

Digital multi-axis NC control

RE 30156/04.05 1/16

Type VT-MAC8

Component series 1X



H/A/D 7304/04

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Features

The MAC8 is a digital Rexroth multi-axis NC control of modular design. It consists of a master card with no, 2 or 4 axis controllers and can be extended as required with up to seven slave cards for four axes each. It is therefore the ideal solution for complex control tasks with up to 32 interpolatable axes. Further MAC8s can be connected via local Ethernet. The MAC8 communicates via field bus (Profibus DP® or CAN) or via Ethernet with the higher-level PLC machine control. It is provided with special hydraulic closed-loop control characteristics and can control movements of the machine or machine parts on its own and therefore assumes PLC functions. Sensors and actuators can also be evaluated and controlled via CAN bus.

Fields of application:

- Presses (tube forming, metal / ceramic, powder, plastic, deep drawing, glass presses, press brakes, die cushion controls, IHF (internal high pressure forming, etc.)
- Materials handling (container cranes, balance cranes, train/truck lifts, belt drive, etc.)
- Steelworks and rolling mill technology (continuous casters, curved casting machines, mould oscillation, roll stands, 3-roll bending machines, turning cooling beds, flying shears, ladle cars, moulding plant, etc.)
- Testing technology (weld testing machine, shock absorber test bench, tube testing press, etc.)
- Special machinery (coal distributors, thick sheet turning equipment, engine turning system, etc.)

Process interfacing

32 digital inputs, 24 digital outputs, Profibus DP®, CAN open, TCP-IP

Interfacing / visualisation

- By means of "OPC server"
- By means of "Active X" elements
- Interfaces: RS 485 or Ethernet

Programming

- Use programming by means of a PC
- Comprehensive diagnosis and debugging tools
- Comfortable data management on a PC
- High-level language-oriented
- 32 NC programs that can be executed in parallel
- High processing speed due to compiled programs
- Fast integer and real arithmetic
- Exponential and angle functions

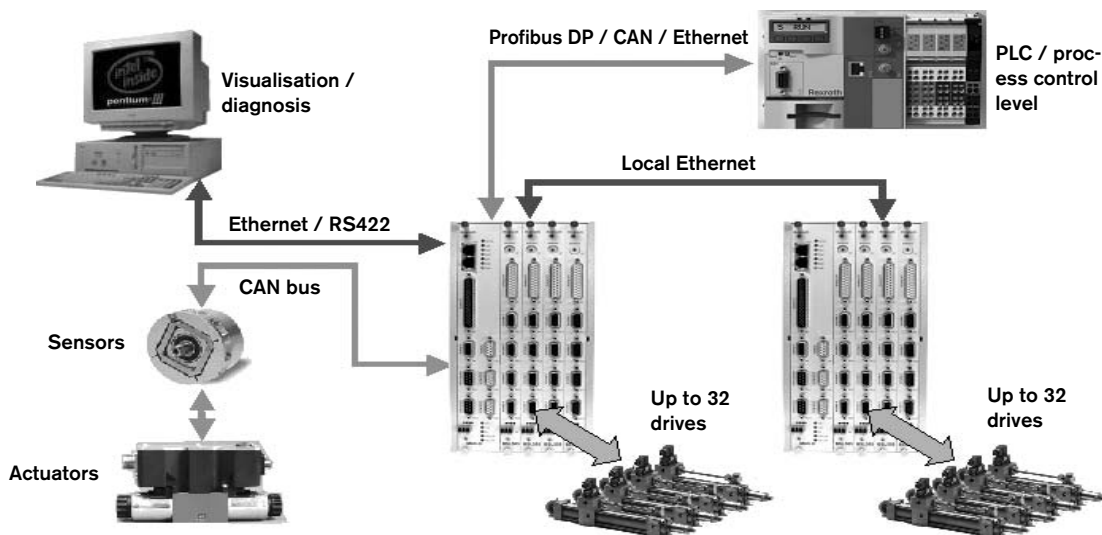
Hydraulic axes

- Measuring system Incremental or absolute (SSI)
Analogue ± 10 V and 4 to 20 mA
 ± 10 mA and ± 20 mA
- Control output Analogue ± 10 V and 4 to 20 mA
 ± 10 mA and ± 20 mA

Closed-loop control

- Following controller
- State controller
- Position-dependent braking
- Synchronisation controller for up to 32 axes (various variants)
- Pressure/force controller

System overview



Ordering code for system

| | | | | |
|------------------------------------|-----|----------|------------|-------------------------------------|
| VT-MAC 8-1X/S | | M | AX4 | * |
| System with | | | | Further details in clear text |
| 1 slot | = 1 | | | 4 axis slaves |
| 5 slots | = 5 | | | Number |
| 8 slots | = 8 | | | 0 to 7 = Master |
| Bus variant | | | | 1 = Without axis module, with RS485 |
| No field bus | = A | | | 2 = 2-axis version, with RS 485 |
| Profibus DP slave interface module | = P | | | 4 = 4-axis version |

Selection aid

| Part of ordering code | Analogue In | RS 232 RS 485 | CAN Open | Profibus DP | Analogue I/O | Encoder plug |
|-----------------------|-------------|------------------|----------|-------------|--------------|--------------|
| AM 1 | X | X | X | | | |
| AM 2 | X | X | X | | X | 2X |
| AM 4 | X | | X | | X | 4X |
| PM 1 | X | X | X | X | | |
| PM 2 | X | X | X | X | X | 2X |
| PM 4 | X | | X | X | X | 4X |

