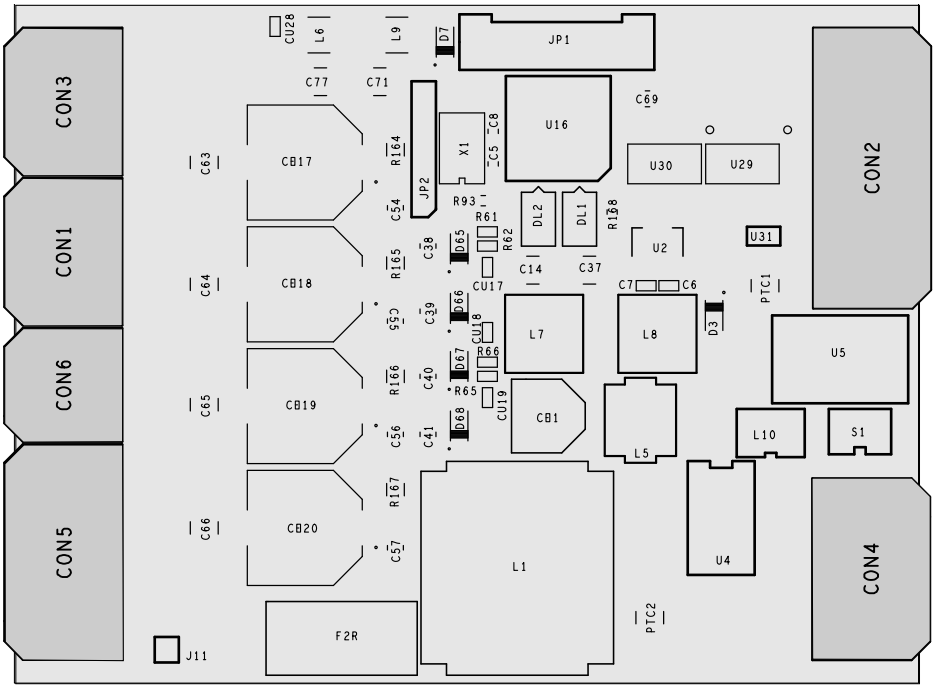


Figure 2.10: MOH-D Connectors

2.7.1 CON1 - Hall sensors connector

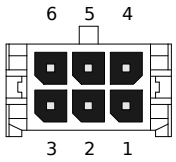


Figure 2.11: MICROFIT 3.0 430450600

pin	*name*	*type*	*description*
1	5V	OUT	5V sensors power supply
2	reference	-	5V common reference
3	reference	-	5V common reference
4	hallA	IN	hall sensor A
5	hallB	IN	hall sensor B
6	hallC	IN	hall sensor C

* CON3 is not present on MOH-A and MOH-B models. In this case it is possible to configure and use CON1 as encoder connector

2.7.2 CON2 - I/O connector

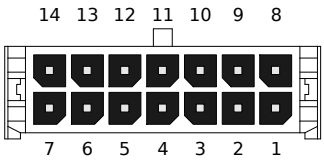


Figure 2.12: MICROFIT 3.0 430451400

pin	*name*	*type*	*description*
1	AI	IN	analog input
2	24V	OUT	24V digital input 2
3	DI_2	IN	digital input2
4	reference	-	common reference digital input 2
5	24V	OUT	24V digital input 1
6	DI_1	IN	digital input 1
7	reference	-	common reference digital input1
8	reference	-	common reference analog input / digital output 1
9	DO_1	OUT	digital output 1
10	DO_0	OUT	digital output 0
11	reference	-	common reference digital output 0
12	24V	OUT	24V digital input 0
13	DI_0	IN	digital input 0
14	reference	-	common reference digital input 0

2.7.3 CON3 - Encoder connector

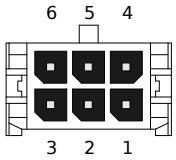


Figure 2.13: MICROFIT 3.0 430450600

pin	*name*	*type*	*description*
1	5V	OUT	5V encoder power supply
2	reference	-	5V common reference
3	reference	-	5V common reference
4	SA	IN	A signal
5	SB	IN	B signal
6	SC	IN	C sgnal (index)

* CON3 is not present on MOH-A and MOH-B models.

