

Digital Controller for Position and Pressure/Force Control

RA 30917/06.01

1/12

Model DMX

Series 1X

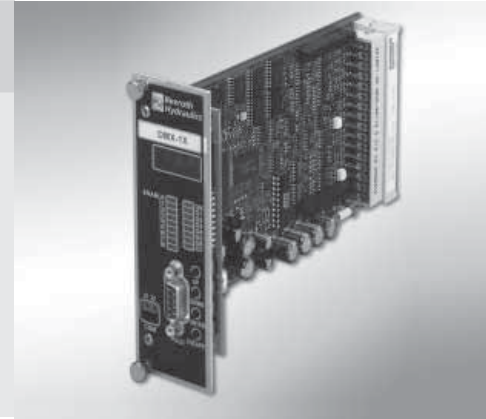


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Features

- Absolute digital input for 24-bit SSD position transducer
- High resolution input for analog position transducer
- Accepts 2 pressure transducers or load cell as force feedback
- Fine Positioning integration for superior accuracy
- Analog input for external velocity control
- Active Damping for low natural frequency systems
- Gain matching for a differential area cylinder
- Internal tables of stored command values
- 4–20 mA, 10 V, or ± 10 V options for most analog inputs
- Range checking on analog inputs
- Outputs ± 10 Vdc or 4–20 mA to valve amplifier
- Multifunction analog output to monitor control values
- Program accessible by pushbuttons with front display
- WinHost software included for setup and commissioning
- RS232 and RS485 communication ports
- Allen Bradley SLC communication interface
- Password protection available
- 24 VDC powered digital platform
- Optimizes hydraulic axis for closed loop control
- Achievable position accuracy of $\pm 0.05\%$ with analog feedback, < 0.001 in ($< 25 \mu\text{m}$) with SSD*
- Achievable steady state, pressure accuracy of $\pm 1.0\%$ *

* (typical, but not guaranteed)

Ordering code

	DMX	-1X	(valve type)
Digital Controller for Position and Pressure Regulation			
Series (10 to 19 externally interchangeable)			
Valve Type			
Valve type selected by user			= 0
Valve type set by Rexroth			= (valve)
Specify valve type to series number. Nominal flow rating is not required. Analog output to valve is ± 10 V. If using valves with F1 electronics, this must be set to 4–20 mA prior to enabling the DMX.			
Common valves include:			
4WREE6E-2X			
4WREE6V-2X			
4WREE10E-2X			
4WREE10V-2X			
4WRSE6E-3X			
4WRSE6V-3X			
4WRSE10E-3X			
4WRSE10V-3X			
4WRTE10E-3X**			
4WRTE10V-3X**			
4WRDE10E-5X**			
4WRDE10V-5X**			

**Linear L-flow type recommended.

Example: **DMX-1X/ 4WREE10E75-2X**
or **DMX-1X/ WREE10-E**

From the valve model, Rexroth determines how to configure the valve parameters. The valve model can be abbreviated. In most cases, it is best to always include the valve type, valve size, spool type and design series.

Technical data

Power supply voltage:	V_{DC}	21 V to 35 V
Power requirement: (additional power for sensors)	P	8 W
Digital position transducer:		SSD 24-bit gray code increasing
Analog inputs and outputs:		0 V to 10 V
	V_{IN}	0 to ± 10 V
		4 to 20 mA
* current not available on all I/O		
Input impedance (analog inputs):		
Voltage inputs	R_{IN}	200 k Ω or higher
Current inputs		100 Ω
Minimum load (analog outputs):		
± 10 V	R_L	1 k Ω ± 10 V
4–20 mA		500 Ω 4–20 mA
Discrete input voltage:		
log 0 (high)		10 V to 35 V
log 1 (low)		<5 V
Input impedance (discrete inputs):	R_D	1 k Ω
Discrete input voltage:		10 V to 35 V (V_{DC})
Minimum load (discrete outputs):	R_L	500 Ω (50 mA)
Internal reference voltage:	V_{REF}	+10 Vdc, –10 Vdc
Minimum load on ± 10 V: from card ± 10 V @ ± 30 mA	R_L	400 Ω
Serial interface:		RS232, RS485
Fuse (5 mm x 20 mm): (0.196 in x 0.787 in)		4 A
Connector type: (DIN 41494, type G)		64-pin, rows z, b, d, f
Card dimension: (DIN 41494)		Euro card 100 mm x 160 mm (3.93 in x 6.29 in)
Space requirements:		
Height	3U	128 mm (5.05 in.)
Conductor side		1 division 0.20" 5.08 mm (0.20 in)
Component side		7 divisions
Face plate	8HP	8 divisions
Ambient temperature range:	T	0 to 50 °C (32 to 122 °F)
Storage temperature:		–20 to 70 °C (–4 to 158 °F)
Weight:		0.27 kg (0.6 lb)

Description

The Rexroth DMX-1X digital controller optimizes the hydraulic axis for analog position, pressure or force control. All card settings can be accessed with the onboard pushbuttons and a digital display.

Configuration for the application and commissioning are the responsibility of the user. This includes the correct mechanical, hydraulic and electrical installation.

While the DMX-1X contains advanced control options that can deliver impressive performance, it can only work within the limits of the given system. Note that proportional valves with closed center spools are normally preferred, except when using Force Regulation. Consult Rexroth for further analysis to determine the best valve and system configuration for the desired performance.

