PROCESS AUTOMATION

# Freelance 2019

## Mounting and Installation Instructions
## Rack System



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Document Number: 3BDD012603-111
Revision: A
Release: Dezember 2018

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# 7 Technical Data of the Process Station

## 7.1 Environmental specifications

| | |
|---|---|
| Max. ambient temp. | 0 °C ... 50 °C (no fan required) |
| Max. internal module temp. | 0 °C ... 70 °C<br>temperature monitoring on CPU and I/O modules. |
| Temperature gradient to DIN/IEC 68, Part 14 | operational: 1 °C/minute |
| Storage and transportation temperature | - 25 °C ... + 85 °C |

**Air humidity/air temperature diagram**

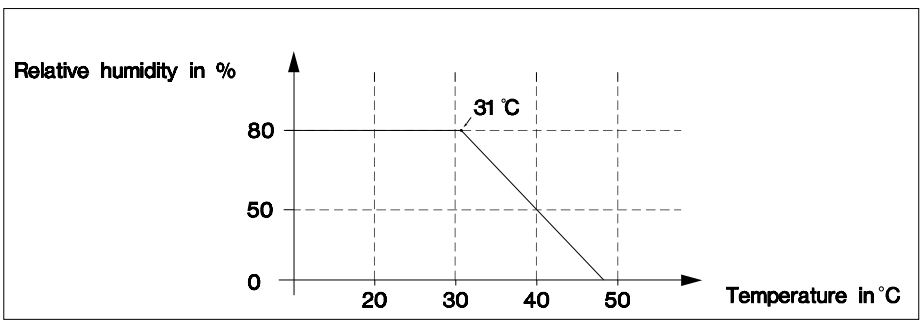



Fig. 7-1 Max. relative humidity

| | |
|---|---|
| Degree of relative humidity | RH-1 according to EN 61131-2:1994 (IEC 1131-2) |
| Operating altitude | max. 2000 m above sea level; higher altitudes on request |
| Climate class | KWF to DIN 40 040<br>3K3 to DIN IEC 721, Part 3-3 |
| Corrosion resistance | to IEC 68-2-30<br>lower air temperature 25 °C<br>upper air temperature 55 °C/ 95 % air humidity<br>9 hours dwell time, 6 cycles |
| Protection | IP 20 for rack with mounted modules |

## 7.2 Mechanical specifications

Test to DIN IEC 68, T. 2 - 27 and T. 2 - 6

**Transportation**

| | |
|---|---|
| Shock | 30 g/18 ms/18 shocks<br>Max. values for the individual modules. The values are valid for assembled process stations only if a transportation restraint is used. |
| Vibration, 3 * 5 cycles | 2 g/0.15 mm/5 ... 150 Hz |

Always put the modules in their original packing for transportation to avoid damage. When transporting completely assembled racks with mounted modules, always protect the modules with transportation restraints DSU 482.

**Operation**

| | |
|---|---|
| Vibration, 3 * 2 cycles | 2 g/0.075 mm/5 ... 150 Hz |

## 7.3 Electromagnetic compatibility (EMC)

Meets the requirements of the EC directive 89/336/EEC for EMC, as of May 1989, or the EMCG regulation dated November 1992, respectively.

| | |
|---|---|
| RFI suppression | to EN 55022 1987<br>(DIN VDE 0878, Part 3/11.89, Class B) expanded by limits specified in regulation 243/1991 of the German Federal Telecommunications Office |
| EMI/RFI shielding to EN 50 082 | |
| Test in accordance with IEC 1000-4/IEC 801/EN 60801/ EN 61000-4/VDE 0843 | - shielded I/O cables meet Parts 1 to 6, degree 3<br>- unshielded I/O cables meet Parts 1 to 4 and Part 6, degree 3 |

ESD degree to EN 61131-2:1994 : degree ESD-3

The industrial standard to NAMUR 21 as of 05.93 is met.

