Mizar

External technical documentation

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REVISIONS

Revision number	Date	Protocol	List of changes and/or modified paragraphs
Rev 0	16/05/2024		Initial
Rev 0.1	21/05/2024		Next
Rev 1.0	05/06/2024		First release
Rev 2.0	10/07/2024		Added firmware performance
Rev 3.0	26/06/2025		Modified WD page (drawing and numbering)
Rev 4.0	21/07/2025		Modified “optional” 5V COM1

Albatros - Logo

TPA S.r.l - Logo

CONTENTS

This document describes the Mizar 300/600 numeric control.

Technical documentation is issued by TPA for use by experienced personnel inside and outside TPA.

DESCRIPTION

Mizar is a line of fanless Computerized Numerical Controls manufactured by TPA. Each control consists of an embedded Single Board Computer (SBC) PC board connected to other boards and hardware devices in a small metal enclosure, suitable for installation in an electrical cabinet, with an omega DIN rail mounting.

Mizar has a series of connections that allow it to be integrated into a control network for tool machines (field interfaces) and to connect to supervisory units with Human-Machine Interface (HMI) function.

Mizar has a number of advantages:

- small size
- fuel efficient
- high computing power
- mechanical chassis dissipation (fanless)
- integration with Tpa's Albatros software
- standard fieldbus and communication for automation available
- wireless communication possible (optional).

Mizar is available in two models that are characterized by the different performances of the computer:

- Mizar 300
- Mizar 600.

For both models, full versions of the WiFi LAN interface (Mizar 300/600-WiFi models) are available on order.

Code	Name
Mizar.300	Mizar 300
Mizar.300.WiFi	Mizar 300-WiFi
Mizar.600	Mizar 600
Mizar.600.WiFi	Mizar 600-WiFi

FUNCTIONAL SPECIFICATIONS

2.1 General Requirements

The basic requirements of the device are as follows:

- based on a small embedded PC architecture
- omega rail mounting (both high and low profile)
- connection to supervisory PC via Ethernet 10/100/1000 MB/s.
- embedded Linux operating system
- fanless with heat dissipation through the chassis
- IP20 protection rating
- Watchdog Hardware built-in
- front end connections (except for Watchdog)
- external power supply 12 Volt
- automatic saving of sensitive data in case of power down
- fully remote upgradeable firmware system.

2.2 Control Specifications

- 2 Single Board computer (SBC) embedded PC Board models, differentiating Mizar 300 (Basic) from Mizar 600 (higher Performance)
- 2 GB RAM for Mizar 300, 8 GB RAM for Mizar 600
- 1 HDMI output per monitor (for service use only)
- 1 RS232 serial
- 1 RS485 serial
- 1 Ethernet LAN 10/100/1000 MB/s for Supervisor PC connection
- 1-2 Ethernet ports for EtherCAT bus (alternative to Ethernet LAN)
- 2 USB ports
- 1 Multifunction connector with CAN bus v2.1b
- 2 independently managed, autonomous control processes with different RTC, sharing information for dual CNC machines/lines.

2.3 Fieldbus supported

- EtherCAT on 2 independent channels
- CAN Bus (CAN Open v2.1b)
- RS232/RS485.

2.4 Additional Functions

- Dual Feed Rate Override port
- Dual Watchdog Hardware output.

2.5 Power Specifications

- Required input power +12 Vdc ±5%, 3 A – stabilized
- integrated control on the supply voltage
- input protected against reverse voltage and filtered
- in the event of power down, the internal protection system allows data to be saved, delaying the shutdown for a useful time to save.

FIRMWARE PERFORMANCE

Firmware performance is licensed through Windows PC by Albatros TPA software. It is necessary (only during license activation) that the PC is connected to the internet network.

3.1 Mizar Model 300 – Firmware

Item number	Mizar.300
Interpolation (basic configuration)	3 axes
RTCP Interpolation (optional)	Fourth axis (at 500µs / 0.5ms)
Point-to-point axes (optional)	Up to 5 additional axes
Total axes that the product can handle	8 axes (maximum 4 interpolated)
Real time Cycle	3-axis interpolation: 500µs / 0.5ms
PLC language	GPL (proprietary language)
Powertrains	Cartesian
Trajectory Generator Performance	• Acceleration ramp modulation from coefficient • 6 interpolation channels • Chain axis management (Gantry) • Linearity self-corrector, cross and joint corrector (X+Y → Z) • Direct execution of axes dimensions defined externally to the RT or multiple (Motion Control outside the control).