Applications - Selections for the application are made in the Setup menu. Some common examples include:

- Direct drive, only (no feedback)
- Position regulation, only (analog or digital feedback)
- Pressure regulation, only (1 pressure transducer)
- Force regulation, only (2 pressure transducers or 1 load cell)
- CNC drive, only (feedback to CNC)
- Direct drive or Position regulation or CNC drive
 - with pressure limiting, either side
 - with pressure limiting, both sides;
 - or force limiting
 - with clamp control on +side only
 - with clamp on +side, pressure limiting on -side

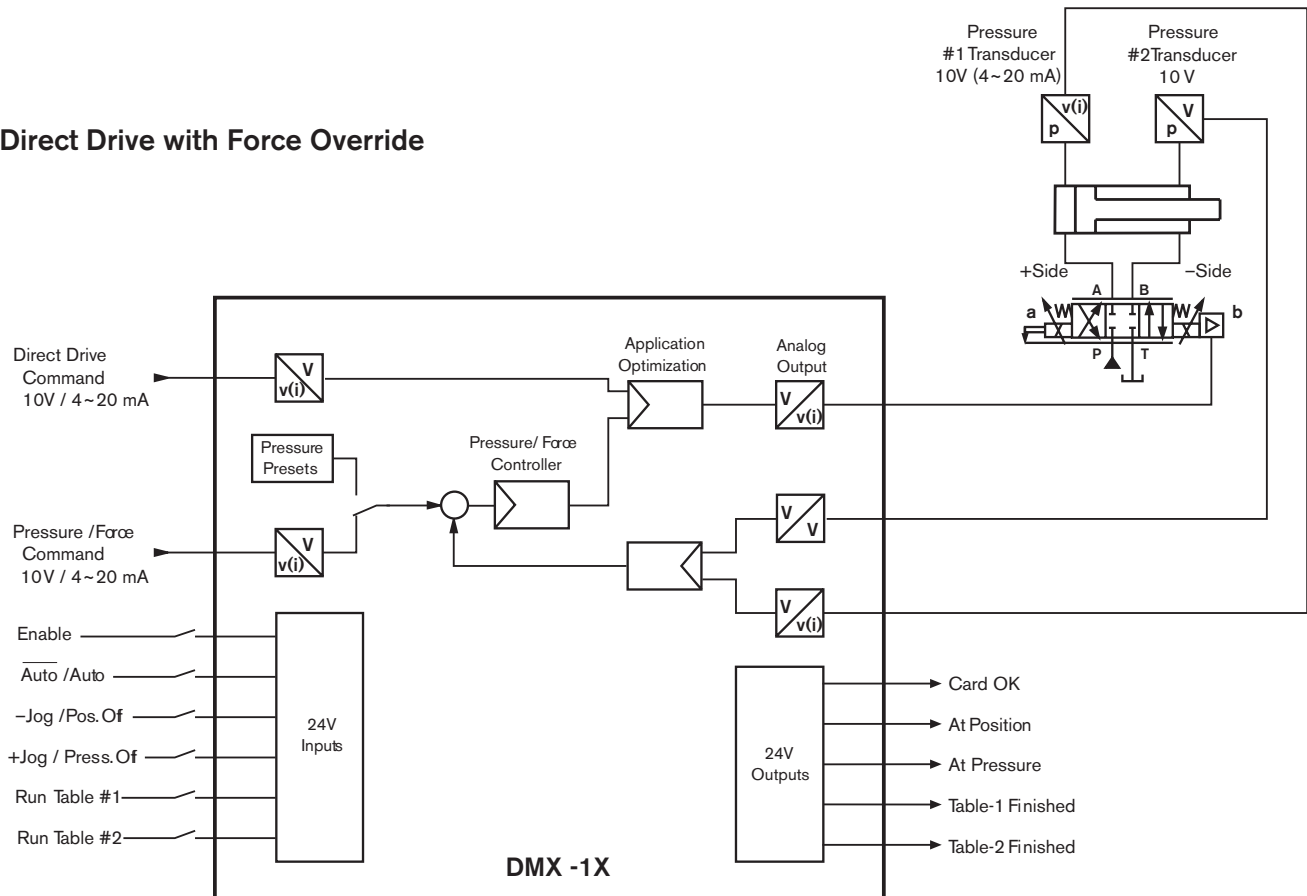
Direct Drive does not use position feedback. This is an open loop velocity control that can be used alone. It can also be combined with pressure control functions. New cards are normally configured as Direct Drive, only.

Position Control requires position feedback. Position control may be used alone or with pressure control functions. The transition between position and pressure control can be shock free. This depends on the valve and system. For example, if a low dynamic valve like 4WRZE is wide open, some pressure overshoot is expected when the cylinder suddenly stops. The position controller can also be externally disabled by a discrete input. This override is immediate. It does not permanently alter the internal configuration.

Position applications can also include a velocity limit. The maximum velocity is limited by a ramp which changes the position command over time ($v = \Delta x / \Delta t$). Velocity may be changed externally using the Velocity Limit analog input. A 0 to 10 Volt signal will scale the velocity where 10 Volts is equal to the Velocity Limit parameter and 0 Volts is equal to zero velocity. However, acceleration and deceleration are still determined by the closed loop system. Velocity is not regulated.