Components

| Material no. | Type | Designation |
|--------------|---|---|
| R901075726 | VT-MAC8-1X/K-AM1 | Master card without axis controller |
| R901075728 | VT-MAC8-1X/K-AM2 | Master card with 2 axis controllers |
| R901075730 | VT-MAC8-1X/K-AM4 | Master card with 4 axis controllers |
| R901075732 | VT-MAC8-1X/K-PM1 | Master card with Profibus DP, without axis controller |
| R901075734 | VT-MAC8-1X/K-PM2 | Master card with Profibus DP, with 2 axis controllers |
| R901075738 | VT-MAC8-1X/K-PM4 | Master card with Profibus DP, with 4 axis controllers |
| R901075752 | VT-MAC8-1X/K-AX4 | Salvekarte with 4 axis controllers |
| R901075757 | VT-MAC8-1X/K-DUMMY | Blank location cover for one slot |
| R901075714 | VT-MAC8-1X/K-RACK1 | Blank rack with one slot (master card) |
| R901075722 | VT-MAC8-1X/K-RACK5 | Blank rack with 5 slots (1 master, 4 slaves) |
| R901075725 | VT-MAC8-1X/K-RACK8 | Blank rack with 8 slots (1 master, 7 slaves) |
| R901052075 | Cable set MAC8/ABS/SF/3M | Cable for absolute value encoder SSI (X2), 3 metres, open end |
| R901052153 | Cable set MAC8/INC/24V/SF3M | Cable for incremental encoder 24V (X2), 3 metres, open end |
| R901052152 | Cable set MAC8/INC/5V/SF/3M | Cable for incremental encoder 5V (X2), 3 metres, open end |
| R901052141 | Cable set MAC8/AE/SF/3M | Cable for analogue inputs (X4), 3 metres, open end |
| R901052069 | Cable set MAC8/AEA/SF/3M | Cable for analogue inputs/outputs (X1), 3 metres, open end |
| R901052150 | Cable set MAC8/DEA/SF/3M | Cable for digital inputs/outputs (X5), 3 metres, open end |
| R901074828 | Cable set MAC8/PC/RS232/5M | Cable for PC-MAC8 RS232 interface (X3.4), 5 metres |
| R901074832 | Cable set MAC8/PC/RS422/RS232/ADAPT/5M | Cable for PC-MAC8 RS422 with RS232 adapter (X3.4), 5 m |
| R901074837 | Cable set MAC8/PC/RS422/RS232/ADAPT/30M | Cable for PC-MAC8 RS422 with RS232 adapter (X3.4), 30 m |
| R901074840 | Cable set MAC8/PC/RS422/RS232/ADAPT/50M | Cable for PC-MAC8 RS422 with RS232 adapter (X3.4), 50 m |
| R901058546 | SYS-MAC8- D/E | Installation CD for MAC8 Tools |

Software engineering

Creation of program with MACpro

- Windows version with integrated editor with command highlighting
- Creation of project groups for the management of individual programs on the slots, with automatic change-over
- Global header files for common definitions
- Programs can be organised in modules (files)
- Nesting depth for up to 50 subroutines
- Change-oriented compiling and transfer to the MAC8
- Reference list of variables and subroutines used
- Automatic comparison of version PC <-> MAC8
- Saving of different desktop settings
- Program saved in the flash

Debugging

- On-line help for "Syntax", "Tools" and "Keys"
- Tracing of program execution (trace)
- Process variable tracing by means of Trend
- Program view (View) with search functions
- Function level display (call hierarchy)
- 5 break points are managed
- Stop / Start / Continue and Single Steps (Single, Step, Stepper) of individual or all programs
- Saving of memory image (program with data)

View of variables

- All variable windows can be selected by means of hot keys or from the menu; flexible window size
- Configurable variable window (mix-variables) with hexadecimal, decimal, binary and floating point representation: Simple inclusion of optional variables from the program view into the tracing window and structuring by means of comments
- Setup window with all axis-specific process variables
- System parameter assistant

Acquisition of measured data

- 12 recording channels with start and stop trigger
- Recording option for all process variables
- Graphic and numeric representation (DBF format) of recorded channels
- Continuous data recording (Trend)

Commissioning functions

- Inputs can be simulated
- Outputs can be set
- Analogue output variables can be set
- Inching mode for optimising the controller
- Activation / deactivation of individual controller components

Project-related administration of:

- programs
- configurable programming user interface
- system parameters
- measured data

System requirements of MACpro:

- IBM-PC or compatible system
- Windows NT®, Windows 2000®, Win XP®
- Processor 300 MHz or faster
- Min. 64 MB RAM (recommended: 128 MB)
- Min. 100 MB free hard disk space

The program is installed from a CD (SYS-MAC-8-D/E, material no. **R901058546**)

Overview of controller functions

Position controller:

- Following controller
- Alternating control (position / pressure)
- Force limitation in positive and negative direction
- Direction-dependent gain adjustment
- "Inflected" gain characteristic curve
- Fine positioning
- Residual voltage principle
- Compensation of zero point offsets
- State feedback
- Command value feedforward
- Control output limitation by means of NC program