3.2 Mizar Model 600 – Firmware

Item number	Mizar.600
Interpolation (basic configuration)	6 axes
RTCP Interpolation (optional)	Fourth (at 500µs / 0.5ms) and fifth axis (at 1000µs / 1 ms)
Point-to-point axes (optional)	Up to 58 additional axes
Total axes that the product can handle	64 axes (maximum 16 interpolated)
Real time Cycle	5-axis interpolation: 250µs / 0.25 ms 10-axis interpolation: 500µs / 0.5 ms 16-axis interpolation: 1000µs / 1ms
PLC language	GPL (proprietary language)
Powertrains	Cartesian
Trajectory Generator Performance	• Acceleration ramp modulation from coefficient • 16 interpolation channels • Chain axis management (Gantry) • Linearity self-corrector, cross and joint corrector (X+Y → Z) • Direct execution of axes dimensions defined outside the RT or multiple (Motion Control outside the control).

TECHNICAL SPECIFICATIONS

4.1 Mizar Model 300 – Hardware

Processor	2 core, 1.1 GHz
RAM	2GB built-in
Flash	16GB built-in
Video	HDMI 1.4 x 1
Operating system	LINUX Real Time Extension
Operating temperature	0° - 45°C
Power supply	12 Volt DC ±5%
Network	REALTEK.RTL8111H-CG, 10/100/1000Base x 2
IF CAN	Can Open standard (Cia301) operating with selectable baud rate: • 1 MHz • 500 KHz • 250 KHz • 125 KHz
Ethernet LAN	Third Ethernet LAN connector for use as an additional network or as a second EtherCAT channel. Baud rate 10/100 Base-T
2 IF Feed Rate Override	Feed Rate Override, execution speed control. 2 channels for 2 independent control processes
IF Watchdog	Dual channel, software settable as astable, square wave output, as simple output: • channel 1 • channel 2
LEDs	Power supply, board operation and on-board circuit activity signaling.

4.2 Mizar Model 600 – Hardware

Processor	4 core, 2.0 GHz
RAM	8GB built-in
Flash	MSATA disk 64 GB
Video	HDMI 1.4 x 1
Operating system	LINUX Real Time Extension
Operating temperature	0° - 45°C.
Power supply	12 Volt DC ±5%
Network	Intel® i226, 10/100/2500Base x 1 REALTEK.RTL8111H-CG, 10/100/1000Base x 1
IF CAN	Can Open standard (Cia301) operating with selectable baud rate:

	• 1 MHz • 500 KHz • 250 KHz • 125 KHz
Ethernet LAN	Third Ethernet LAN connector for use as an additional network or as a second EtherCAT channel. Baud rate 10/100 Base-T
2 IF Feed Rate Override	Feed Rate Override, execution speed control. 2 channels for 2 independent control processes
IF Watchdog	Dual channel, software settable as astable, square wave output, as simple output: • channel 1 • channel 2
LEDs	Power supply, board operation and on-board circuit activity signaling.

4.3 Electrical Quantities

Absorption

- I_{ave} = 850 mA no-load
- I_{peak} = 1150 mA at start
- I_{prog} < 1500 mA on programming.

Operating voltage

- V_{max} = 13.5 V
- V_{min} = 11.4 V
- V_{ave} = 12.0 V.

A “preferential voltage” V_{best} (+) is also provided

- V_{best} = 12.6 V

(+) due to the fact that inside the board there is:

- An anti-reversing polarity diode that allows a voltage drop of 0.35 V
- A series of super capacitors that guarantee a lifetime of UPS function depending on the operating voltage.

WARNING! Due to the presence of the super-capacitor unit, the system is charging at least 40 seconds after the power-on event. For the same reason, wait at least 20 seconds before turning the power back on.

Fuse on 12 V

- 3A-T (delayed) LittleFuse SLO-BLO model cod. 454003.0 T (154003.3 T).

Watchdog power supply

- V_{min} = 11.0 V
- V_{max} = 28.0 V
- I_{max} = 300 mA.

Operating temperature and environment

Do not exceed the range: 5° - 45° (this is the range of computer devices).