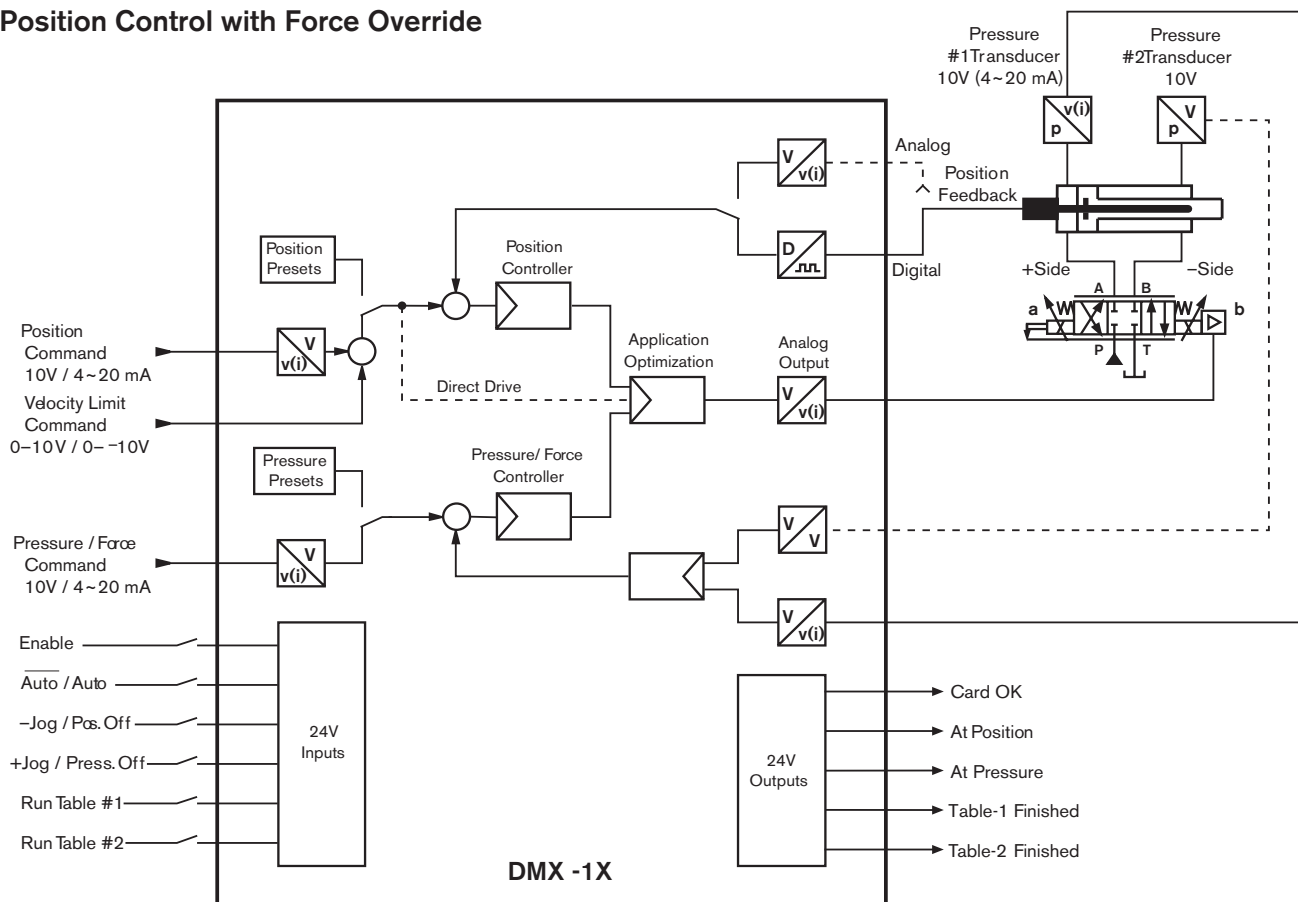
Utilizing internal tables, up to five different velocity and pressure limits may be set. The Table moves from step to step when either the programmed position or pressure is reached. The Table may be combined with analog commands. The Table is started with a discrete input and discrete outputs energize when position and pressure are within a setpoint window and/or the end of the Table is reached.

Direct Drive with Force Override



Description

Position Control with Force Override



CNC Drive is a special DMX-1X configuration for interfacing to a motion controller or computer numerical controller. The DMX-1X optimizes the hydraulic axis and drives the valve. The CNC or controller accepts the axis feedback. For high accuracy, digital feedback is required. A typical hydraulic axis uses a Rexroth cylinder with an integral absolute SSD (serial synchronous data) feedback. The CNC error of ± 10 V connects to the Position Feedback/CNC Error Input. The DMX-1X compensates for valve symmetry, throttle characteristics and spool overlap. It has gain matching for differential area cylinders.

The DMX-1X provides both passive and active damping. It also uses a Fine Positioning for superior accuracy. CNC Drive can also be combined with DMX-1X pressure control functions. If the CNC uses fault detection for excess following error, it must be ignored while pressure is limited.

Pressure regulation is essentially the same as pressure limiting. It may be used alone or combined with Direct Drive, Position Control or CNC Drive. If pressure must be limited on both sides of a cylinder, a shuttle valve may be used with a single pressure transducer. The DMX-1X can also accept two pressure transducers.

Clamp Control is a form of pressure control suitable for some clamping applications. Clamp control is only available on the +side. The only difference between Clamp Control and Pressure Limiting is that the valve spool is not allowed to shift over-center, while commanded to move in the +direction. Maximum pressure relief protection for the +side of the cylinder may be advisable. The load induced pressure could exceed the commanded pressure limit! Normal pressure limiting is still available for the -side. One example of Clamp Control is for an injection molding machine where the clamp must not open during injection. This could occur if a sufficient external force acted against the clamp

direction. Clamp Control limits pressure on the +side while moving or clamped. To prevent the valve from opening the mold, this spool can not shift through center. The position command must remain greater than the actual clamp position, to stay in this pressure mode.

An internal table for pressure command is available when fixed pressure settings are desired. The table can eliminate the need for the analog connection to the Force Command Input when the DMX-1X is also used for Direct Drive, Position Control or CNC Drive. The table is influenced by the pressure ramp function to control the rate of change, when enabled or disabled by the corresponding discrete input.

The Counterbalance parameter provides a fixed offset to pressure. Unlike the Table, this is located after the pressure ramp. This parameter is similar to using a counterbalance valve. Note that the DMX-1X can not hold this offset under all conditions, as during a power failure. This may not be a problem for all applications or when using directional proportional valves with closed center spools. The situation may be quite different when using a servo valve or proportional pressure relief valve.

The pressure or force controller can be externally disabled by a discrete input. Like the position control option, the override is immediate. For example, it may be necessary to disable the pressure limit for a short time to assure maximum acceleration, then release the override before approaching the final position with the pressure limit operating.

Force regulation requires a load cell, two pressure transducers or a differential pressure transducer. When selecting this menu option, it is not necessary to configure Force Limiter options in the Setup menu. The DMX-1X will automatically be set to external analog controller for both sides. Input #1 is normally used as the ± 10 V Force feedback input.

Description

Ramps - The +Direct Ramp and -Direct Ramp limits acceleration and deceleration in Direct Drive. Acceleration is the same in both directions. Deceleration is independently adjusted. These ramp times range from 0 to 100 seconds. The +/-Velocity Limit parameters can be used for Position Control for a different reason. In this mode, the traverse velocity is limited by changing position over time. Velocity may be changed externally using the Velocity Limit analog input. A 0 to 10 Volt signal will scale the velocity where 10 Volts is equal to the Velocity Limit parameter and 0 Volts is equal to zero velocity. The +Velocity Limit works with the +Velocity parameter. No ramp is used with the CNC Error input. The Pressurization Ramp and Decompression Ramp are available for pressure and force commands. These ramp times range from 0 to 30 seconds. The Jog Ramp limits acceleration and deceleration when moving the valve with Jog commands. The Jog ramp is the same for both directions. The Jog Ramp has a range from 0 to 30 seconds.