- "Position-dependent braking"
- External controller function via NC program
- Following operation
- Velocity override
- Gain can be changed via NC program
- Interpolation of up to 32 axes
- Pre-acceleration
- Force / distance; force / time curves
- Position/input value curves
- Transformation of coordinates of spatial axes

Overview of controller functions (continued)

Status controller:

- Velocity feedback
- Acceleration feedback
- Pressure feedback
- External feedback

Pressure / force controller:

- PID controllers
- I-component can be activated/deactivated via window
- Differential pressure evaluation
- P / Q pilot control
- Various modes for the transition from position to force controller

Velocity controller:

- PI controllers
- I-component can be activated/deactivated via window

Synchronisation controller:

- Synchronisation of optional groups of up to 32 axes that can be varied during operation
- Active synchronism with force limitation or parallel making way
- Passive synchronism with tilt compensation control, with definable, average counterforce
- Synchronisation offsets of the axes can be dynamically changed
- Axes can be dynamically added to or withdrawn from the synchronised group (also during operation)
- Relative synchronism, also in opposite direction

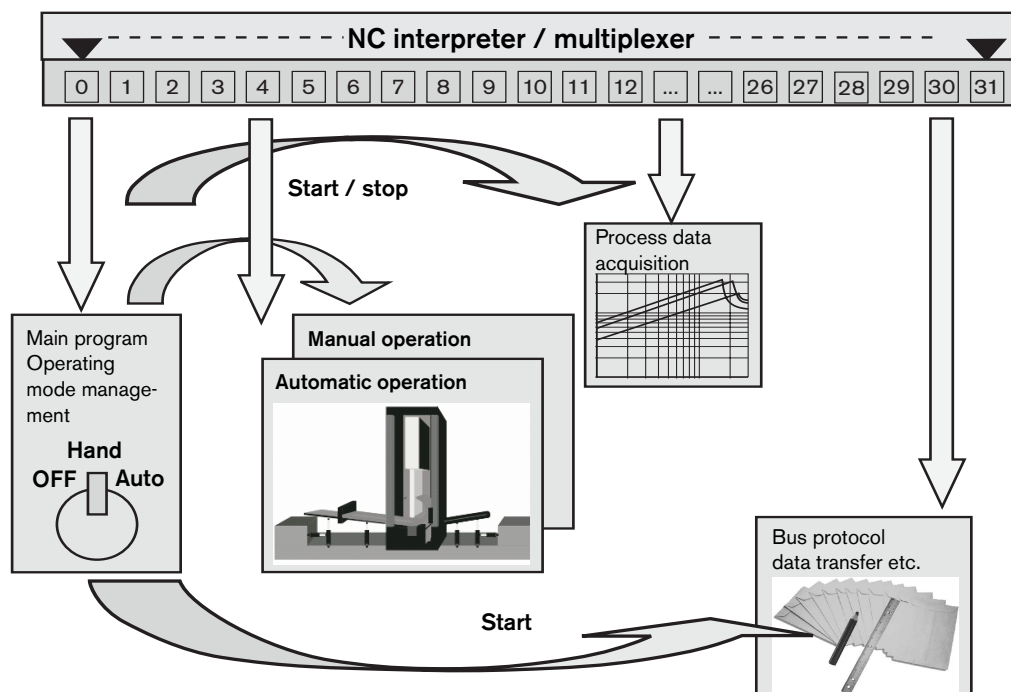
Monitoring functions:

- Dynamic following error monitoring
- Traversing range limits (electronic limit switches)
- Cable break monitoring for incremental and SSI encoders
- Cable break monitoring for sensors with 4 to 20 mA output
- Valve monitoring
- Encoder voltage monitoring

NC interpreter

The NC interpreter organises the execution of the 32 parallel NC programs. Each program operates sequentially on its own. The change-over between parallel programs takes place after a program line was worked off. In the case of commands that wait for an event (e.g.: "WAIT", "POS"), branching to the next program takes place immediately after the event query in order not to hinder the execution of other programs. All system re-

sources are available to all programs (I/O, axes, variables etc.). Programs can start, stop or delay each other. This concept allows optimum imaging of the sequence structure of the machine in the NC program of the MAC8.