### 7.6.2 Technical data of link module DLM 01

**Features**

- Application of 24 V supply voltage from power supply DPW
- Supply voltage monitoring
- LED status indicator
- Connection of additional I/O units possible
- Replaceable battery for redundant CPU module RAM buffering
- Connector plug for external RAM buffering
- Short-circuit and overvoltage protection

**Technical data**

| | |
|---|---|
| Supply voltage | 24 V DC, ± 10 %<br>120 W from power supply DPW |
| Power consumption | 1 W for internal supply<br>max. 120 W for module supply in rack |
| Glass fuse, type 5 AT | Model: Wickmann 19195 (UR) |
| Buffer battery | 3.6 V |
| Add. external battery voltage | 3.6 V (nominal voltage) and/or 24 V DC<br>permissible range 2.9 ... 4.5 V or 18 ... 30 V |
| Weight | 1.7 kg |

### 7.6.3 Technical data of link module DLM 02

**Features**

- 24 V double connection , powered by two power supplies DPW
- Supply voltage monitoring
- Automatic switch-over in case one power supply fails
- Microprocessor for module monitoring
- Module temperature monitoring
- LED status indicator
- Connection of additional I/O units possible
- Replaceable battery for redundant CPU module RAM buffering
- Connector plug for external RAM buffering
- Short-circuit and overvoltage protection

**Technical data**

| | | |
|---|---|---|
| Supply voltage | | 24 V DC, ± 10 %<br>120 W from power supply DPW |
| Power consumption | | max. 7 W for internal supply<br>max. 120 W for module supply in rack |
| Fuse | external<br>internal | glass fuse type 5 AT, Wickmann 19195 (UR)<br>glass fuse type 0.4-AT, Wickmann 19198 (UL) |
| Buffer battery | | 3.6 V |
| Add. external battery voltage | | 3.6 V (nominal voltage) and/or 24 V DC<br>permissible range 2.9 ... 4.5 V or 18 ... 30 V |
| Weight | | 1.7 kg |

### 7.6.4 Technical data of CPU module DCP 02

CPU module DCP 02 has been modified. The new version can be identified through its hardware revision level (HW index 50.00 or higher). The differences were kept as small as possible. In the following text, the modified DCP 02 module (HW index ≥ 50.00) is described. Therefore, the major differences from the previous version are

al data.

**Features**

- Efficient super scalar RISC CPU
- Coprocessor for DigiNet S Ethernet bus
- 8 MB static RAM, battery-buffered, ensures quick restart after failure of the primary power
- Write-protection for main memory, programmable areas
- Main memory with error detection and correction (EDC) unit, automatically correcting 1-bit errors and recognizing all 2-bit errors in a data word for both CPU and DMA memory access of the coprocessor
- Hardware configuration and diagnostic data stored in serial 16 Kbit EEPROM
- Flash EPROM, software/firmware update possible without replacing EPROM
- Connectors for DigiNet S system bus meet Ethernet standard
- Serial interfaces RS485 and RS232C
- Module self-test , inquiry via diagnostic interface
- Reset switch, Run/Stop switch
- LED status indicators
- Internal and/or external RAM buffering
- Processing of ‘Battery low‘ or ‘No battery‘ signals
- CPU board temperature monitoring, both cyclic temperature measurement and asynchronous signaling when a temperature limit is exceeded
- DCP 02 with a HW index < 50.00 only provides asynchronous signaling when a temperature limit is exceeded
- Counter for running hours at normal and at excess temperature.
- Monitoring of the internal operating voltage.
- Independent watchdog function block, reliably preventing that the operating system gets “stuck“
- Battery-buffered real-time clock retaining the system time while the process station is off
- Processing of power-fail signal