Fine Positioning - This can greatly improve position accuracy. Without this advanced option, accuracy is a direct function of the optimized Proportional gain alone. Additional Proportional gain would cause over-shoot. With Fine Positioning enabled, a switching integrator reduces the position error without requiring increased Proportional gain. An over-lapped spool is preferred for this option. For greatest accuracy, proper shielding, grounding and wiring practices must be observed.

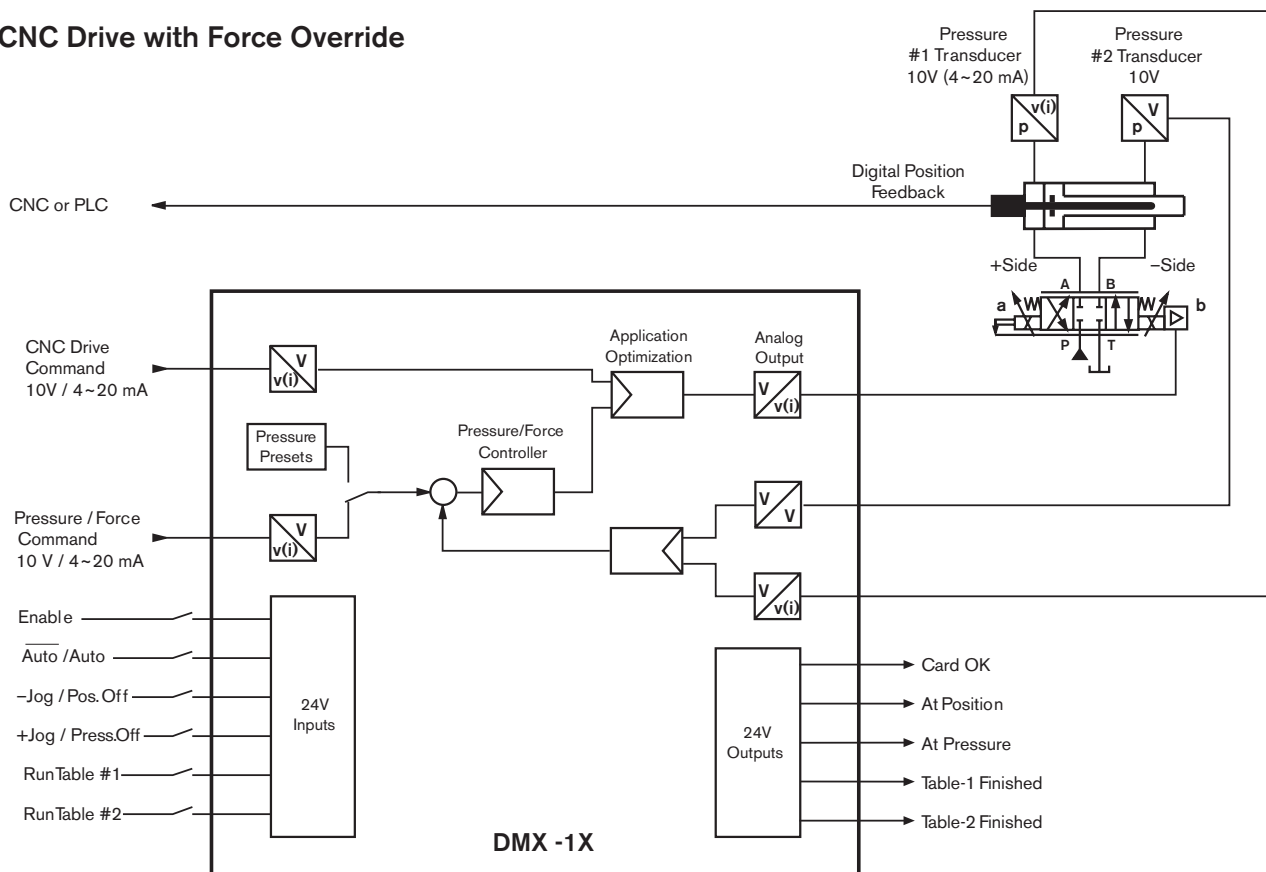
Active Damping - This is another advanced feature that can improve position accuracy. The active compensation can allow higher Proportional gain for greater performance. Active Damping requires two pressure transducers or a load cell, even if force or pressure control is not desired. Cylinders with low natural frequencies that use high response valves normally benefit the most from active damping.

Valves - Typical proportional valves include: 4WRABE, 4WRAE, 4WREE, 4WRSE, 4WRDE, 4WRKE, 4WRTE, 4WRZE. For position control with DMX-1X, use the proportional valve with an E-spool or positive overlap for best results. This includes position applications with pressure limiting, CNC applications with pressure limiting, and direct drive with pressure limiting. For exclusive pressure or force regulation, use a zero or underlap spool design, like the V-spool. A more dynamic proportional valve is preferred when pressure or force control is involved. Although servos can be used in any case, they may only be required for very small flows or special applications. The DMX-1X could be used with proportional relief valves with integrated electronics in some pressure applications.

Position Feedback - The position transducer can be 0 to 10 VDC, ± 10 V, 4–20 mA, or SSD. The DMX-1X provides excitation voltage for potentiometer feedback. Most single rod cylinders for position control are fitted with a magnostriptive feedback device. This has many advantages and normally works well. Special considerations may be required for critical applications where high acceleration or sudden temperature changes are expected.

Pressure Feedback - Pressure transducer #1 may be 0 to 10 VDC or 4–20 mA. A 0 to 5 VDC transducer can be used, but resolution is reduced. There are two pressure transducer inputs. The unused transducer input can be disabled. For pressure regulation only, select "Force Only" under the menu for application and enable the desired feedback input. For Direct Drive, Position Control or CNC Drive with Pressure control, first select "Direct Drive", "Position Ctrl" or "CNC Drive" then enable the desired transducer input.

CNC Drive with Force Override



Description

Force Feedback - Most force control applications will use two pressure transducers that output 0 to 10 VDC. #2 Transducer input cannot be

4–20 mA. Load cells and pressure transducers can be 0 to ± 10 VDC or 4–20 mA. The DMX-1X sets the pressure ratio for Inputs #1/#2, to accommodate differential cylinders.