2.7.4 CON4 - CANopen connector

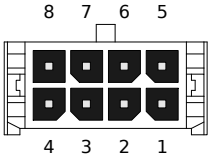


Figure 2.14: MICROFIT 3.0 430450800

pin	*name*	*type*	*description*
1-5	CH+	IN/OUT	CAN high
2-6	CH-	IN/OUT	CAN low
3-7	CAN reference	-	0V CAN reference
4-8	CAN reference	-	0V CAN reference

* Questo connettore è presente solo nei modelli MOH-C e MOH-D

2.7.5 CON5 - Power supply connector

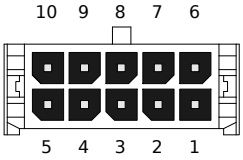


Figure 2.15: MICROFIT 3.0 430451000

pin	*name*	*type*	*description*
1	reference	-	24V common reference
2	24V logic	IN	locig circuits power supply
3	ground	-	ground
4	24V power	IN	main power supply
5	brake resistor	OUT	brake resistor
6	reference	-	24V common reference
7	24V logic	IN(OUT)	locig circuits power supply
8	ground	-	ground
9	24V power	IN(OUT)	main power supply
10	24V res brake	OUT	brake resistor reference

2.7.6 CON6 - Motor connector

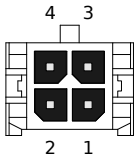


Figure 2.16: MICROFIT 3.0 430450400

pin	*name*	*type*	*description - three-phase (brushless)*	*description - double single-phase (stepper)*
1	B	OUT	brake resistor	H2-
2	U	OUT	U phase	H1+
3	W	OUT	W phase	H2+
4	V	OUT	V phase	H1-

FCC Statement

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Industry Canada statement

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

1. *this device may not cause interference, and*
2. *this device must accept any interference, including interference that may cause undesired operation of the device.*

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

1. *l'appareil ne doit pas produire de brouillage, et*
2. *l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.*

CAN ICES-3 (A)/NMB-3(A)

Chapter 3

Hardware MQA

3.1 Operational description

3.1.1 MQA

Sirius MQA is a compact servo driver. It can operate in position, speed or torque control mode, driving brushless DC or AC motors, stepper or brushed DC motors.

It can be used in network or stand alone environments. Standard feedback is provided by Hall sensors and incremental encoders. It can be configured, tested and be driven from a PC via serial TTL connection.

Our drivers communicate using CANOpen protocol and up to 127 drivers can be hooked up to the master in a CAN network. As a CAN node it can operate in position profile mode, speed mode and torque mode.

MOH can operate in conjunction with an external positioner in torque, speed or posizion mode. Speed reference input operates from 0 to 5 volts.

Sirius MQA has the same characteristics of the MOH series but has an Ethernet communication interface on which it is possible to use the CANopen protocol.

Two different hardware configurations are available.

MQA is mechanically compatible with the MOH series, with which it shares the pitch of the mounting holes and the dimensions of the printed circuit board.