Programming language ECL-Win

| | |
|--|--|
| <p>The data organisation of the MAC8:</p> <p>Numeric variables (integers):</p> <p>V: Standard variables P: Local variables N: Process variables</p> <p>Fields (integers):</p> <p>A: Custom fields S: System parameters</p> <p>Real variables:</p> <p>R: Floating point figures</p> <p>Logic variables:</p> <p>I: Inputs O: Outputs F: Process flags</p> <p>Signs and operators:</p> <p><num. sign> { " " "!" "#" <num. operator> { "*" "/" "+" "-" "&" " " "^" "<<" ">>" <num. real operator> { "sin" "cos" "tan" "asin" "acos" "atan" "sqrt" <log. operator> { "&" " " "^" <num. comp. operator> { "<=" ">=" "<" ">" "=" }</p> | <p>Program sequence control:</p> <p>IF ELSE Instruction WHILE Loop {..} Command block [.] Bundling of commands BEGIN END Program definition Label JUMP <label> or <soubroutine> START/STOP/BREAK/CONT<program> WAIT <time> or <condition></p> |
| <p>Compiler instructions:</p> <p>„“ <comment> „#include“ <file name> „#modul“ <file name> „#define“ <name> <text> „#global“ <file name></p> | <p>Data manipulation:</p> <p>DIM Field declaration COPY Field copying function SET Assign variable MSET Preset fields PSET Assign local variable</p> |
| <p>Acquisition of measured values:</p> <p>TIMER Timer TRACE Oscilloscope function</p> | <p>Axis/process functions:</p> <p>AXINIT Initialise axes AXSET Take over axis data STOP Interrupt axis movement HALT Immediate halt of axis movement POS HALT Immediate halt of axis movement BREAK Interrupt axis movement CONT Resume axis movement EQUIT Acknowledge axis error LOCK Lock axis control UNLOCK Unlock control OVER Determine axis override ACC Acceleration (\pm) of axis VEL Axis velocity POS Position axis SYNCH Define axes to be synchronised LIN Linear interpolation FORCE Force control DAC Voltage output FUNC Axis functions SIMU Simulation of axis HOME Referencing TABLE Create process curve VIRTUAL Define virtual axes REAL Inverse calculation formula to VIRTUAL FREEZE Freeze axis velocity</p> |
| <p>Dialogue commands (hand-held control box or terminal):</p> <p>DIALOG Start dialogue WINDOW Define window DISPLAY Output variable or text INPUT Input definition LEVEL User level READ_KEY Softkey query SSET String assignment</p> | <p>For operating parameters that are not listed here, it is usually possible to enter a constant, a variable or a term!</p> |
| <p>Special commands:</p> <p>CALL <address> Call C-function START/STOP TASK Start C-task</p> | |



Technical data

| | | |
|--|---------------------|---|
| Operating voltage | U_O | 18 to 36 VDC / max 3.6 A |
| Current consumption | Master without axis | 500 mA |
| | Master with axis | 800 mA |
| | Slave | 400 mA |
| Processor | | MPC860 and MPC555 |
| Memory | | 16 MB SDRAM, 16 MB flash, 8 KBytes DPR 4 MB Flash (MPC555) 2 MB SRAM (MPC555) |
| Analogue inputs: | | |
| – Voltage inputs (differential inputs) | | |
| • Input voltage | U_I | ± 10 V 12 bits with 4-fold oversampling max. +10 V to –10 V |
| • Input resistance | R_I | 160 k Ω |
| • Resolution | | 5 mV |
| – Current inputs | | |
| • Input current | I_I | 4 – 20 mA, ± 20 mA |
| • Input resistance | R | 100 Ω |
| • Power loss | I_L | 12 μ A |
| • Resolution | | 4 μ A |
| Analogue outputs: | | |
| – Voltage outputs | | |
| • Output voltage | U_{nom} | ± 10 V PWM (pulse-width modulation) |
| • Output current | I_{max} | 10 mA |
| • Load | R_{min} | 2 k Ω |
| – Current outputs | | |
| • Output current, normalised | I_{nom} | ± 20 mA |
| • Load | R_{max} | 500 Ω |
| • Resolution | | 1 mV |
| Serial interfaces | Standard | RS232 (19.2 KBaud) RS485 (115 KBaud) |
| | Optional | Profibus DP (max. 12 MBaud) CAN open (max. 1 MBaud) |
| Switching inputs | Number | 32 |
| | Logic level | log 0 (low) 0 V to +5 V log 1 (high) +10 V to 36 V |
| | R_I | 3 k Ω ± 10 % |
| Switching outputs | Number | 24 |
| | Logic level | log 0 (low) 0 V to +5 V; log 1 (high) +10 V to 36 V; |
| | | Current carrying capacity up to 50 mA |

Technical data (continued)

| | | |
|---|-----------|-------------------------------|
| Digital position transducers | | |
| – Incremental transducer | | |
| • Transducer with TTL output | | |
| Input voltage | log 0 | 0 to 1 V |
| | log 1 | 2.8 to 5.5 V |
| Input current | log 0 | –0.8 mA (at 0 V) |
| | log 1 | 0.8 mA (at 5 V) |
| Max. frequency referred to Ua 1 | f_{max} | 250 kHz, 24 bits |
| SSI position transducer | | |
| – Coding | | Gray code |
| – Data width | | Adjustable up to max. 28 bits |
| – Line receiver (TTL) | f_{max} | 250 kHz |
| – Input voltage | log 0 | 0 to 1 V |
| | log 1 | 2.5 to 5.5 V |
| – Input current | log 0 | –0.5 mA (at 0 V) |
| | log 1 | 0.5 mA (at 5 V) |
| – Line driver | | |
| – Output voltage | log 0 | 0 to 0.5 V |
| | log 1 | 2.5 to 5.5 V |
| Permissible operating temperature range | | 0 to 50 °C |
| Storage temperature range | | –20 to 70 °C |
| Weight: | | |
| – Rack 1 | <i>m</i> | 1000 g |
| – Rack 5 | <i>m</i> | 1800 g |
| – Rack 8 | <i>m</i> | 2500 g |
| – Master card | <i>m</i> | 400 g |
| – Slave card | <i>m</i> | 350 g |
| – Blank cover | <i>m</i> | 100 g |