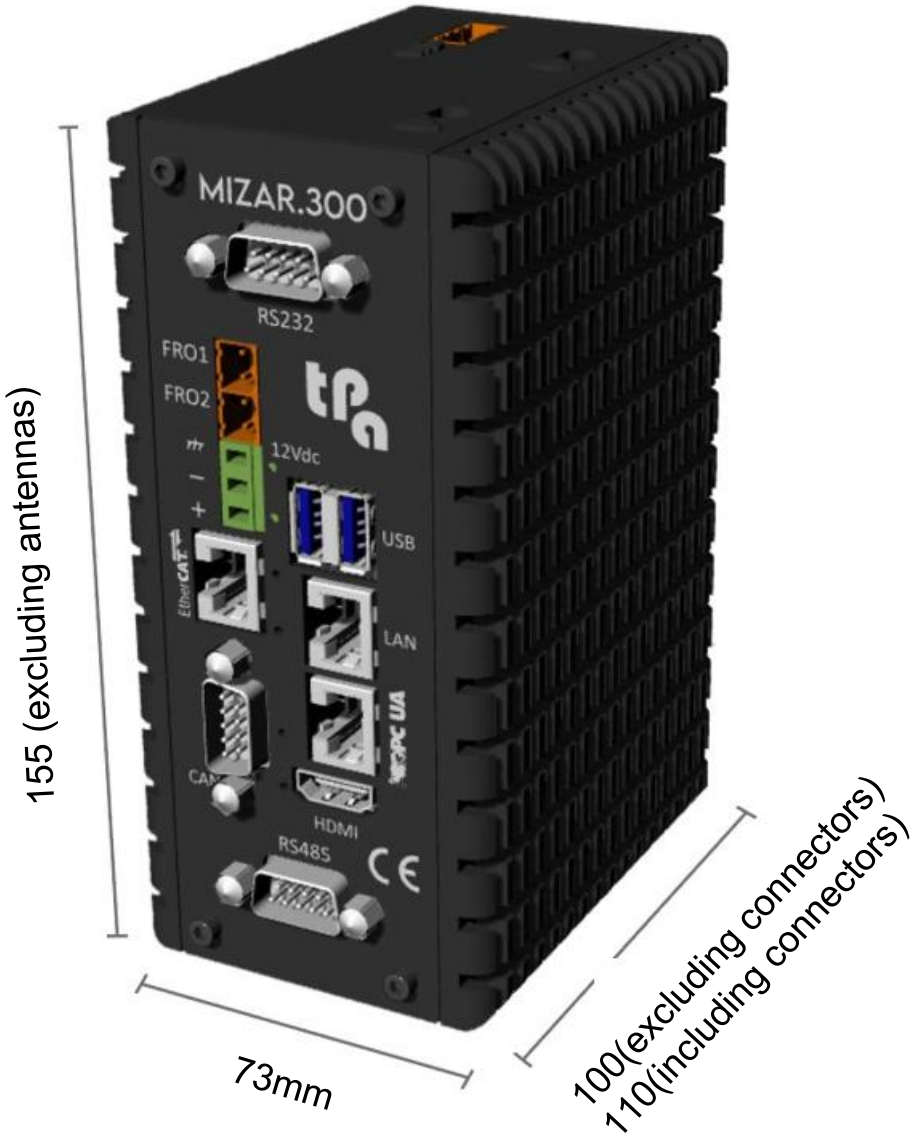
WARNING! Be aware of potentially flammable devices due to the presence of Li_2O Lithium oxide (super capacitors and buffer battery).

4.4 Model - WiFi

LAN & WiFi Antennas	Wireless LAN Kit 802.11ac/a/b/g/n + BT4.0, 2 sets cable & antenna.

4.5 Size

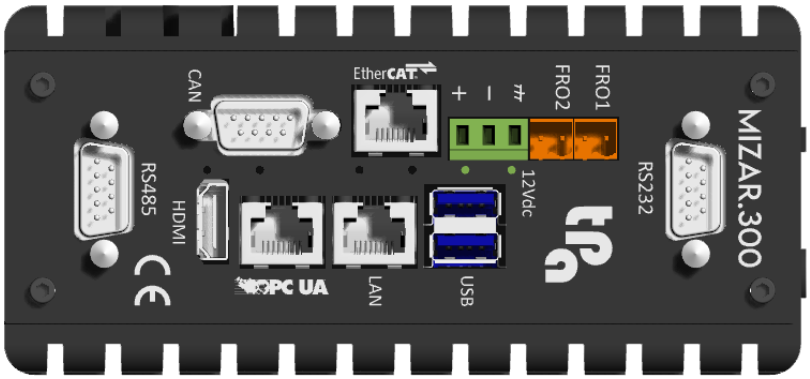
Mizar



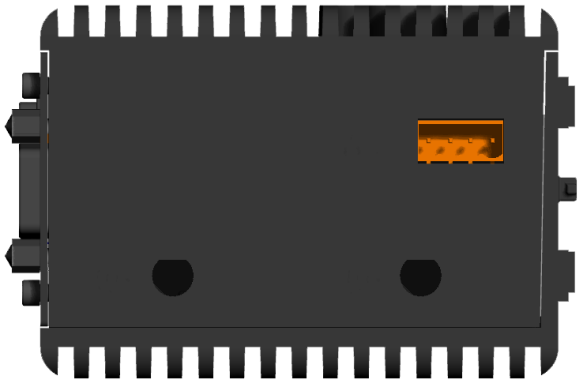
DESCRIPTION OF INTERFACES

The layout of the connections on the front panel and the side panel is shown:

