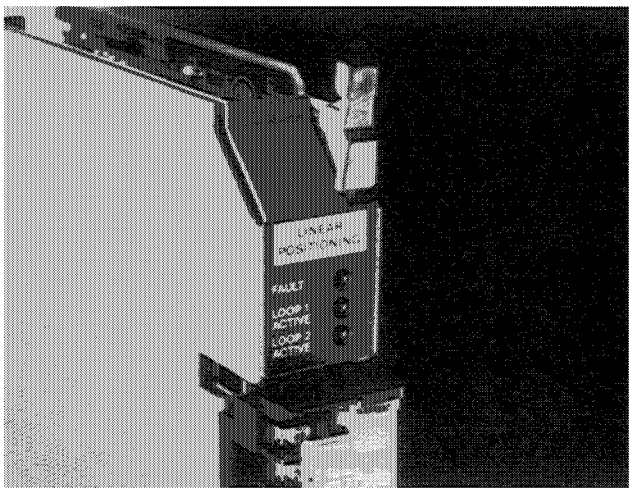
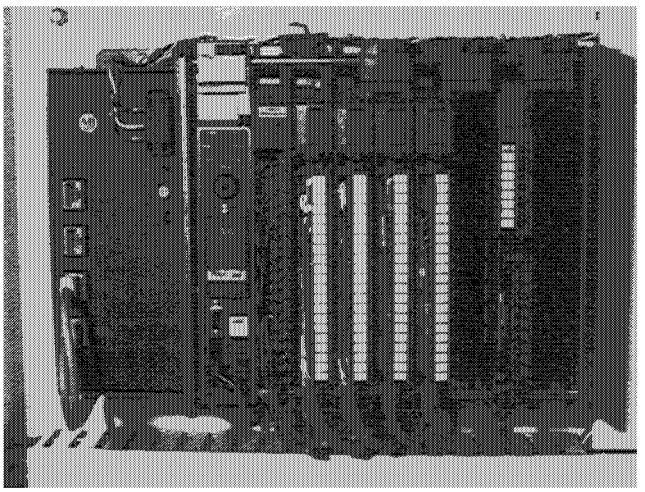
ALLEN-BRADLEY

Linear Positioning Module

(Cat. No. 1771-QB)

Product Data





Achieve accurate, high speed control of 1 or 2 linear closed loop axes with our 1771-QB Linear Positioning Module.

Integrates the machine control capabilities of a programmable controller. The 1771-QB now teams with our programmable controllers to give you precise control of your closed loop system.

Gives your programmable controller system the performance of hydraulics. The high level of performance of hydraulics is now available with your programmable controller systems.

Benefits

Fast system control – Fast update times on the 1771 -QB module (2 ms for servo loop and digital measurement updates) give you fast response to position command and load upsets.

Accurate system control – The resolution over 60 inches has improved to better than ±0.001 inches. Positioning is repeatable to 0.002 inch for 180 inch axis. Proportional, Integral, Derivative, acceleration, velocity and feed-forward parameters, for example, provide smoother profiles.

Transducer compatibility – The 1771-QB module connects directly to the Temposonics™II Linear Displacement transducer or a Balluff BTL transducer, or Norstat GYRG transducer.

Reduced equipment wear – The Linear Positioning Module allows you to control the rate of change in acceleration and deceleration. This velocity smoothing feature significantly reduces system jerk and costly repair.

High speed overall performance – The 1771-QB integrates the machine control capabilities of a programmable controller with the performance of a stand alone hydraulic servo controller. No hand-held programmer is required to change parameters.

Reduced installation costs – The Linear Positioning Module connects directly to hydraulic servo valves requiring up to ±100 mA or directly to servo motor controllers requiring ±10V DC. Also it connects directly to the linear displacement transducer. Direct connection reduces installation costs.

Simplified PLC programmable controller program development – Simulation modes permit PLC programmable controller programs to be developed and tested without having the transducer or hydraulics present.

Increased productivity levels – The 1771-QB reduces down time by performing built-in diagnostics. These diagnostics can detect transducer failure (loss of feedback) or positioning error and permit display of these failures to the operator.