Pin assignment of master card VT-MAC8

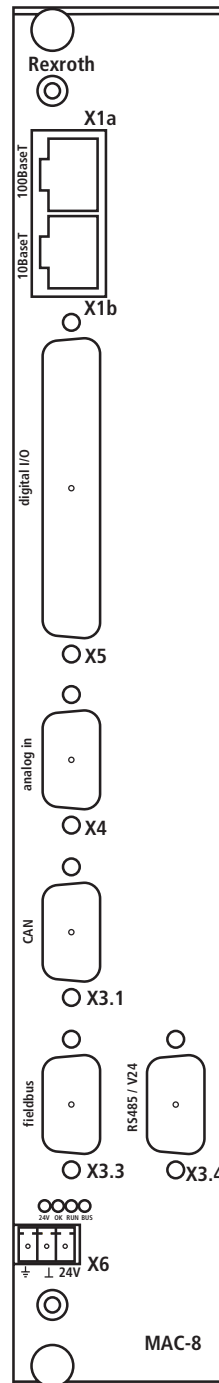
Front panel shows: VT-MAC8-1X/K-PM1

| X1a RJ-45; 100BaseT Ethernet | | |
|------------------------------|---------|--|
| 1 | TPO+ | |
| 2 | TPO- | |
| 3 | TPI+ | |
| 4 | 75K-GND | |
| 5 | 75K-GND | |
| 6 | TPI- | |
| 7 | 75K-GND | |
| 8 | 75K-GND | |

| X1b RJ-45; 10BaseT Ethernet | | |
|-----------------------------|------|--|
| 1 | TPO+ | |
| 2 | TPO- | |
| 3 | TPI+ | |
| 4 | n.c. | |
| 5 | n.c. | |
| 6 | TPI- | |
| 7 | n.c. | |
| 8 | n.c. | |

| X4 Analogue in | | |
|----------------|-------------------|---|
| 1 | U _{in1C} | |
| | U _{in2C} | 6 |
| 2 | U _{in3C} | |
| | U _{in4C} | 7 |
| 3 | AGND | |
| | U _{in1D} | 8 |
| 4 | U _{in2D} | |
| | U _{in3D} | 9 |
| 5 | U _{in4D} | |

| X6 Voltage supply | | |
|-------------------|--------|--|
| 1 | Shield | |
| 2 | GND | |
| 3 | +24 V | |



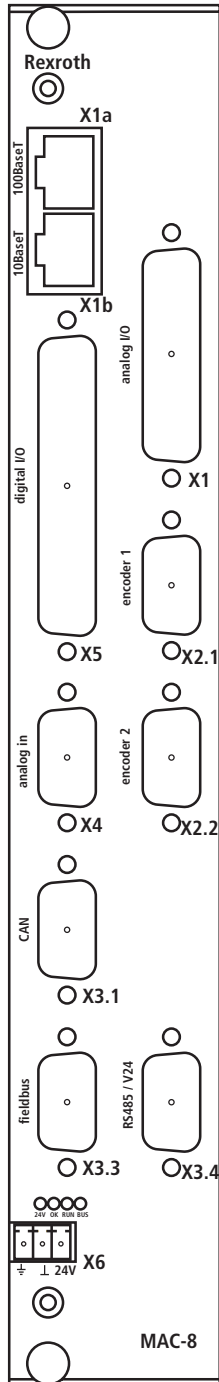
| X3.1 CAN open | | |
|---------------|---------|---|
| 1 | n.c. | |
| | n.c. | 6 |
| 2 | CAN_Lx | |
| | CAN_Hx | 7 |
| 3 | GNDCANx | |
| | n.c. | 8 |
| 4 | n.c. | |
| | n.c. | 9 |
| 5 | n.c. | |

| X3.3 Profibus DP | | |
|------------------|------------|---|
| 1 | n.c. | |
| | VP | 6 |
| 2 | n.c. | |
| | n.c. | 7 |
| 3 | RxD/TxD -P | |
| | RxD/TxD -N | 8 |
| 4 | CNTR -P | |
| | n.c. | 9 |
| 5 | DGND | |

| X3.4 V 24 | | |
|--------------|------|---|
| 1 | GND | |
| | RxD | 6 |
| 2 | TxD | |
| RS485 | | |
| | GND | 7 |
| 3 | 5 V | |
| | RxD+ | 8 |
| 4 | RxD- | |
| | TxD+ | 9 |
| 5 | TxD- | |