Analog Inputs - All analog inputs are bipolar, 0 to ± 10 VDC differential type. The position command, position feedback, force command, and #1 Transducer may also be configured for 4–20 mA. The position feedback is a special high resolution design. For greater accuracy with 0 to 10 VDC devices, the analog inputs can be re-configured as uni-polar. Refer to DMX-1X Setup Instructions regarding configuring analog inputs.

The DMX-1X provides range checking on the analog inputs. This can be used to check for a cable break.

Before connecting the PLC analog or external analog source to the DMX-1X differential inputs, determine if the analog common is isolated. An isolated or floating analog common should be grounded at one point. It is recommended to connect an isolated analog common to 0 VDC or to the ground bus, at one point.

Discrete Inputs - These are 24 V (10 to 35 V) inputs.

ENABLE input (pin-d18) must be selected or high to allow motion from analog inputs. In most installations, this is activated by a PLC permissive. After a DMX-1X fault is cleared, the ENABLE input will reset the fault.

AUTO (pin-d2) is energized for normal operation and is de-energized to allow jog functions.

–JOG inputs (pin-d4) and +JOG (pin-d6) open the valve to the corresponding internal jog speeds. The AUTO input must be off to allow jog.

These same inputs (pin-d4 and pin-d6) have another function if the AUTO input has been selected. Input pin-d4 or “Pos. Off”, disables the Position Controller, if AUTO is selected. Input pin-d6 or “Press Off”, disables the Pressure Controller, if AUTO is selected.

When AUTO is “off”,

Input (pin-d4) is energized for -JOG
Input (pin-d6) is energized for +JOG

When AUTO is “on”,

Input (pin-d4) is energized to disable Position Control
Input (pin-d6) is energized to disable Pressure Control

The remaining two inputs select Table-1 or Table-2.

Input (pin-d8) is energized to run Table 1.
Input (pin-d10) is energized to run Table 2.

Discrete Outputs - The DMX-1X has five 24 V discrete outputs for interface with a PLC or other types of controllers. Each output is short circuit protected. Maximum output current is 50 mA per channel.

TABLE-1 FINISHED

This output is energized when all the steps in Table-1 have been completed. Table-1 Finished is located at **pin-d20**.

TABLE-2 FINISHED

This output is energized when all the steps in Table-2 have been completed. Table-2 Finished is located at **pin-d26**.

CARD OK

This output is energized if no faults exist (see Error Messages). Card OK is located at **pin-d22**.

AT POSITION

This output is energized when the position error is within the At Position Window parameter for the At Position Window Delay time. At Position is located at **pin-z22**.

AT PRESSURE

This output is energized when the pressure error is within the At Pressure Window parameter for the At Pressure Window Delay time. At Pressure is located at **pin-z24**.

DMX-1X Menu

Pushbuttons on the front of the DMX-1X select menu items or adjust values. Text can continuously scroll across the 4 digit display. Parameter values include the decimal point, as needed. A plus or minus sign will illuminate depending on the polarity. Units, like [%], [V], [mV], and [sec] are listed behind the parameter name. The display automatically adjusts the range. In some cases, the voltage range below 1 volt will be displayed as 0 to 999 mV. Over 1 volt the range changes to 1.00 to 10.0 V, which includes the decimal point.

UP	Increases displayed value, next option at this level
DOWN	Decreases displayed value, previous option at this level
ENTER	Accept this value or option, move into this parameter
ESC	Cancel any change, exit to previous level in menu

Note that some “force” terms in the DMX-1X menu may represent pressure, and vice versa, depending on the specific application. If a pressure transducer was replaced by a current transducer, sensing the electric motor current, the “force” terms would represent power.

Parameters that optimize the application are grouped under the Main menu. Press ENTER to see this menu. Configuration parameters are hidden under the Setup menu. To call the Setup menu, press both ENTER and ESC for 5 seconds. Then press ENTER to access these options. Password protection is available.

When power is applied, the display shows the configuration: Rexroth DMX-1X, firmware version, valve type selected. Then a default display value will appear, like Valve Command [%]. Units are indicated with the option name. The display eventually returns to the default value, unless the buttons are touched. Access the “Display..” option under the main menu. The default can be changed to other options like: Valve Feedback [%], Direct Command [%], CNC Error [%], Position Command [mm], Position Feedback [mm], Position Error [mm], Force Command [%], Force Feedback [%], Force Error [%], #1 Transducer [%], #2 Transducer [%]. Only the available options for the application will appear. The DMX-1X can also continuously scroll the text during startup by selecting “Configuration”. After an idle time, the display may dim. Press any key to restore the display to full brightness. This feature can be disabled.

Faults - When a fault is detected, the valve command is set to zero. FAIL

Description

will flash on the display until ENTER is pressed. The detected fault is continuously scrolled across the display in clear text, until ENTER is pressed again. Cycle power or lower the ENABLE input to reset the DMX-1X, after clearing a fault. Some faults are related to the application and user settings, for example, Position Fault or Pressure Fault. Other faults are related to the valve, like Valve Loop. The DMX-1X monitors the discrete outputs for excessive current. The analog inputs are monitored for out of range faults. The DMX-1X verifies FLASH memory during power up. It also continuously monitors the internal reference voltages.

Valve Code - All valve parameters are set by Rexroth. The more common valve settings will be assigned a specific 3-digit code number and stored in the DMX-1X memory. The valve Code is a simple menu option that loads these parameters for a valve. More than one code may exist for the same valve. As new designs are introduced, this table will grow without affecting codes for existing products. After power is applied, the display includes the abbreviated valve model.