**Technical data**

| | |
|---|---|
| **Weight**<br>CPU board in module case. | 2 kg |
| **Power consumption**<br>Depending on CPU load and cycle times | - typ.: 10 W<br>- max.: 12 W |
| **Voltage monitoring**<br>If either of the two internal supply voltages is fallen below by the specified value, a reset of the CPU board is initiated. In this case supply voltages of 5.0 V ± 3 % and 3.3 V ± 3 % are generated on the DCP02.<br>(DCP 02 with a HW index < 50.00 only has an internal supply voltage of 5 V.) | Reset threshold with 5 V: 4.65 V<br>Reset threshold with 3.3 V: 3.08 V |
| **Power failure**<br>Short-time interruptions of the primary power supply can be bridged by the DPW power supplies without generating a power fail signal. Also, in cases where a power fail signal is generated the power supplies continue to power the system for a time $T_{PF}$ to ensure that all running processes can be shut down properly. | $T_{PF} \geq 15$ ms |
| **CPU**<br>Intel 80960HD 25/50, 32-bit super scalar RISC processor<br>(with HW index < 50.00: Intel 80960 CA processor) | 50 MHz CPU clock<br>100 MIPS |
| **Coprocessor**<br>Intel 82596 CA, for Ethernet communication | 25 MHz |
| **Processing time for 1000 commands**<br>(preliminary specifications) binary IL<br>fixed point arithmetic<br>floating point arithmetic | < 2.0 ms<br>< 3.5 ms<br>< 4.5 ms |
| **RAM**<br>32-bit words, battery-buffered data retention. | 8 MB static RAM |
| **EDC unit**<br>Every 32-bit value in the main memory is provided with a checksum, to improve the data integrity | Correct 1-bit errors<br>Signal 2-bit errors |
| **EPROM**<br>Flash EPROM, allowing for quick access; can be programmed while installed in the system, no EPROM change required | 2 MB, 32-bit words |
| With HW index < 50.00: | 512 kB, 32-bit words |

| | |
|---|---|
| **EEPROM**<br>Configuration data and diagnostic data memory, independent of battery buffering | Serial 16-Kbit EEPROM,<br>Write cycles ≥ $10^7$,<br>Data retention time ≥ 10 years |
| **Temperature monitoring**<br>When the module is used at temperatures below or above the specified operating temperature, the MTBF is reduced. For this reason the temperature is measured cyclically, and excess temperature is immediately signaled. The signal is reset at hysteresis temperature. The running hours at excess temperature and at normal temperature are measured separately. | Resolution: 0.5 °C<br>Accuracy: ± 2 °C<br>Excess temperature: 70 °C<br>Hysteresis 65 °C |
| **Hot swapping (inserting/removing module when live)** | Permissible without restrictions |
| **Watchdog**<br>An independent watchdog function block must be triggered within the specified time. Otherwise, a module reset is initiated. This prevents that the operating system gets “stuck“. | Trigger time ≤ 1.6 s |
| **Real-time clock**<br>The correct time and date of the real-time clock must be set when the module is used for the first time. When a buffer battery is used, the time and date is retained even when the system is off. If the specified max. deviation should be too great for your application, it is recommended to use a radio clock instead. | Basic accuracy: ± 20ppm<br>Temperature influence:<br>-10/+120 ppm<br>Aging: ± 5ppm/a<br>Max. deviation p. a.:<br>-1104 ... +4573 s/a |
| **Internal fuses** | Self-resetting, no replacement required |
| **Battery DSU 08**<br>Replaceable, external and redundant buffering possible | 3.6 V lithium battery,<br>Battery life > 1.5 years (full-time operation) |
| **I/O polling/ output cycle**<br>The I/O modules are driven through 3 powerful CAN communication controller ASICs (HiCAN)<br>(DCP 02 with HW index < 50.00 is only provided with three standard CAN controllers). | **digital**, at least 2 ms per rack<br>**analog**, at least 10 ms per rack |

**System bus**

| | |
|---|---|
| Full Ethernet | according to 10Base5 (AUI connector) |
| Thin Ethernet | according to 10Base2 with 50 Ω coaxial cable |
| Fiber optic cable | according to 10Base-FL via AUI connector |

**Serial interface RS485 / Ser 1**

| | |
|---|---|
| RS485 | 9-pole Sub D female connector, half-duplex, suitable for bus operation, max. 32 bus nodes, configurable transmission rate, max. 19200 Baud. |

**Diagnostic interface RS232C / Diag**

| | |
|---|---|
| RS232C | 9-pole Sub-D male plug, RTS and CTS handshake signals available, connection of radio clock possible, configurable transmission rate, max. 19200 Baud connection of diagnostic PC possible via diagnostic cable DSU 141<br><br>Also suitable for connection of a radio clock, provided that the instructions given in Section 12.2.4. are observed. |