3.2 Product images

3.2.1 MQA

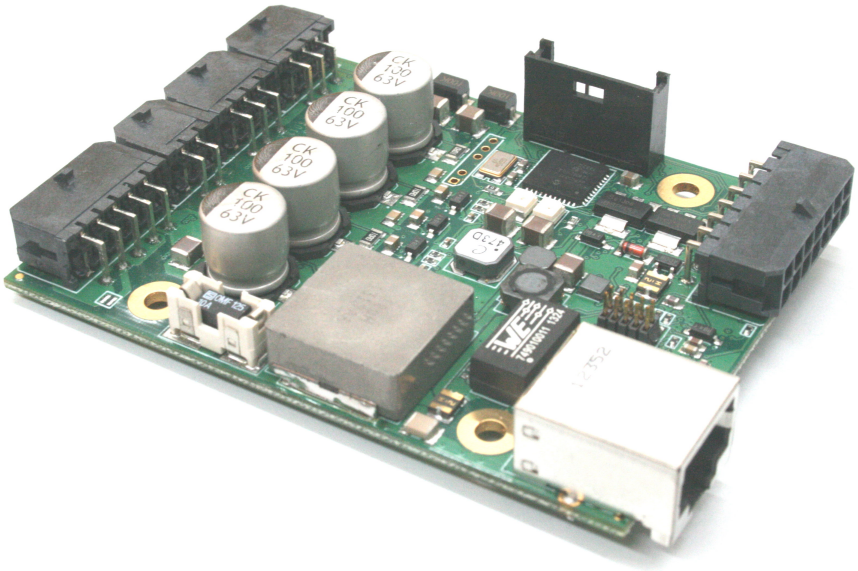


Figure 3.1: MQA-D

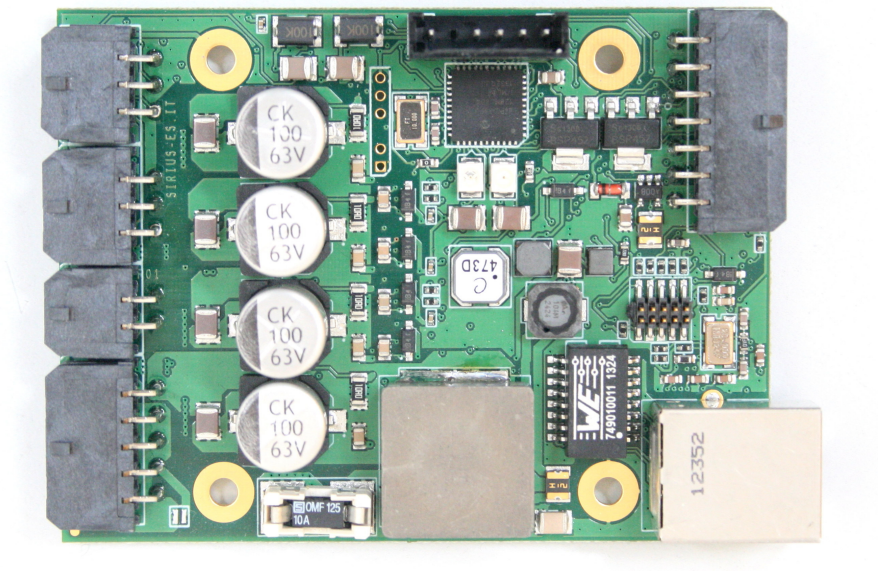


Figure 3.2: MQA-D

3.3 Configurations

	MQA-C	*MQA-D*	*U.M.*
CAN			-
ETHERNET	√	√	
MAXIMUM CURRENT	10	20	A
NOMINAL CURRENT	5	10	A
VDC	20-55	20-55	V

3.4 Specifications

3.4.1 Output power

	MQA-C	*MQA-D*	*U.M.*
Peak current *	10	20	A
Constant current	5	10	A
Peak power *	480	960	W

* these limits are due to Molex Microfit connectors

3.4.2 Input power

	MQA-C	*MQA-D*	*U.M.*
Input voltage	20-55	20-55	V
Peak current	10	20	A
Constant current	5	10	A

3.4.3 Digital control

	MQA-C,D
Control loops	Current, speed, position. 100% digital control loops
Sampling frequency	Speed and current loops at 20 kHz (50us), position loop 1kHz (1ms), stepper/brush DC 40kHz
Commutation	FOC (field-oriented control) sinusoidal, step/microstepping
Modulation	Center-weighted PWM with space-vector modulation, full bridge
Minimum load inductance	200 uH line-line

3.4.4 PWM Outputs

	Brushless	*Stepper/Brush DC*	*U.M.*
Type	3-phase mosfet inverter centered 20 kHz PWM	double H bridge 40kHz PWM microstepping	-
PWM frequency	20k	40k	Hz

PWM CONFIGURATION

The possible configurations are shown below.

In fig. 2.3 two coils are controlled independently so it is possible to control individual bipolar stepper motors.

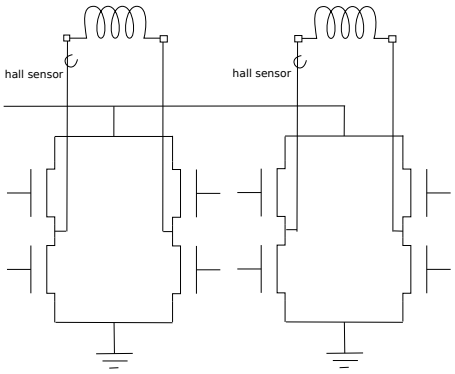


Figure 3.3:

In fig. 2.4 are driven the coils of a three-phase motor and a braking resistor. This configuration allows control of brushless motors. The third current is calculated by difference from the other two.