FRONT



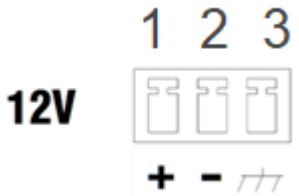
SIDE



CN	Features
1	3-pin power connector – green
2	Feed Rate Override 1 – FRO1
3	Feed Rate Override 2 – FRO2
4	Dual USB 3.0 connection
5	LAN Ethernet #1 – 10/100/1000 Base-T
6	LAN Ethernet #2 – 10/100/1000 Base-T
7	LAN Ethernet #3 – 10/100 Base-T
8	CAN connector
9	Serial line connector COM2 – RS232
10	Serial line connector COM1 – RS485
11	HDMI 1.4 connector (service use only)
12	Watchdog connector – WD
13	Antenna 1 (optional)
14	Antenna 2 (optional)

LED	Features
DL2	On-board MPU activity LED (on), power supply fault (flashing)
DL3	12 V power supply present
DL4	CAN activity LED
DL5	System in fault
DL6	UPS correct voltage/active control
DL7	UPS voltage under threshold/control in fault
DL2	On-board MPU activity LED (on), power supply fault (flashing)

5.1 Power Connector CN1



Pin	Power Supply
1	12 V 3 A ±5%
2	0 Volt
3	Ground

Mating connector: PHOENIX MC1,5/3-ST-5.08 – 3 positions – green.

Power the CNC with a stabilized power supply with adjustable tension (trimmer). The nominal supply voltage is 12 V with ±5% margin.
Mizar is equipped with a power control device, therefore the power threshold should be adjusted with a calibration to make the control as precise as possible. In addition, Mizar has a built-in data protection device to protect your data from sudden shutdown. This device takes over when the power supply falls below the threshold (approximately 11 V). It is therefore highly advisable to adjust the supply voltage to ensure a certain operating margin.
WARNING! Do not exceed the maximum limit of 13 V.
WARNING! There is a reverse polarity protection diode (drop 0.3 V).
WARNING! Avoid power supplies with rectified output (diode bridge and capacitor).

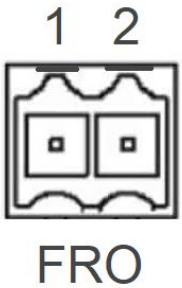
12 V power supply calibration operation

- Connect terminals 1 and 2 of the CN1 power connector to an adjustable stabilized power supply
- Verify that the DL3 LED (green) is on
- Check the operation of the DL6 (green), DL7 (red) and DL2 (green) LEDs by comparing it with the table:

DL6 LED GREEN	DL7 LED RED	DL2 LED GREEN	SITUATION	ACTION
FLASHES QUICKLY	STEADY ON	FLASHES QUICKLY	The voltage supplied is too high	Immediately reduce the supply voltage
STEADY ON/ FLASHES	OFF	STEADY ON	The voltage supplied is good	Adjustment OK
STEADY ON/ FLASHES	OFF	FLASHES QUICKLY (*)	The supplied voltage is sufficient, but with little margin	Adjust the voltage so that the DL7 flashing is OFF
OFF	FLASHES QUICKLY	FLASHES QUICKLY (*)	The voltage supplied is too low	Increase the supply voltage.

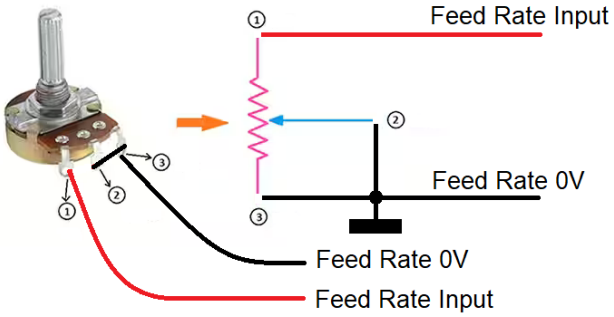
(*) WARNING!
The behaviour of the DL2 LED is such when the connection with the supervisor unit (HMI) is established, or when the cyclical PLC has been activated. Otherwise, the DL2 led is OFF.
Therefore, on a system with the supervisor disconnected, the calibration must take into account only the light indications of the DL6 and DL7 LEDs.
Once the supervisor is connected, the calibration operation shall be completed taking into account also the DL2 LED.