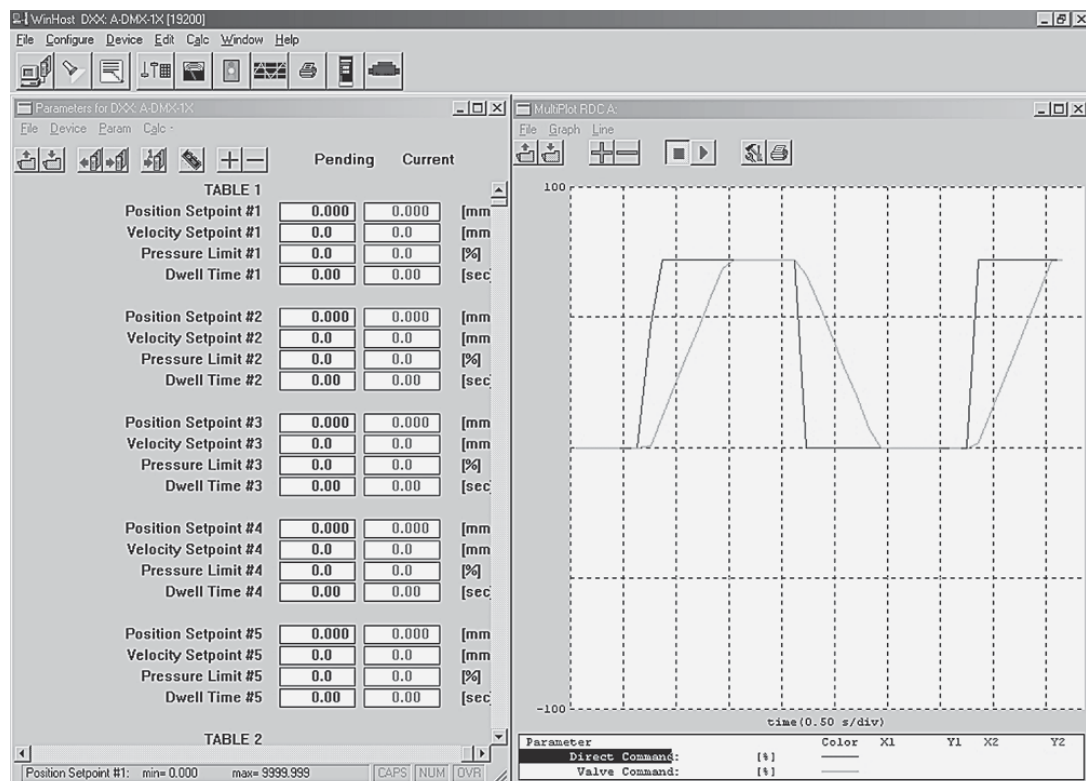
All valve parameters are available under "Custom.." in the Setup menu. If the default valve settings are changed, the original valve code will end with a "C". After power is applied, the display will show "Custom" instead of a valve model. If the DMX-1X had a "C" when delivered, the original valve Code and custom values are noted on the Certificate of Conformance. Restore the default parameters by setting the desired Code number and removing the "C" with the UP or DOWN pushbutton. Then press ENTER.

Communications - An RS232 serial port is available for programming and diagnostics. An RS232 cable can be ordered separately, (US00 910 888). RS485 allows multiple DMX-1X cards to communicate to a host computer, over a single twisted pair cable. The Rexroth DMX-1X host program runs on a personal computer or PC. The DMX-1X host program will automatically detect the baud rate and find all available DMX-1X stations. Baud rates of 9600, 19200 and 38400 are supported. An RS232 to RS485 converter for COM1 or COM2 is normally required when communicating with multiple cards. A serial converter can be ordered separately, Rexroth COM485 Kit (US00 888 281).

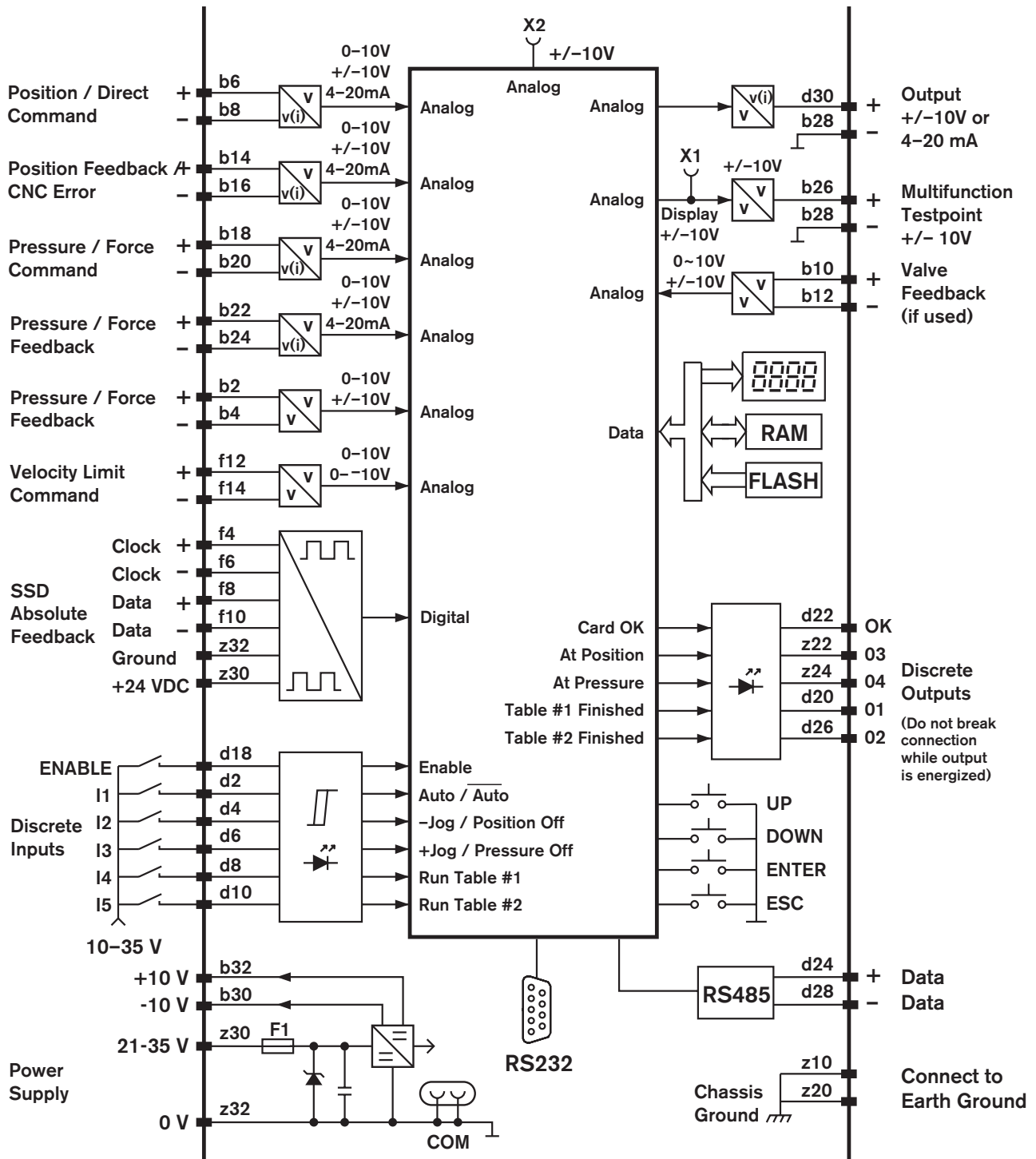
The PC interface is optional since the DMX-1X can be commissioned exclusively by using the front display and pushbuttons.