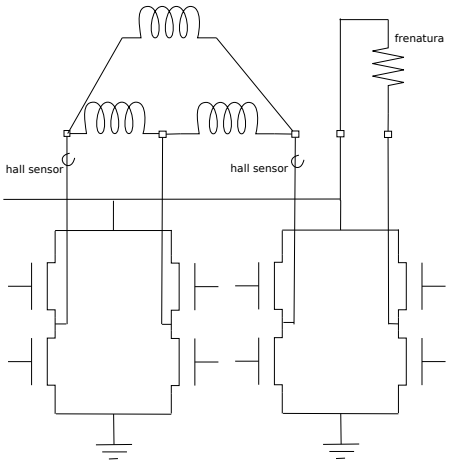


Figure 3.4: Three-phase bridge

3.4.5 Inputs

	MQA-C,D
CANopen	Position and homing profiles
Speed	0-5V
TTL serial	Position, speed, torque, and homing profiles

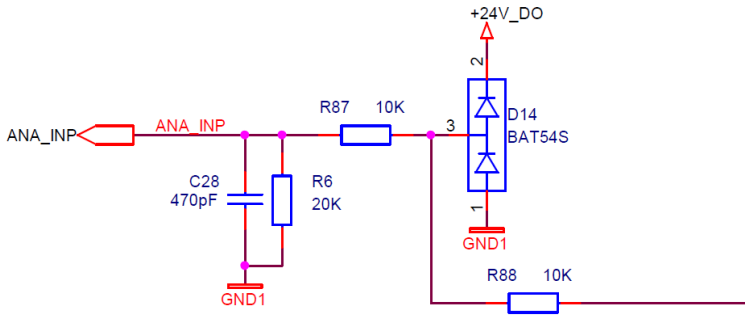


Figure 3.5: Analog inputs

3.4.6 Digital inputs

	MQA-C,D
Number, type	3, not insulated, programmable
Inputs	active from 24V with RC filter
Logical levels	Vin-LO < 5.6V, Vin-HI > 13V
MS (IN1,2)	2 inputs @ 22us RC
MS (IN0)	1 input @ 22us RC with the possibility of reading through interrupt (homing)
Current consumption	10mA @ 24V

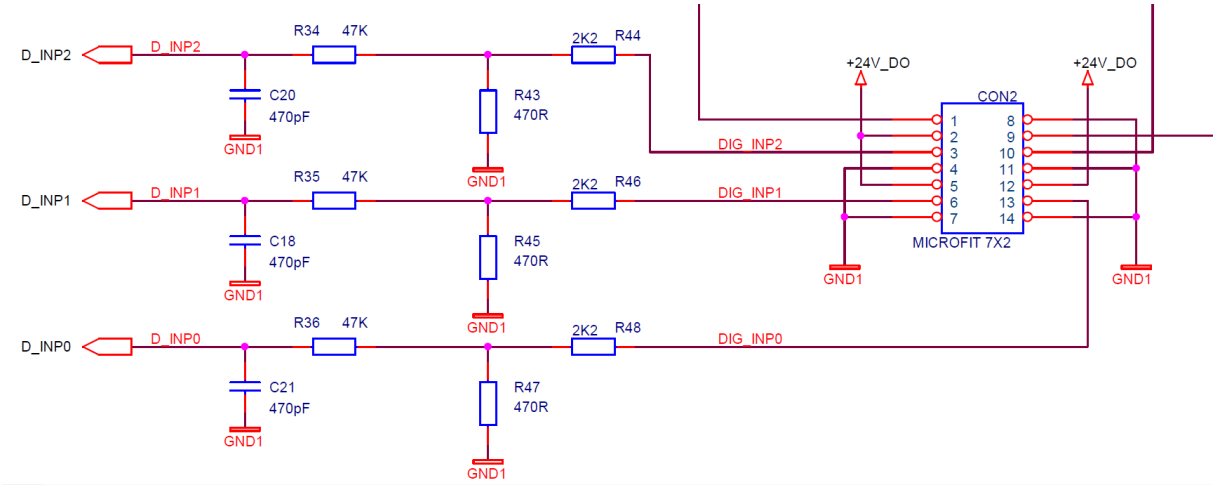


Figure 3.6: MS inputs

3.4.7 Digital outputs

	MQA-C,D
Number, type	2, not insulated, programmable
(OUT0,1)	Current-sourcing MOSFET at 24V (PNP)
Current consumption	200mA with PTC protection