5.2 Feed Rate Override Connector FRO1



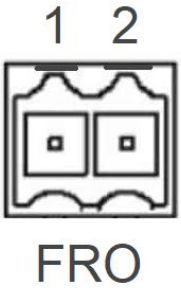
Pin	FRO1
1	Feed Rate 0 Volt
2	POT1 (3.3 V max out) – Feed Rate Input

Mating connector: BL 3.50/02/180 Weidmueller 1597360000 2 orange poles.



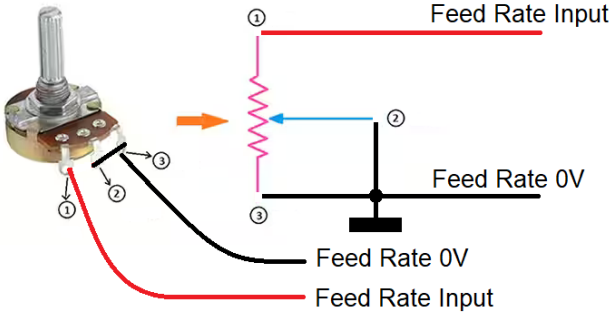
To increase the forward speed turn the potentiometer clockwise.
Linear potentiometer 4.7 KOhm – max. current 1 mA.

5.3 Feed Rate Override Connector FRO2



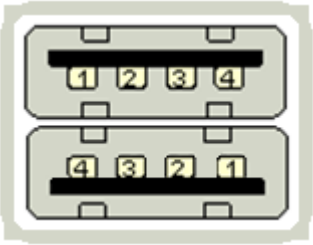
Pin	FRO2
1	Feed Rate 0 Volt
2	POT2 (3.3 V max out) – Feed Rate Input

Mating connector: BL 3.50/02/180 Weidmueller 1597360000 2 orange poles.



To increase the forward speed turn the potentiometer clockwise.
Linear potentiometer 4.7 KOhm – max. current 1 mA.

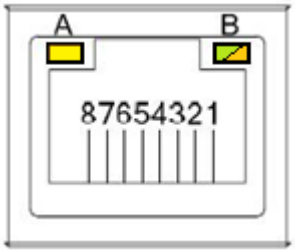
5.4 Connectors USB 3.0



Pin	Description
1	USB Vcc
2	USB -
3	USB +
4	USB GND

Mating connector: Molex 51021-0400 *or equivalent standard cable USB 3.0.*

5.5 Ethernet LAN Connector 1



Pin	Description
1	MDI0+
2	MDI0–
3	MDI1+
4	MDI2+
5	MDI2–
6	MDI1–
7	MDI3+
8	MDI3–
A	Activity LED
B	Speed/Link LED

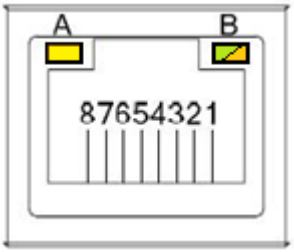
LAN 1 connection to 10/100/1000 Base-T. It can be configured as EtherCAT network.

WARNING! There are no LEDs on Mizar 600.
WARNING! It is recommended to use CAT6 cables, for short distances (a few meters) an S/STP or S/FTP shield and an AWG24 section are sufficient.

The network interface manages the 2 LEDs of the Ethernet port in these ways:

Baud Rate (Duplex)	LED B – link (green/orange)	LED A – ACTIVITY (YELLOW)
10 BaseT	OFF	YELLOW (blinking if active)
100 BaseT	GREEN	YELLOW (blinking if active)
1000 BaseT	ORANGE	YELLOW (blinking if active)

5.6 Ethernet LAN Connector 2



Pin	Description
1	MDI0+
2	MDI0–
3	MDI1+
4	MDI2+
5	MDI2–
6	MDI1–
7	MDI3+
8	MDI3–
TO	Activity LED
B	Speed/Link LED

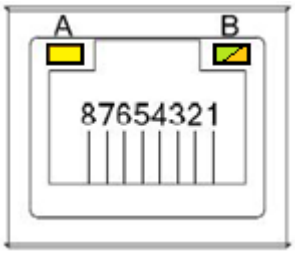
LAN 2 connection to 10/100/1000 Base-T. It can be configured as EtherCAT network alternating with LAN1.

WARNING! There are no LEDs on Mizar 600.
WARNING! It is recommended to use CAT6 cables for short distances (a few meters) an S/STP or S/FTP shield and an AWG24 section are sufficient.