WinHost Interface Tool

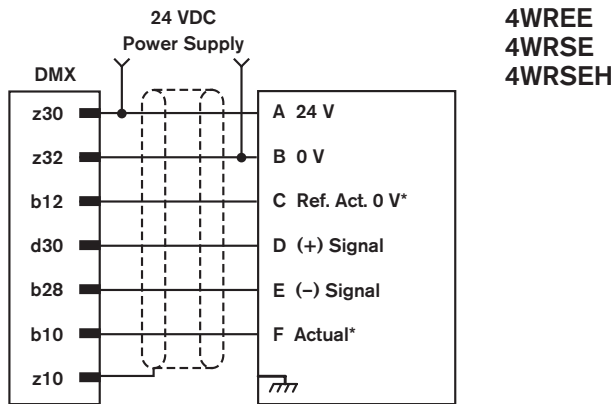
The Winhost Interface Software is used for setup, diagnostics, and trouble-shooting. Shown here is the plotting feature with the parameter screen for online tuning. The WinHost Program can plot up to six signals which can be saved to disk or printed.



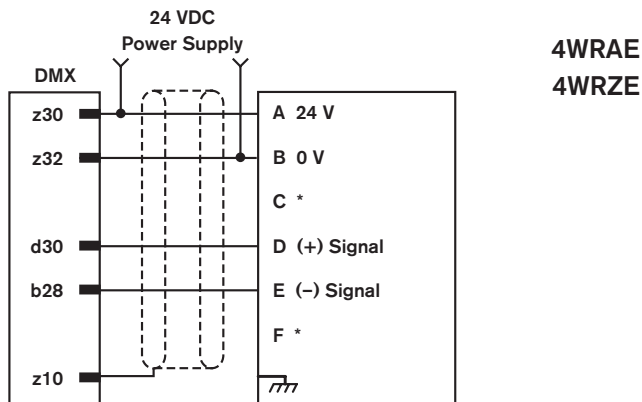
DMX-1X/ connections



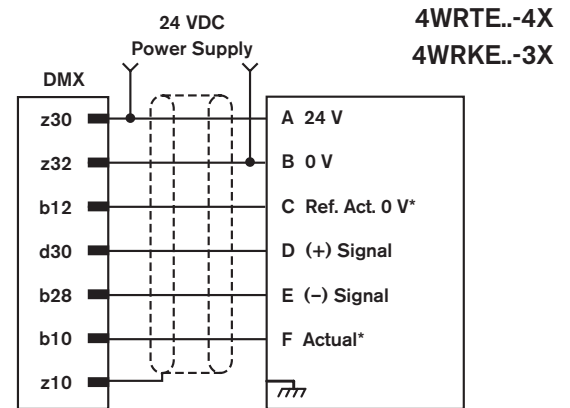
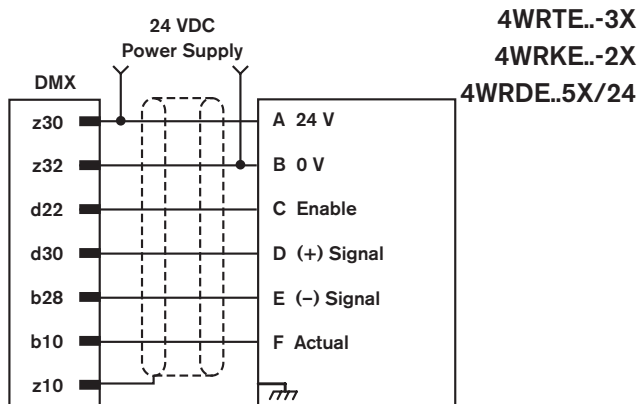
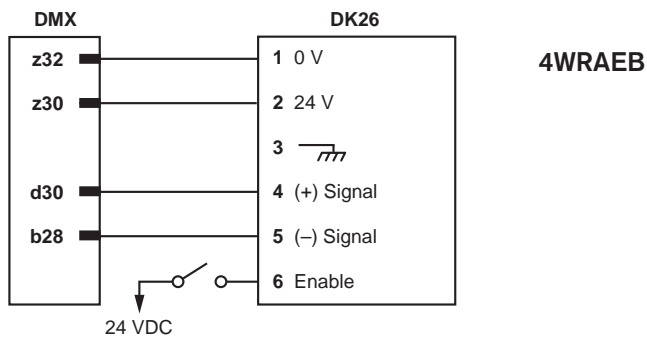
DMX-1X/ connections



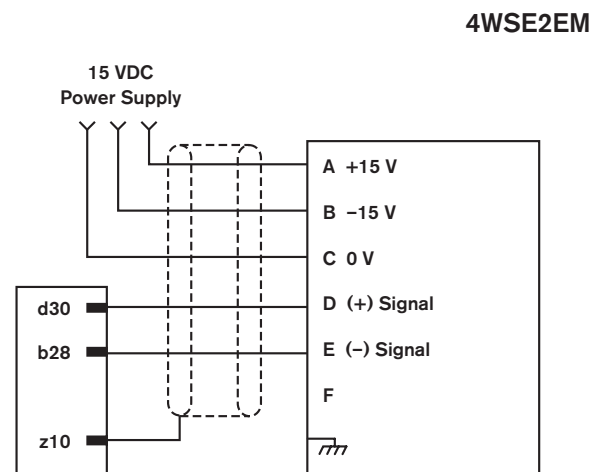
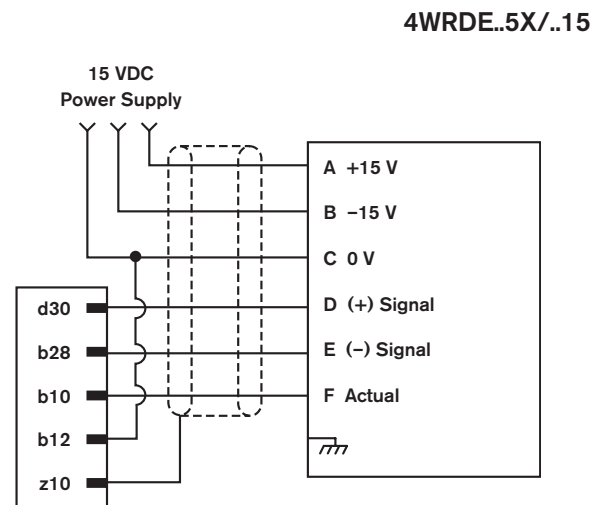
* With F1 electronics (4–20mA), Refer to page 23 of RA 30 915, DMX Setup Manual.