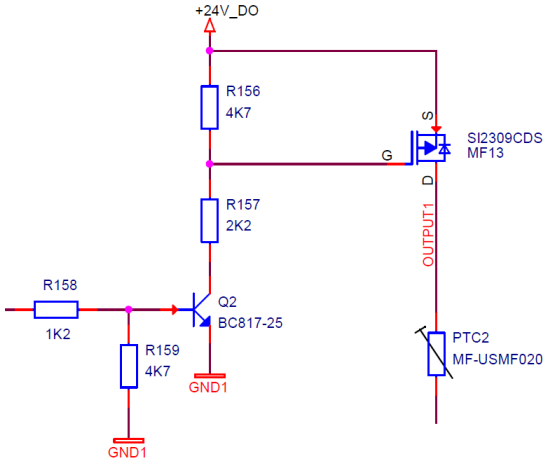


Figure 3.7: Outputs

3.4.8 UART port

	MQA-C,D
Signals	RX, TX, GND
Modes	full-duplex, serail port for motor control and setup, 115200 - 1250000 baud
Protocol	Binary

3.4.9 CAN port

	MQA-C,D
Signals	CANH, CANL, GND
Insulation	Optically insulated power and interface circuits +5 Vdc CAN
Format	conforming to the CAN V2.0b physical layer for high speed connections
Data	in accordance with CANopen CIA DS301
Address selection	dip-switch configurable
Stub	121 ohm selectable

3.4.10 Encoder port

	MQA-C,D
Signals	A, B, X
Levels	5V
Frequency	4MHz (post quadrature)
Power supply	5V @ 400mA

3.4.11 Digital Halls

	MQA-C,D
Type	single ended digital, electrical phase-shifted by 120°
Levels	U, V, W
Frequency	10kHz
Power supply	5V @ 400mA

3.4.12 Motor connections

	MQA-C,D
U, V, W phases	three-phase PWM or 2 H bridges output, ungrounded.
Braking	dout(0).out can be configured as a brake without the needing of an external flyback diode.

3.4.13 Status lights

	MQA-C,D
CAN status	Red and green lights, in accordance with CAN DR303-3

3.4.14 Protections

	MQA-C,D
I²T current limit	direct current
HV undervoltage	HV < 18V programmable

3.4.15 Meccaniche e ambientali

	MQA-C	*MQA-D*
Dimensions	79.5 x 54 mm	
Height	16.5 mm	
Weight	50	55 g
Temperature	Operativity from 0 to +45 °C, Storage from -40 to +85 °C	
Umidity	0 to 95%, non condensing	
Cooling	Heatsink or inducted airflow	

3.4.16 Conformance

	MQA-C,D
CE	CE compliant
61000_6_4	Generic standards - Emission Standard for industrial environments
61000_6_2	Generic standards - Immunity for industrial environments
RoHS	RoHS Compliant

3.5 Lights

There are two leds to indicate the status of the drivers.

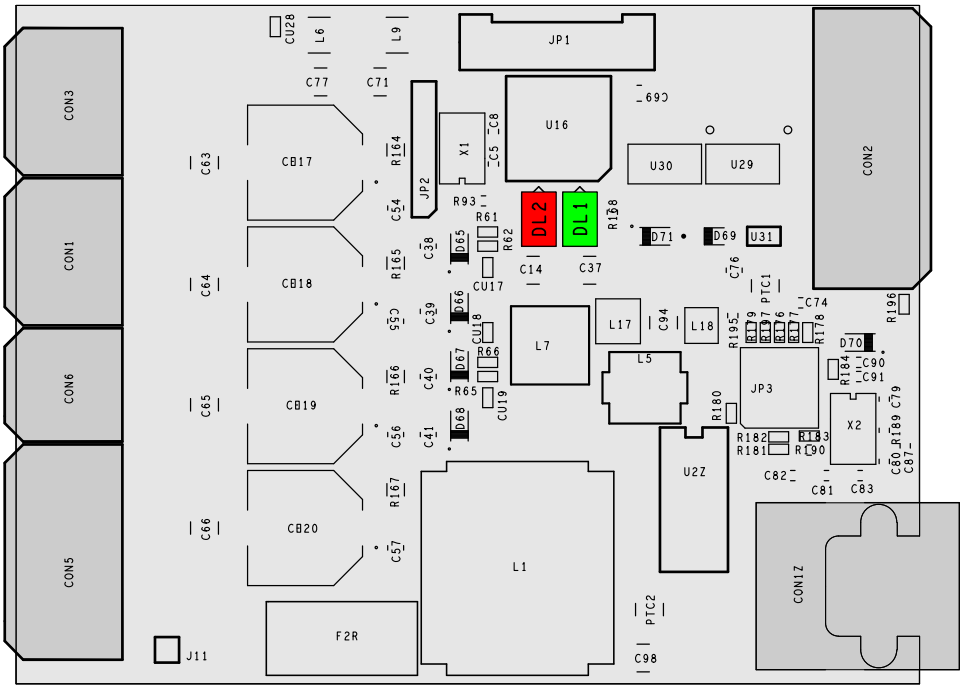
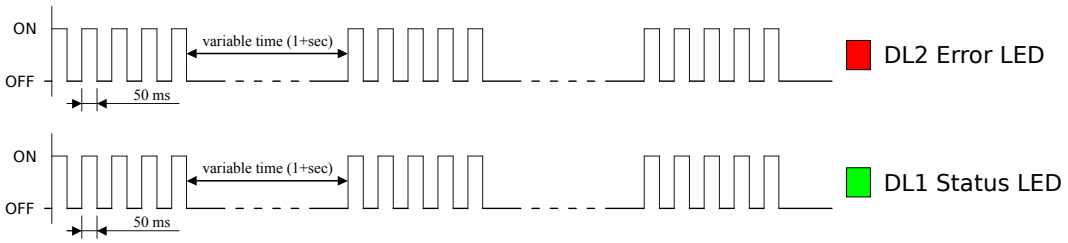