**Cables**

| | |
|---|---|
| DSU 13: | RS485 cable for DCP 02<br>9 pole Sub-D connector at one end, wire end sleeves at the other end, |
| DSU 141: | RS232C cable for DCP 02<br>9-pole Sub-D connector (male) for connection to diagnostic interface at one end,<br>25-pole Sub-D connector for connection to PC or terminal at the other end |
| NA 00x: | AUI cable for connecting system bus DigiNet S in accordance with 10Base5<br>15-pole Sub-D connector (male) for connection to DCP 02 at one end, 15-pole Sub-D connector (female) for connection to AUI transceiver NTC 03, star coupler NCU 02 or 10Base-FL transceiver NTC 02. |
| NC 200: | 10Base2-cable (coax) for connecting to system bus DigiNet S in accordance with 10Base2<br>coax. connectors at both ends. |

### 7.6.5 Technical data of CPU module DCP 10

**Features**

- Efficient super scalar RISC CPU
- Coprocessor for DigiNet S bus and redundant Diginet Sr bus
- 8 MB static RAM, battery-buffered, ensures quick restart after failure of the primary power
- Write-protection for main memory, programmable areas.
- Main memory with error detection and correction (EDC) unit, automatically correcting 1-bit errors and recognizing all 2-bit errors in a data word for both CPU and DMA memory access of the coprocessors
- Hardware configuration and diagnostic data stored in serial 16 Kbit EEPROM
- Flash EPROM, software/firmware update possible without replacing EPROM
- Connectors for DigiNet S system bus and redundant DigiNet Sr system bus meet Ethernet standard
- Serial interfaces RS485, RS422 and RS232C, electrically isolated
- Module self-test and inquiry via diagnostic interface
- Serial interfaces and diagnostic port suitable for redundancy mode
- Reset switch, Run/Stop switch, redundancy toggle switch
- LED status indicators
- Internal and/or external RAM buffering
- Processing of ‘Battery low‘ or ‘No battery‘ signals
- CPU board temperature monitoring, both cyclic temperature measurement and asynchronous signaling when a temperature limit is exceeded
- Counter for running hours at normal and at excess temperature.
- Monitoring of the internal operating voltage.
- Independent watchdog function block, reliably preventing that the operating system gets “stuck“
- Battery-buffered real-time clock retaining the system time while the process station is off
- Processing of power-fail signal

## Technical data

| | |
|---|---|
| **Weight**<br>CPU board in module case. | 2 kg |
| **Power consumption**<br>Depending on CPU load and cycle times | - typ.: 10.4 W<br>- max.: 14 W |
| **Voltage monitoring**<br>If either of the two internal supply voltages is fallen below by the specified value, a reset of the CPU board is initiated. In this case supply voltages of 5.0 V ± 3 % and 3.3 V ± 3 % are generated on the DCP10. | Reset threshold with 5 V: 4.65 V<br>Reset threshold with 3.3 V: 3.08 V |
| **Power failure**<br>Short-time interruptions of the primary power supply can be bridged by the DPW 01, DPW 02 and DPW 03 power supplies without generating a power fail signal. Also, in cases where a power fail signal is generated the power supplies continue to power the system for a time $T_{PF}$ to ensure that all running processes can be shut down properly. | $T_{PF} \geq 15$ ms |
| **CPU**<br>Intel 80960HD 25/50, 32-bit super scalar RISC processor | 50 MHz CPU clock<br>100 MIPS |
| **Co-processors**<br>Two Intel 82596 CA communication processors for Ethernet. | 25 MHz |
| **Processing time for 1000 commands** | |
| (preliminary specifications) binary IL | < 1.0 ms |
| fixed point arithmetic | < 1.5 ms |
| floating point arithmetic | < 1.5 ms |
| **RAM**<br>32-bit words, battery-buffered data retention. | 8 MB static RAM |
| **EDC unit**<br>Every 32-bit value in the main memory is provided with a checksum, to improve the data integrity | Correct 1-bit errors<br>Signal 2j-bit errors |