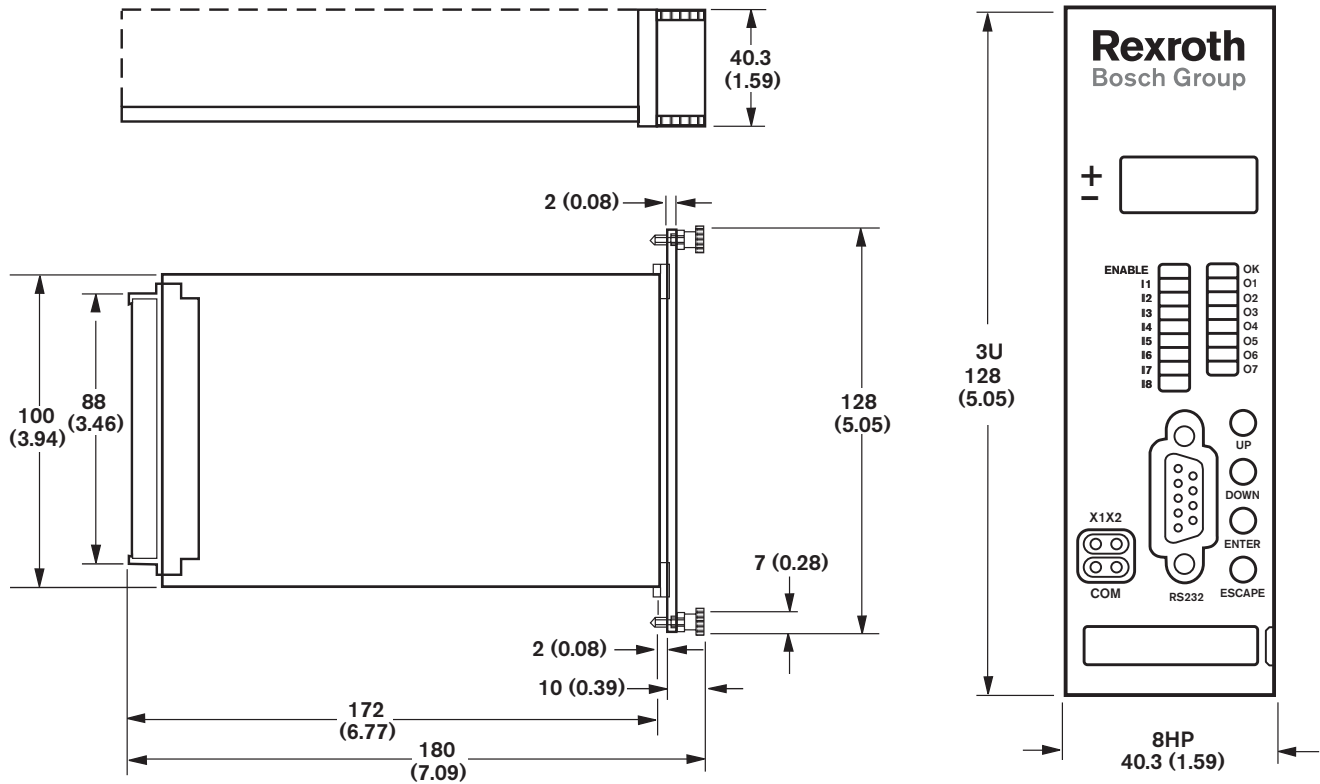
* Do not connect pin-C or pin-F



* 1) With F1 electronics (4–20mA), Refer to page 23 of RA 30 915, DMX Setup Manual.
2) Change at Pin-C (0 V) with new series



Unit dimensions – dimensions in millimeters (inches)



Additional information

- Do not unplug the card while power is being supplied.
- The minimum distance to antenna cables, radio sources, and radar systems is 3 ft. (1 meter).
- The RS485 converter (COM485 Kit US00 888 281) includes a 9/25 pin adapter and 120 V AC wall cube.
(For use with multiple cards.)

Engineering / maintenance instructions / supplementary information

Installation

Do not install the DMX-1X next to power electronics (e.g. frequency converters); the power supply unit of the DMX-1X should be installed as close as possible to the DMX-1X.

Voltage supply

The connection should be as short as possible; lay the supply and return lines (+24 V / GND) together.

Operating voltage range: 18 to 35 V (ripple < 1.5 V; ≤ 0.9 mA)

Input fuse: 4 A (recommendation)

When providing the power supply to an inductive position transducer via the interface of the DMX-1X, the supplied voltage must meet the requirements of the position transducer.

Shielding

Always use shielded cable as signal lines. Typically, the shield is connected on one end to the side of the DMX-1X. Connect a large area of the cable shield to the metal part of the plug connector housing (push the shield back and clamp the cable while it is stress-relieved).

Wiring

- The distance between signal and load lines should be as great as possible
- Do not route signal lines through strong magnetic fields
- Lay signal lines without interruptions
- Twist load lines (e.g. volt. supply), which are laid as two single wires
- Do not lay signal lines in parallel to load lines

Interference suppression of the system

- Transient suppression:
 - DC – reverse biased (anode –, cathode +) standard diode for flyback
 - AC – standard RC snubber or MOV
- Electric motors:
 - Connect R/C combinations from each motor winding to earth
- Frequency converter:
 - Provide input filter in the power supply of the frequency converter
 - Shield control lines of the motor and install them separately from other lines and/or provide output filters for motor lines
 - Large-area contact of the frequency converter housing with the back panel of the switch cabinet

Notes

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