Pin assignment of master card VT-MAC8

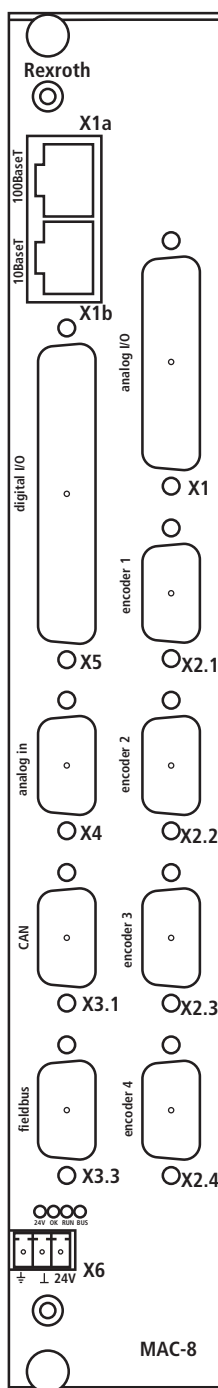
Front panel shows: VT-MAC8-1X/K-PM2



| X5 Digital I/O | | | | | |
|----------------|-------------|-----|-------------|-----|-------------|
| Pin | Description | Pin | Description | Pin | Description |
| | | 22 | Reserved | | |
| 43 | Reserved | | | 1 | Reserved |
| | | 23 | In0 | | |
| 44 | In2 | | | 2 | In1 |
| | | 24 | In3 | | |
| 45 | In5 | | | 3 | In4 |
| | | 25 | In6 | | |
| 46 | In8 | | | 4 | In7 |
| | | 26 | In9 | | |
| 47 | In11 | | | 5 | In10 |
| | | 27 | In12 | | |
| 48 | In14 | | | 6 | In13 |
| | | 28 | In15 | | |
| 49 | In17 | | | 7 | In16 |
| | | 29 | In18 | | |
| 50 | In20 | | | 8 | In19 |
| | | 30 | In21 | | |
| 51 | In23 | | | 9 | In22 |
| | | 31 | In24 | | |
| 52 | In26 | | | 10 | In25 |
| | | 32 | In27 | | |
| 53 | In29 | | | 11 | In28 |
| | | 33 | In30 | | |
| 54 | Out0 | | | 12 | In31 |
| | | 34 | Out1 | | |
| 55 | Out3 | | | 13 | Out2 |
| | | 35 | Out4 | | |
| 56 | Out6 | | | 14 | Out5 |
| | | 36 | Out7 | | |
| 57 | Out9 | | | 15 | Out8 |
| | | 37 | Out10 | | |
| 58 | Out12 | | | 16 | Out11 |
| | | 38 | Out13 | | |
| 59 | Out15 | | | 17 | Out14 |
| | | 39 | Out16 | | |
| 60 | Out18 | | | 18 | Out17 |
| | | 40 | Out19 | | |
| 61 | Out21 | | | 19 | Out20 |
| | | 41 | Out22 | | |
| 62 | 0 V | | | 20 | Out23 |
| | | 42 | 0 V | | |
| | | | | 21 | 0 V |

Pin assignment of master card VT-MAC8

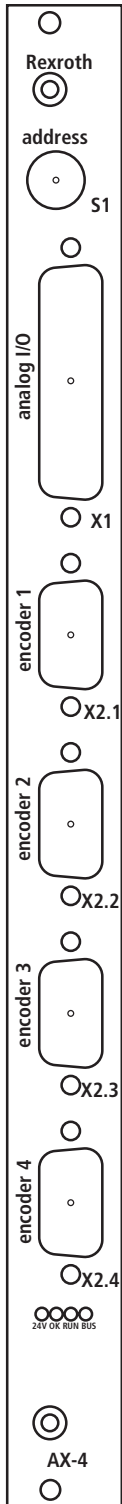
Front panel shows: VT-MAC8-1X/K-PM4



| X1 Analogue I/O on master card | | | |
|--------------------------------|---------------------------------|-----|---|
| Pin | | Pin | Description |
| 1 | n.c. | | |
| | n.c. | 14 | |
| 2 | AGND | | Analogue ground |
| | n.c. | 15 | |
| 3 | n.c. | | |
| | AGND | 16 | Analogue ground |
| 4 | IU _{in} 1 _A | | Current / voltage input 0.. 20 mA / ±10 V |
| | IU _{in} 1 _B | 17 | Current / voltage input 0.. 20 mA / ±10 V |
| 5 | IU _{in} 2 _A | | Current / voltage input 0.. 20 mA / ±10 V |
| | IU _{in} 2 _B | 18 | Current / voltage input 0.. 20 mA / ±10 V |
| 6 | AGND | | Analogue ground |
| | IU _{in} 3 _A | 19 | Current / voltage input 0.. 20 mA / ±10 V |
| 7 | IU _{in} 3 _B | | Current / voltage input 0.. 20 mA / ±10 V |
| | IU _{in} 4 _A | 20 | Current / voltage input 0.. 20 mA / ±10 V |
| 8 | IU _{in} 4 _B | | Current / voltage input 0.. 20 mA / ±10 V |
| | AGND | 21 | Analogue ground |
| 9 | U _{out} 1 | | ±10 V |
| | U _{out} 2 | 22 | ±10 V |
| 10 | U _{out} 3 | | ±10 V |
| | U _{out} 4 | 23 | ±10 V |
| 11 | AGND | | Analogue ground |
| | I _{out} 1 | 24 | ±20 mA |
| 12 | I _{out} 2 | | ±20 mA |
| | I _{out} 3 | 25 | ±20 mA |
| 13 | I _{out} 4 | | ±20 mA |

| X2.x Encoder plug | | |
|-------------------|----------|----------|
| Pin | INC | SSI |
| 1 | /Ua 2 | |
| 2 | | +Clk |
| 3 | Ua 0 | |
| 4 | / Ua 0 | |
| 5 | Ua 1 | |
| 6 | / Ua 1 | |
| 7 | | -Clk |
| 8 | Ua 2 | |
| 9 | | -Data |
| 10 | 0 V | 0 V |
| 11 | | +Data |
| 12 | 5 V TTL | |
| 13 | n. c. | n. c. |
| 14 | Reserved | Reserved |
| 15 | n. c. | n. c. |