| | |
|---|---|
| **EPROM**<br>Flash EPROM, allowing for quick access; can be programmed while installed in the system, no EPROM change required | 2 MB, 32-bit words |
| **EEPROM**<br>Configuration data and diagnostic data memory, independent of battery buffering | Serial 16-Kbit EEPROM,<br>Write cycles ≥ $10^7$,<br>Data retention time ≥ 10 years |
| **Temperature monitoring**<br>When the module is used at temperatures below or above the specified operating temperature, the MTBF is reduced. For this reason the temperature is measured cyclically, and excess temperature is immediately signaled. The signal is reset at hysteresis temperature. The running hours at excess temperature and at normal temperature are measured separately. | Resolution: 0.5 °C<br>Accuracy: ± 2 °C<br>Excess temperature: 70 °C<br>Hysteresis 65 °C |
| **Hot swapping (inserting/removing module when live)** | Permissible without restrictions |
| **Watchdog**<br>An independent watchdog function block must be triggered within the specified time. Otherwise, a module reset is initiated. This prevents that the operating system gets “stuck“. | Trigger time ≤ 1.6 s |
| **Real-time clock**<br>The correct time and date of the real-time clock must be set when the module is used for the first time. When a buffer battery is used, the time and date is retained even when the system is off. If the specified max. deviation should be too great for your application, it is recommended to use a radio clock instead. | Basic accuracy: ± 20ppm<br>Temperature influence:<br>-10/+120 ppm<br>Aging: ± 5ppm/a<br>Max. deviation p. a.:<br>-1104 ... +4573 s/a |
| **Internal fuses** | Self-resetting, no replacement required |
| **Battery DSU 08**<br>Exchangeable, external and redundant buffering possible | 3.6 V lithium battery,<br>Battery life > 1.5 years (full-time operation) |
| **I/O polling/ output cycle**<br>The I/O modules are driven through 3 powerful CAN communication controller ASICs (HiCAN) | **digital**, at least 2 ms per rack<br>**analog**, at least 10 ms per rack |

**System buses DigiNet S and DigiNet Sr**

| | |
|---|---|
| Full Ethernet | according to 10Base5 (AUI-connector) |
| Thin Ethernet | according to 10Base2 with 50 Ω coax. cable |
| Fiber optic cable | according to 10Base-FL, via AUI connector |

**Serial interface Ser 1**

15-pole Sub-D female connector. Depending on connector pin assignment

| | |
|---|---|
| RS485 | half-duplex, suitable for bus operation with max. 32 bus nodes, suitable for redundant operation |
| RS422 | full-duplex, point-to-point connection, suitable for redundant operation |
| RS232C | full-duplex with RTS/CTS handshake; point-to-point connection, suitable for redundant operation. |
| Transmission rate | configurable, max. 19200 Baud. 9-pole Sub-D connector (female) |

**Diagnostic interface Diag**

| | |
|---|---|
| RS232C | 9-pole Sub-D connector, male. Handshake signals RTS, CTS available, suitable for redundant operation only in conjunction with a radio clock DSU 153<br>configurable transmission rate, max. 19200 Baud;<br>connection of diagnostic PCs via diagnostic cable DSU 141 |
| RS232C radio clock cable | DSU 153: two 9-pin Sub-D plug (male) on one side and 25-pin Sub-D connector plug for connection to DCF77 radio clock or GPS satellite radio clock on the other side |

**Cables for non-redundant use**

| | |
|---|---|
| RS232C cable for DCP 10 | DSU 212: 15-pole Sub-D connector at one end, wire end sleeves at the other end |
| RS422 cable for DCP 10 | DSU 213: 15-pole Sub-D connector at one end, wire end sleeves at the other end |
| RS485 cable for DCP 10 | DSU 211: 15-pole Sub-D connector at one end, wire end sleeves at the other end |
| RS232C diagnostic cable for DCP 10 | DSU 141: 9-pole Sub-D connector (male) for connection to diagnostic interface at one end, 9-pole Sub-D connector for connection to PC or terminal at the other end |
| AUI cable NA 00x | for connecting DigiNet S and DigiNet Sr system buses: 15-pole Sub-D connector (male) for connection to DCP 10 at one end, 15-pole Sub-D connector (female) for connection to AUI transceiver NTC 03, star coupler NCU 02 or 10BaseFL transceiver NTC 02. |
| 10Base2 cable NC 200 | for connection to DigiNet S and DigiNet Sr system buses, coax. cable connectors at both ends |