The network interface manages the 2 LEDs of the Ethernet port in these ways:

Baud Rate (Duplex)	LED B – link (green/orange)	LED A – ACTIVITY (YELLOW)
10 BaseT	OFF	YELLOW (blinking if active)
100 BaseT	GREEN	YELLOW (blinking if active)
1000 BaseT	ORANGE	YELLOW (blinking if active)

5.7 Ethernet LAN Connector 3



Pin	Description
1	MDI0+
2	MDI0–
3	MDI1+
4	MDI2+
5	MDI2–
6	MDI1–
7	MDI3+
8	MDI3–
TO	Activity LED
B	Speed/Link LED

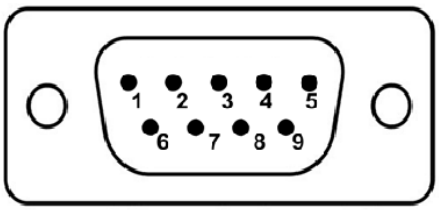
LAN 3 connection to 10/100/1000 Base-T. It can be configured as second EtherCAT network, alternating with LAN 1/2, or as a second Ethernet network port.

WARNING! It is recommended to use CAT6 cables for short distances (a few meters) an S/STP or S/FTP shield and an AWG24 section are sufficient.

The network interface manages the 2 LEDs of the Ethernet port in these ways:

Baud Rate (Duplex)	LED B – link (green/orange)	LED A – ACTIVITY (YELLOW)
10 BaseT	OFF	YELLOW (blinking if active)
100 BaseT	GREEN	YELLOW (blinking if active)
1000 BaseT	ORANGE	YELLOW (blinking if active)

5.8 CAN connector and options



Pin	Description
1	TX422+ (high)
2	CAN L (low)
3	CAN 0 Volt
4	RX422+ (high)
5	RX422 0 Volt (§)
6	TX422- (low)
7	CAN H (high)
8	FINP (*)
9	RX422- (low)
Shield	Ground

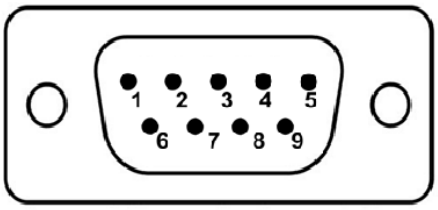
(§) Internal 0 Volt signal, connected to power supply pin (-).
(*) Fast Input Signal refers to the 0 Volt CAN signal.

Mating connector: DSUB 9 female poles (straight solder buckets).

Ex. HARTING 9670094704.

WARNING! Shielded cables with twisted pairs are strongly recommended to prevent interference induced by EMC phenomena. It is required that at least one end of the cable is connected to a ground/ground potential.

5.9 Connector COM2 RS232



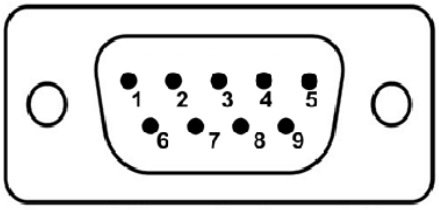
Pin	Description
1	DCD
2	RX (RS232 in)
3	TX (RS232 out)
4	DTR
5	0 Volt (§)
6	DSR
7	RTS
8	CTS
9	RI
Shield	Ground

(§) Internal 0 Volt signal, connected to power supply pin (-).

Mating connector: DSUB 9 female poles (straight solder buckets).
Ex. HARTING 9670094704.

WARNING! Shielded cables with twisted pairs are strongly recommended to prevent interference induced by EMC phenomena. It is required that at least one end of the cable is connected to a ground/ground potential.

5.10 Connector COM1 RS485 (422)



Pin	Description 485	Description 422
1	RS485–	TX422–
2	RS485+	TX422+
3	---	RX422
4	---	RX422–
5	0 Volt (§)	0 Volt (§)
6	---	---
7	---	---
8	---	---
9	5 Volt (#)	5 Volt (#)
Shield	Ground	Ground

(#) Supplied externally not as a power supply, but as a Voltage Reference.
(§) Internal 0 Volt signal, connected to power supply pin (-).

Mating connector: DSUB 9 female poles (straight solder buckets).

Ex. HARTING 9670094704.

WARNING! Shielded cables with twisted pairs are strongly recommended to prevent interference induced by EMC phenomena. It is required that at least one end of the cable is connected to a ground/ground potential.
WARNING! The RS485 serial line is not terminated by any resistance.

It is strongly recommended to insert a 120 Ohm 1/2 Watt termination both at the above connector and at the last connection point of the line. Refer to EIA RS-485 or CCITT V11.

WARNING! There is no polarization network (on both lines).