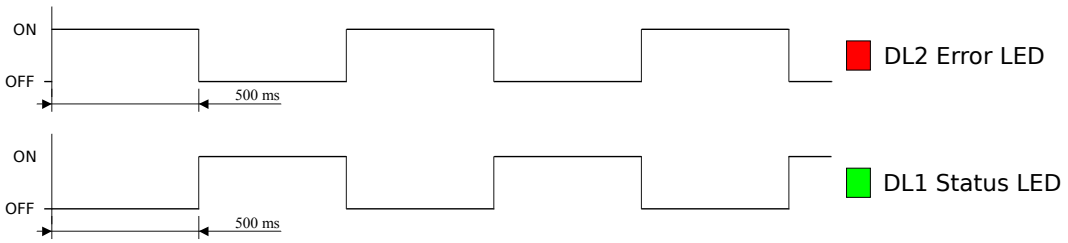
Figure 3.8: Lights position

The specifications of lights during operation of the device reflect what indicated in the document CiA DR 303-3 v1.2. In addition, two custom conditions have been defined

Corrupted or not installed application



Configuration parameters not found



3.6 Connections

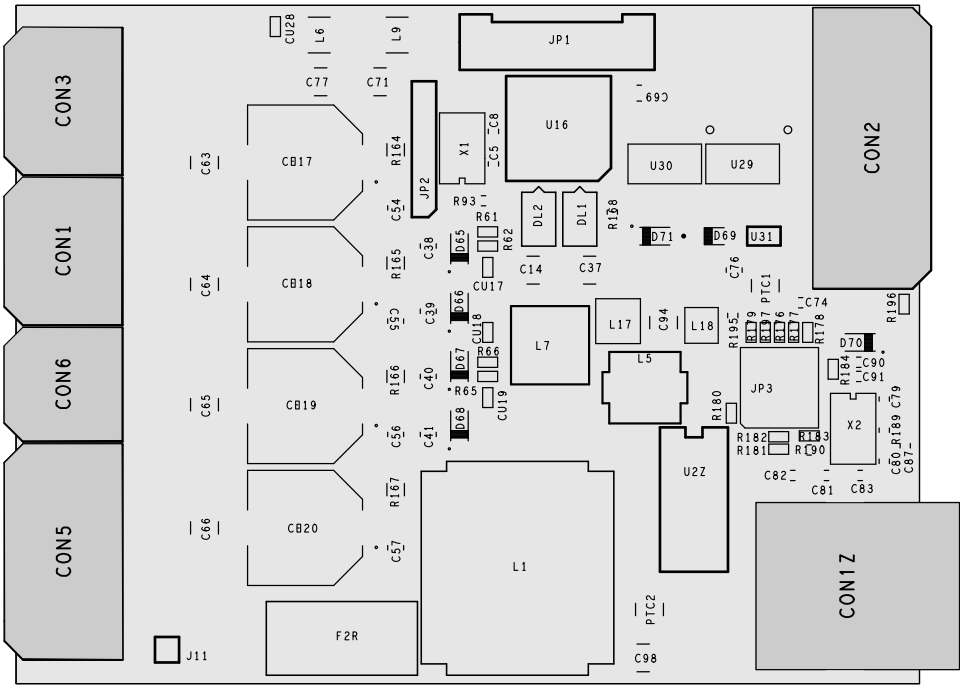


Figure 3.9: MQA-C/D connectors

3.6.1 CON1 - Hall sensors connector

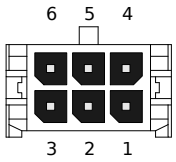


Figure 3.10: MICROFIT 3.0 430450600

pin	*name*	*type*	*description*
1	5V	OUT	5V sensors power supply
2	reference	-	5V common reference
3	reference	-	5V common reference
4	hallA	IN	hall sensor A
5	hallB	IN	hall sensor B
6	hallC	IN	hall sensor C

3.6.2 CON2 - I/O connector

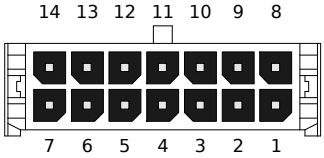


Figure 3.11: MICROFIT 3.0 430451400

pin	*name*	*type*	*description*
1	AI	IN	analog input
2	24V	OUT	24V digital input 2
3	DI_2	IN	digital input2
4	reference	-	common reference digital input 2
5	24V	OUT	24V digital input 1
6	DI_1	IN	digital input 1
7	reference	-	common reference digital input1
8	reference	-	common reference analog input / digital output 1
9	DO_1	OUT	digital output 1
10	DO_0	OUT	digital output 0
11	reference	-	common reference digital output 0
12	24V	OUT	24V digital input 0
13	DI_0	IN	digital input 0
14	reference	-	common reference digital input 0

3.6.3 CON3 - Encoder connector

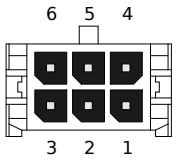


Figure 3.12: MICROFIT 3.0 430450600

pin	*name*	*type*	*description*
1	5V	OUT	5V encoder power supply
2	reference	-	5V common reference
3	reference	-	5V common reference
4	SA	IN	A signal
5	SB	IN	B signal