**Cables for redundant operation**

| | |
|---|---|
| RS232C cable | DSU 222: two 15-pole Sub-D connectors at one end, wire end sleeves at the other end |
| RS422 redundancy cable | DSU 223: two 15-pole Sub-D connectors, wire end sleeves at the other end |
| RS485 redundancy cable | DSU 221: two 15-pole Sub-D connectors, wire end sleeves at the other end |
| RS232C diagnostic cable | DSU 142: two 9-pole Sub-D connectors (male), 9-pole Sub-D connector for connection to a PC or terminal at the other end |
| NA 00X: | AUI cable for connection to DigiNet S or DigiNet Sr system bus in accordance with 10Base5<br>15-pole Sub-D connector (male) for connection to a DCP 10 at one end, 15-pole Sub-D connector (female) for connection to AUI transceiver NTC 03, star coupler NCU 02 or 10Base-FL transceiver NTC 02. |
| NC 200: | 10Base2 cable (coax) for connection to DigiNet S or DigiNet Sr system bus in acc. with 10Base2, coax. connectors at both ends |

### 7.6.6 Technical data of digital input module DDI 01

**General characteristics**

| | |
|---|---|
| Type | digital input, type 1 to EN 61131-2:1994 (IEC 1131-2), current-sinking, protected against polarity reversal |
| Number of channels | 32 |
| Nominal voltage | for active sensors 24 V DC or contacts with external 24 V DC supply |
| Operating mode | self-scan, configurable cycle time, shortest time 2 ms |
| Potential separation | four groups of eight; electrically isolated by opto-couplers, 8 inputs have a common ground potential. |
| Tap of channel indicator LEDs | at I/O side, directly at input |
| Power consumption from rack | 1.8 W |
| Glass fuse, type 1 AT | Model: Wickmann 19198 (UL) |
| Weight | 1.7 kg |
| Max. permissible cable length | 1000 m with appropriate cross-sectional area |
| Insertion/withdrawal under power | permissible, without restrictions |

**Static characteristics**

| Volt/ampere curve over the full operating range | | State 0 UL | IL | Transition region UT | IT | State 1 UH | IH |
|---|---|---|---|---|---|---|---|
| 24 V DC | max. | 5 V | 1 mA | 15 V | 3.7 mA | 30 V | 12.0 mA |
| | min. | -15 V | -9.5 mA | 5 V | 1 mA | 15 V | 3.7 mA |
| Input impedance | | $R_{(IN)} \approx 3\ k\Omega$ | | | | | |
| Rated input current | | $I_{(IN)} = 8\ mA$ | | | | | |

**Dynamic characteristics**

| | |
|---|---|
| Sample repetition time (cycle time) | configurable, 2 ms or slower. |
| Delay time for 1 to 0 and 0 to 1 transitions | configurable in 2 ms steps; additional debouncing function configurable. |
| Input filter characteristic | first order |
| Input filter delay time | ≤ 400 µs |