5.11 HDMI - Video Connector

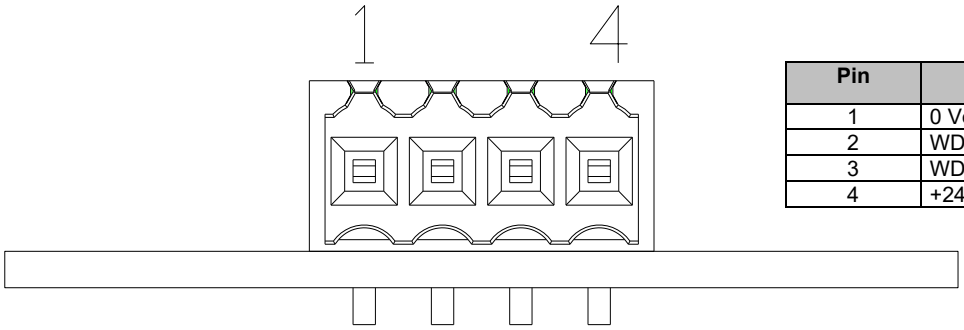
You can link a video for debugging, uploading, and downloading software.
The standard used is HDMI 1.4.

Mating connector: I-PEX 20453-030T.

WARNING! Mizar does not host any type of user interface.

5.12 Watchdog connector - WD

There is a Watchdog connector with 2 outputs. The Watchdog part requires an external power supply in the range +11 Vdc < V < +28 Vdc, I_{max} 300 mA.



Pin	Description
1	0 Volt (riferito a +24)
2	WD OUT2
3	WD OUT1
4	+24 Vdc ±10% 20 mA

WARNING! There is a protection diode on the power supply pin to prevent reverse polarity (drop 0.7 V).

Mating connector: BL 3.50/04/180 Weidmueller 1597380000 4 orange poles.

WATCHDOG AND FINP

There are two outputs on the Watchdog connector called WD_OUT1 and WD_OUT2.
A 24 Vdc (±10%, 20 mA) power input with its 0 Volt reference terminal is also provided. There is an anti-reverse polarity protection on the supply terminal.
Both the power supplies and the WD_OUT1 and WD_OUT2 outputs are decoupled from the rest of the internal circuitry, via opto-isolators.

WARNING! The presence of the 24 V voltage is not controlled by the CNC.

The output behavior can be selected.

WD_OUT1

This output is firmware-settable and can have four modes of operation:

- Mode 1: Operation in OUPUT mode, linked to the GPL code;
- Mode 2: Operation in ASTABLE mode, linked to the RTC1/RTC2 of the system;
- Mode 3: Generating a square wave with a frequency of 500 Hz;
- Mode 4: The WD_OUT2 output is managed by the software (i.e. it is the PLC process that activates/deactivates the output signal).

It is an ASTABLE output, i.e. with a low rest position (0 Volt) and a high active position (24 Volt) which must always be repeated.
Usually, during a proper Mizar operation, an internal RTC1/RTC2 signal is generated and sent to both the firmware and the Watchdog. The Watchdog uses this signal to keep the WD_OUT1 output active high = ACTIVE = 24 V.
The output is low when the control is inactive (the cyclic PLC does not function), or in the event of an internal failure: in both cases the internal RTC signal is not produced.

WD_OUT2

This output is firmware settable and can have 4 operating modes:

- Mode 1: Operation in OUPUT mode, linked to the GPL code;
- Mode 2: Operation in ASTABLE mode, linked to the RTC1/RTC2 of the system;
- Mode 3: Generating a square wave with a frequency of 500 Hz;
- Mode 4: The WD_OUT2 output is managed by the software (i.e. it is the PLC process that activates/deactivates the output signal).

FINP

The Fast INPut signal is present on the 9-pole DSUB connector indicated as CN8 on pin 8. The signal is electrically referenced to pin 3 named CAN 0 V. The signal is optoisolated from the rest of the circuit; it shares only the CAN 0V reference.
This is an input with a range of 0-24 V (activation for V >15 V). Depending on the programming, it can be used as SystemOK, i.e. as a signal of assent to PLC logic, as Fast Input (dimension latch), or as simple input.

UPDATE FIRMWARE

These devices are programmed in-house at TPA during production.
Firmware updates can be performed remotely to fix bugs.
Reprogramming can take place on-site, directly from the Albatros CNC interface.

WARNING! Since these operations are intended to change the hardware performance of the device, these operations must be followed by TPA applicators.
Any update or recovery code is provided by the TPA applicators.

WARNING! In order to prevent any risks arising from the change of firmware code on a machine device, it is mandatory to perform the operation taking care that all external devices (drives, I/O modules, etc.) are disconnected from the CNC, deprived of power and put into inert condition. The GPL cycle (PLC) must be stopped. All safety devices must be engaged, the machine must be safe. Possibly, power only the CNC (Mizar and Supervisor PC/HMI).

PRESCRIPTIONS

In general, it is mandatory not to exceed the power, temperature and humidity values given in chapter 0.
It is mandatory to connect (via power connector) Mizar to earth.
The installation of Mizar in the cabinet/switchboard is recommended.
Mizar is a computerized numerical control for general use in light industrial environment.
It is a Class A product and may cause electromagnetic disturbances in a domestic environment, therefore the end-user must take all the necessary precautions.