Pin assignment of slave card VT-MAC8-1X/K-AX4



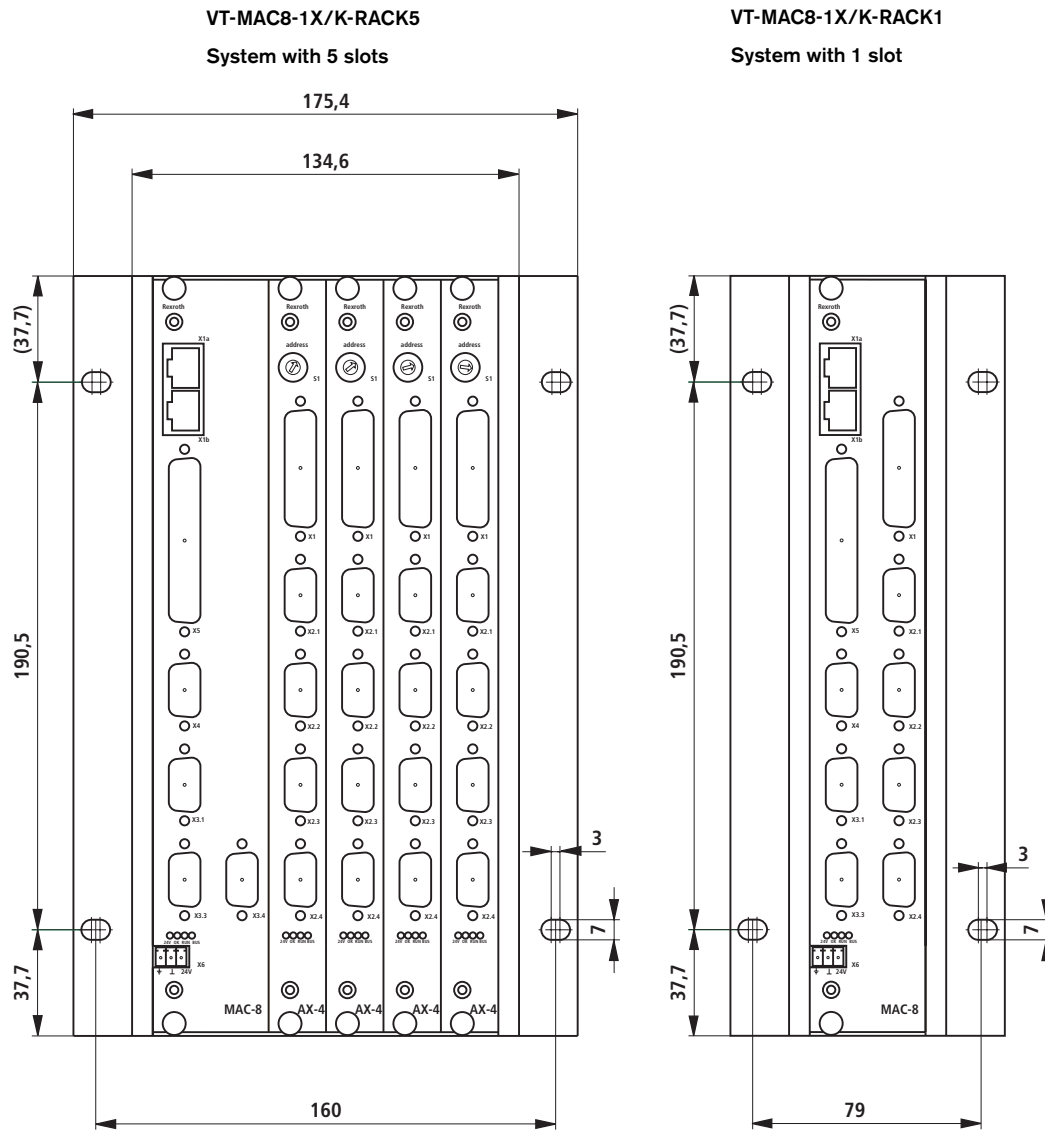
| X1 Analogue I/O on slave card | | | |
|-------------------------------|---------------------------------|-----|---|
| Pin | | Pin | Description |
| 1 | I _{in} 1 _C | | Current input ±20 mA |
| | I _{in} 2 _C | 14 | Current input ±20 mA |
| 2 | AGND | | Analogue ground |
| | I _{in} 3 _C | 15 | Current input ±20 mA |
| 3 | I _{in} 4 _C | | Current input ±20 mA |
| | AGND | 16 | Analogue ground |
| 4 | IU _{in} 1 _A | | Current / voltage input 0.. 20 mA / ±10 V |
| | IU _{in} 1 _B | 17 | Current / voltage input 0.. 20 mA / ±10 V |
| 5 | IU _{in} 2 _A | | Current / voltage input 0.. 20 mA / ±10 V |
| | IU _{in} 2 _B | 18 | Current / voltage input 0.. 20 mA / ±10 V |
| 6 | AGND | | Analogue ground |
| | IU _{in} 3 _A | 19 | Current / voltage input 0.. 20 mA / ±10 V |
| 7 | IU _{in} 3 _B | | Current / voltage input 0.. 20 mA / ±10 V |
| | IU _{in} 4 _A | 20 | Current / voltage input 0.. 20 mA / ±10 V |
| 8 | IU _{in} 4 _B | | Current / voltage input 0.. 20 mA / ±10 V |
| | AGND | 21 | Analogue ground |
| 9 | U _{out} 1 | | ±10 V |
| | U _{out} 2 | 22 | ±10 V |
| 10 | U _{out} 3 | | ±10 V |
| | U _{out} 4 | 23 | ±10 V |
| 11 | AGND | | Analogue ground |
| | I _{out} 1 | 24 | ±20 mA |
| 12 | I _{out} 2 | | ±20 mA |
| | I _{out} 3 | 25 | ±20 mA |
| 13 | I _{out} 4 | | ±20 mA |