### 7.6.13 Technical data of analog input modules DAI 01, DAI 02, DAI 03

**General characteristics**

| | | |
|---|---|---|
| Type | | analog input |
| Number of channels | | 16 |
| Type of input | DAI 01 | current input 0/4 ... 20 mA with standard impedance 50 Ω |
| | DAI 02 | voltage input 0 ... 10 V |
| | DAI 03 | current input 0/4 ... 20 mA with increased input impedance 270 Ω for connection of Hart transmitters **(no further processing)** |
| Operating mode | | self-scan, configurable cycle time, 10 ms or slower |
| Potential separation | | two groups of eight, electrically isolated by opto-couplers |
| 4 voltage control LEDs | | light up if all DC/DC converters are OK. |
| Channel indicator LEDs DAI 01 and DAI 03 | | 16 red LEDs<br>**in the range 4 ... 20 mA**<br>LED on if I < 3.2 mA<br>LED off if I > 3.8 mA<br>LED on if I > 20.8 mA<br>LED off if I < 20.2 mA<br>**in the range 0 ... 20 mA**<br>LED on if I > 20.8 mA<br>LED off if I < 20.2 mA |
| DAI 02 | | **in the range 0 ... 10 V**<br>LED on if I > 10.4 V<br>LED off if I < 10.1 V |
| Tap of channel indicator LEDs | | driven via microprocessor of I/O module by software algorithm |
| Line break detection | | in the range 4 ... 20 mA by signal evaluation. Channel-wise indication by channel-indicator LEDs, alarm generation.<br>in the range 0 ... 10 V or 0 ... 20 mA by transient monitoring in the conversion block. |
| Power consumption from rack | | 9.6 W |

| | |
|---|---|
| Glass fuse, type 1 AT | Model: Wickmann 19198 (UL) |
| Weight | 1.7 kg |
| Max. permissible cable length | twisted-pair cable. 1000 m with appropriate cross-sectional area |
| Insertion/withdrawal under power | permissible, without restrictions |

**Static characteristics of DAI 01**

| | |
|---|---|
| **Input impedance** | 50 Ω, ± 1 % |
| Max. measuring error at 25 °C [1] | ± 1 ‰ |
| Temperature coefficient [1] | ± 1.36 ‰ / 10 K |
| Max. error from 0°... 50 °C [1] | ± 4.4 ‰ |
| **Digital resolution** | 12 bits |
| Value of least significant bit (LSB) | 5.5 µA |
| Permissible overload without the channels influencing each other | up to around 40 mA |
| Max. permanent allowed overload (no module damage) | 50 mA |
| Digital output reading under overload conditions | > 4096 |
| Polarity reversal | permissible |
| Digital output reading under polarity reversal conditions | const. 0 |
| **Type of input** | differential |
| Common-mode voltage | ± 3.5 V referred to GND terminal |
| Noise suppression of differential mode noise sources | 54 dB [2] |
| Noise suppression of common mode noise sources | 56 dB for DC [2], 52 dB for AC [2] |
| Monotonicity with no missing codes | yes |
| Conversion method | successive approximation |
| Non-linearity | ± 0.75 bits |

[1] of end of range value, at ambient temperature

[2] N 60873:1993

**Static characteristics of DAI 02**

| | |
|---|---|
| **Input impedance** | 40.1 kΩ, ±1 % |
| Max. measuring error at 25°C [1] | ± 1 ‰ |
| Temperature coefficient [1] | ± 1.04 ‰ / 10 K |
| Max. error from 0°...50 °C [1] | ± 3.6 ‰ |
| **Digital resolution** | 12 bits |
| Value of least significant bit (LSB) | 2.7 mV |
| Permissible overload without the channels influencing each other | up to around 20 V |
| Max. permanent allowed overload (no module damage) | 25 V |
| Digital output reading under overload conditions | > 4096 |
| Polarity reversal | permissible |
| Digital output reading under polarity reversal conditions | const. 0 |
| **Type of input** | differential |
| Common-mode voltage | ± 5V referred to GND |
| Noise suppression of differential mode noise sources | 23 dB [2], |
| Noise suppression of common mode noise sources | 48 dB for DC [2], 58 dB for AC [2] |
| Monotonicity with no missing codes | yes |
| Conversion method | successive approximation |
| Non-linearity | ± 0.75 bits |

**Static characteristics of DAI 03**

| | |
|---|---|
| **Input impedance** | 271Ω ±1% |
| Max. measuring error at 25°C[1] | ± 1 ‰ |
| Temperature coefficient [1] | ± 1.36 ‰/10K |
| Max. error from 0°...50°C[1] | ± 4.4 ‰ |