8.1 Operating Temperature

The ambient operating temperature is 5°C to 45°C.

8.2 Power supply

A power supply (AC/DC converter) with the following characteristics may be used: Vout = +12 Vdc (trimmable) ±5%, I_{max} = 3 A.
For the presence of an internal power supply safeguard unit in the shut-down phase, it should be taken into account that:

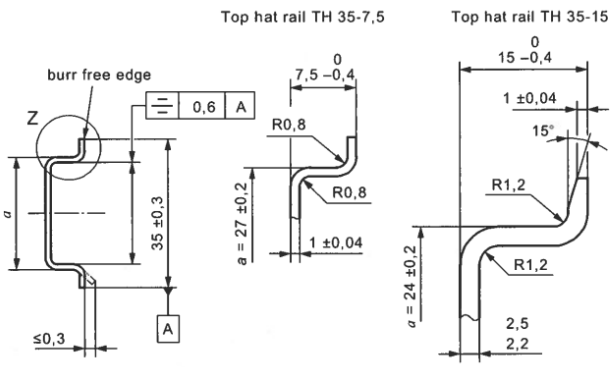
- The Mizar 300/600 unit will be fully active at least 40 seconds after power is applied
- The Mizar 300/600 unit will be fully deactivated at least 20 seconds after the power supply has been switched off (waiting time before a subsequent power-up).

8.3 Precautions

Inside the Mizar 300/600 unit there are devices with lithium oxide technology (Li_2O).
This is a CR2032 battery and a series of capacitors. On the capacitors, when the power supply is removed, there are no residual charges, as the discharge takes place within the shutdown times described above.
Keep away from water, in a non-wet environment.

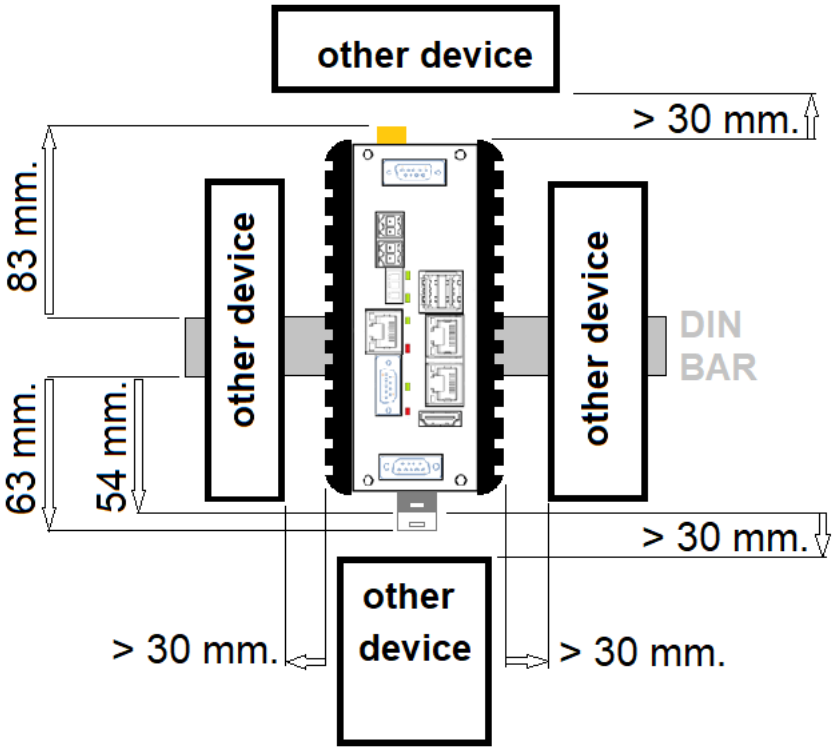
8.4 Mounting

Mizar accepts IEC/EN 60715 omega rail mounting (both high TH 35/15 and low TH 35/7.5 profile).



DIN rail wide 35mm for mounting equipment

For this purpose, a minimum of 3 cm of spacing above and below the overall vertical dimension of Mizar should be provided (17.5 cm from WD connector to mounting tab + 3 cm above + 3 cm below).
Furthermore, as the Mizar unit needs to dissipate heat, it is requested not to limit the air flow by mounting other components laterally which, by covering them, may limit the exchange surface or which, in turn, is a source of heat. It is strongly recommended to keep at least 3 cm spacing to the left and right of Mizar.



Recommended spacing

8.5 WiFi version

The WiFi version must be ordered with its specific product code. For documentation, refer to the appropriate documentation for installation and wiring rules.

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