| X2.x Encoder plug | | |
|-------------------|----------|----------|
| Pin | INC | SSI |
| 1 | /Ua 2 | |
| 2 | | +Clk |
| 3 | Ua 0 | |
| 4 | / Ua 0 | |
| 5 | Ua 1 | |
| 6 | / Ua 1 | |
| 7 | | -Clk |
| 8 | Ua 2 | |
| 9 | | -Data |
| 10 | 0 V | 0 V |
| 11 | | +Data |
| 12 | 5 V TTL | |
| 13 | n. c. | n. c. |
| 14 | Reserved | Reserved |
| 15 | n. c. | n. c. |

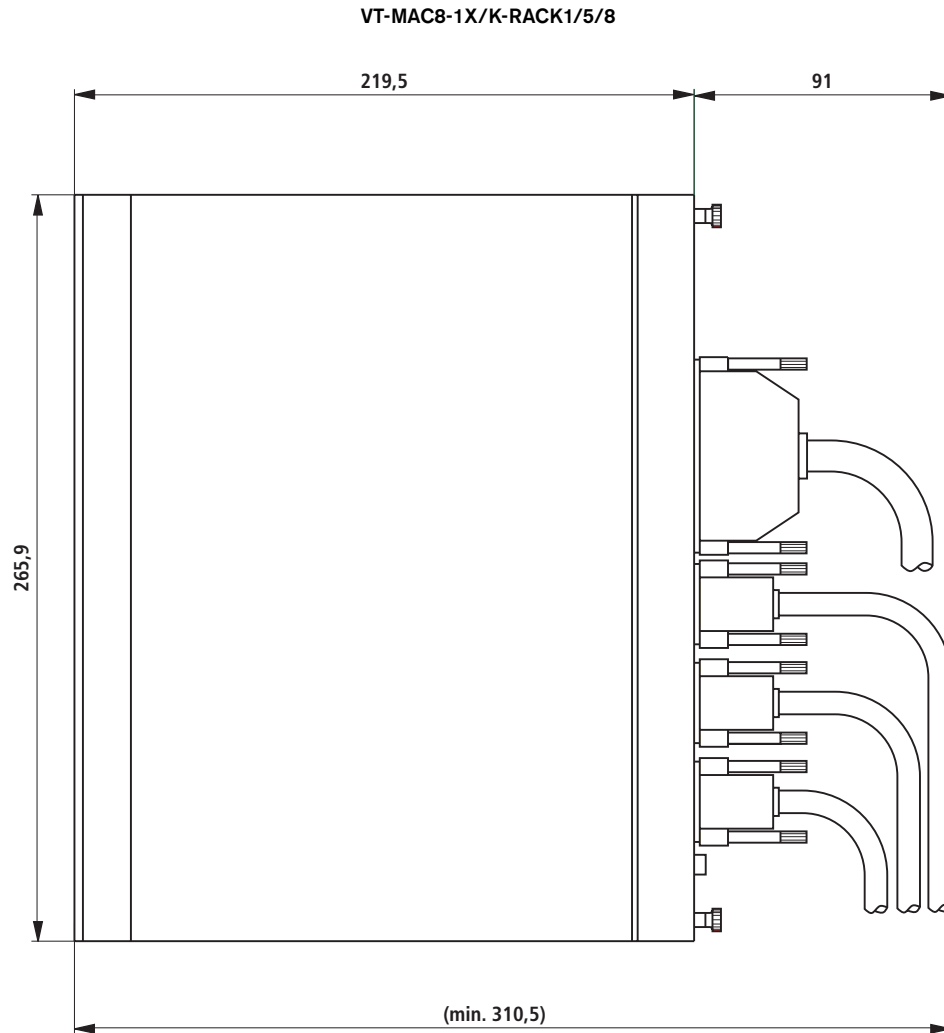
| S1 | Address |
|-------|---------------|
| | Slot |
| 2 | Slot 2 |
| 3 | Slot 3 |
| 4 | Slot 4 |
| 5 | Slot 5 |
| 6 | Slot 6 |
| 7 | Slot 7 |
| 8 | Slot 8 |
| 0 - 1 | Not permitted |
| 9 - F | Not permitted |

⚠ Caution!
Address the card according to the slot!

Unit dimensions (nominal dimensions in mm)



Unit dimensions (nominal dimensions in mm)



Notes

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