[1] of end of range value, at ambient temperature

[2] test procedure following EN 60873:1993

| | |
|---|---|
| **Digital resolution** : | 12 bits |
| Value of least significant bit (LSB) | 5.5 µA |
| Permissible overload without the channels influencing each other | up to around 40 mA |
| Max. permanent allowed overload (no module damage) | 50 mA |
| Digital output reading under overload conditions | > 4096 |
| Polarity reversal | permissible |
| Digital value under polarity reversal conditions | const. 0 |
| **Type of input** | differential |
| Common-mode voltage | ± 3.5 Volt referred to GND terminal |
| Noise suppression of differential mode noise sources | 54 dB [1] |
| Noise suppression of common mode noise sources | 56 dB for DC [1]<br>52 dB for AC [1] |
| Monotonicity with no missing codes | yes |
| Conversion method | successive approximation |
| Non-linearity | ± 0.75 bits |

**Dynamic characteristics**

| | | |
|---|---|---|
| Sample duration time (including settling time) | ≤ 52 µs | |
| Sample repetition time (cycle time) | configurable, 10 ms or slower | |
| Input filter characteristic | first order | |
| Time-constant input filter (70.7% of end value) | DAI 01 | 33 ms |
| | DAI 02 | 24 ms |
| | DAI 03 | 33 ms |

[1] test procedure following EN 60873:1993

### 7.6.16 Technical data of analog output module DAO 01

**General characteristics**

| | |
|---|---|
| Type | analog output for current signals |
| Number of channels | 16 |
| Type of output | 0/4 ... 20 mA, software-configurable |
| Setup | two monolithic D/A converters with eight channels, each |
| Output protection | short-circuit proof, overload proof, external supply proof |
| Operating mode | serial sequential data transfer, asynchronous conversion start |
| Safety values for CPU module failure or communication interruption | configurable. Selectable choice: 0 ... 20 mA or last value. Default setting: all outputs to 0 mA |
| Status after reset | all outputs to 0 mA |
| Potential separation | two groups of eight, electrically isolated by opto-couplers. Eight outputs are powered by a common supply, each. |
| Channel indicator LEDs | none |
| Line break detection | none |
| Power consumption from rack | 1.2 W |
| External power supply | 24 V DC (± 25%).<br>separately for each of the groups of eight. |
| Supply from three-phase mains with three-phase bridge rectifier | permissible. Voltage range 19.2...28 V RMS. Provide for protective separation of the power supply. |
| Power consumption from external power supply at 24 V DC | 6.5 W per group of eight at nominal voltage and maximum output current on all channels. |
| Weight | 1.7 kg |
| Max. permissible cable length | twisted pair cable. 1000 m with appropriate cross-sectional area |
| Insertion/ withdrawal under power | permissible. Switch off external power supply before withdrawing the module. Otherwise, the outputs will be held. |
| Peculiarities | If the module power supply fails, but the external supply keeps on running, the outputs hold their signal.<br>If you don't want this reaction, make sure that the external power supply is switched off via the rack power supply and a relay or an output of the digital output module. |

**Static characteristics**

| | |
|---|---|
| Load | ≤ 400 Ω |
| Output voltage | max. 8 V at 20 mA |
| Max. measuring error at 25 °C [1] | ± 1.0 ‰ |
| Temperature coefficient[1] | ± 1.8 ‰ / 10 K |
| Max. error from 0°... 50 ° C [1]: | ± 5.5 ‰ |
| Digital resolution | 12 bits |
| Value of least significant bit (LSB) | 5.0 µA |
| Overload | up to around 21 mA |
| Monotonicity | 12 bits with no missing codes |
| Conversion method | digital/analog converter. R/2R network, 2-quadrant multiplication, unipolar |
| Non-linearity | < 1 LSB |

**Dynamic characteristics**

| | |
|---|---|
| Transfer time | < 100 µs |
| Output cycle time | configurable, quickest time 10 ms |
| Overshoot | included in intrinsic accuracy |
| Repeatability at fixed temperature after specified stabilization time | within operating error limits |
| Output ripple | ≤ 0.05 % of end of range value |

[1] e at ambient temperature