6	SC	IN	C sgnal (index)

3.6.4 CON5 - Power supply connector

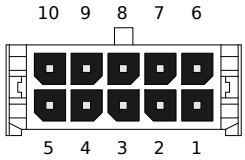


Figure 3.13: MICROFIT 3.0 430451000

pin	*name*	*type*	*description*
1	reference	-	24V common reference
2	24V logic	IN	locig circuits power supply
3	ground	-	ground
4	24V power	IN	main power supply
5	brake resistor	OUT	brake resistor
6	reference	-	24V common reference
7	24V logic	IN(OUT)	locig circuits power supply
8	ground	-	ground
9	24V power	IN(OUT)	main power supply
10	24V res brake	OUT	brake resistor reference

3.6.5 CON6 - Motor connector

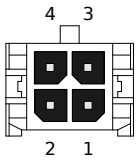


Figure 3.14: MICROFIT 3.0 430450400

pin	*name*	*type*	*description - three-phase (brushless)*	*description - double single-phase (stepper)*
1	B	OUT	brake resistor	H2-
2	U	OUT	U phase	H1+
3	W	OUT	W phase	H2+
4	V	OUT	V phase	H1-

3.6.6 CON1Z - Ethernet connector

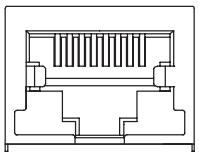


Figure 3.15: RJ45 Ethernet

pin	*nome*	*tipo*	*descrizione*
1	TX +	OUT	Transmit data +
2	TX -	OUT	Transmit data -
3	RX +	IN	Receive data +
4	NC	-	Not connected
5	NC	-	Not connected
6	RX -	IN	Receive data +
7	NC	-	Not connected
8	NC	-	Not connected

FCC Statement

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Industry Canada statement

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

1. *this device may not cause interference, and*
2. *this device must accept any interference, including interference that may cause undesired operation of the device.*

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

1. *l'appareil ne doit pas produire de brouillage, et*
2. *l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.*

CAN ICES-3 (A)/NMB-3(A)