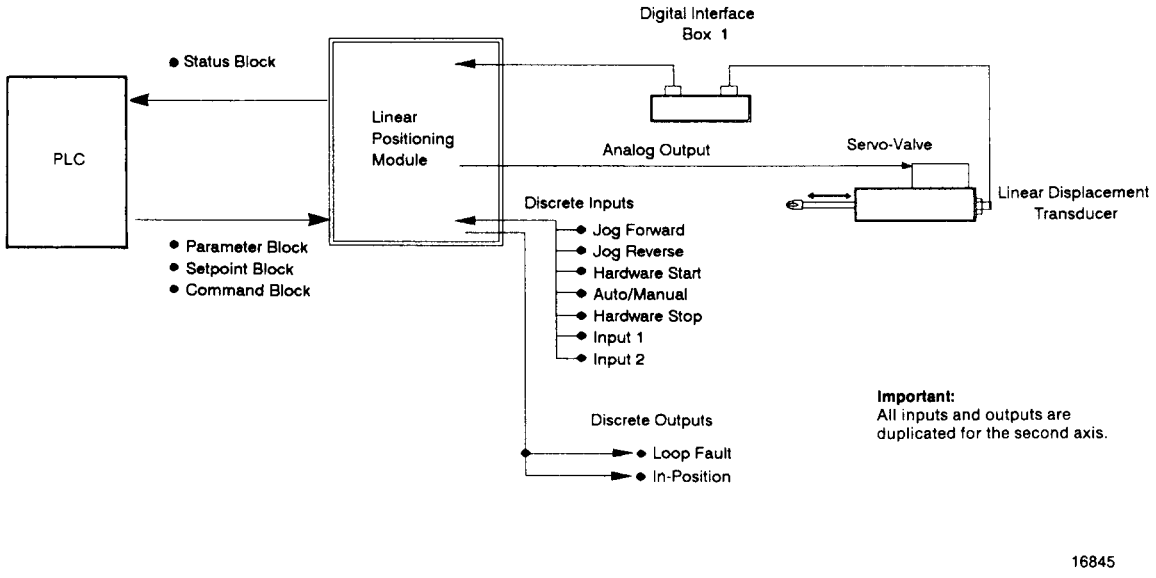
Application flexibility – The Linear Positioning Module brings precise machine control to your programmable controller. It helps you coordinate operation of your automatic machines for more efficient use of machines and raw materials. It also helps you to implement your Computer Integrated Manufacturing (CIM) and Just In Time (JIT) manufacturing strategies.

System Overview

Figure 1 shows a single loop within a linear positioning system for closed-loop axis control. In this example an Allen-Bradley programmable controller reads and writes your programmed commands/ data to and from the data table and module.

The module senses transducer-generated positioning, velocity and direction information, then calculates the polarity and magnitude of the analog output drive signal based on the desired profile. Once the hydraulic axis moves to the desired position, the programmable controller can detect that it is in position.

Figure 1
System Overview



[1] The Temposonics II Norstat, and Balluff transducers do not requires digital interface box.

With its processor operating independently of the controller's I/Oscan, the module samples the Linear Positioning Displacement transducer interface (one for each axis) and determines the position of each axis. If there is an error between a desired axis position and an actual axis position, the module updates the servo valve or motor controllers to correct the system error.

Typical Applications

The module provides monitoring and control in hydraulic and servo motor control systems. Typical industry applications are:

- sawmill setworks
- injection molding control, Reaction Injection Molding (RIM)
- composite material layering
- amusement park rides and flight simulators
- glass or foundry mold forming

Use the Linear Positioning module for applications that require:

- position monitoring or position control
- Linear Displacement transducer or equivalent
- hydraulic cylinders up to 180 inches long
- fast loop updates (2 ms) direct servo-valve control (up to ±100 mA) bi-directional control of servo motor drive controllers (up to ±10 V dc)
- control of 1 or 2 axes
- positioning (resolution) to better than .002 inch
- user-defined axis movement profiles

I/O Connections

In addition to the transducer input connections, the module provides:

- analog outputs (2) for servo valve or servo motor controllers
- discrete inputs (14) and outputs (4) (24V DC)

Analog Outputs

The analog outputs control the motion of their associated loop actuator (loop 1, loop 2). You program loop gains in “real-world units” because the velocity is directly proportional to the analog output. For accuracy, the 1771 -QB uses a 12-bit Digital to Analog converter. The output options (maximum ranges) are:

- ±1.0 to ±100 mA
- ±0.1 to ±10 volts

Discrete Inputs and Outputs

Discrete I/O refers to the input and output terminals on the swing arm that are not needed to interface with the servo valve, the transducer or the power supplies. These discrete inputs and outputs are optional, and are duplicated in the command block and status block. The I/O listed below are available for both loops.

Inputs

- Hardware start
- Jog Forward
- Jog Reverse
- Hardware Stop
- Auto/ Manual input
- General Purpose Inputs (2, user-defined)

Outputs

- In-position
- Loop fault

Axis Movement Profiles

Use axis movement profiles to define acceleration/ velocity best suited for your system. Define the acceleration/ velocity profile best suited for your system with axis movement profiles. Axis movement profiles are active during PLC movement commands, jog commands or discrete jog inputs. Position, velocity, and acceleration can be changed at any time during the axis movement profile.

Figures 2 and 3 show basic movement profiles.

Figure 2
Trapezoidal Axis Movement Profile

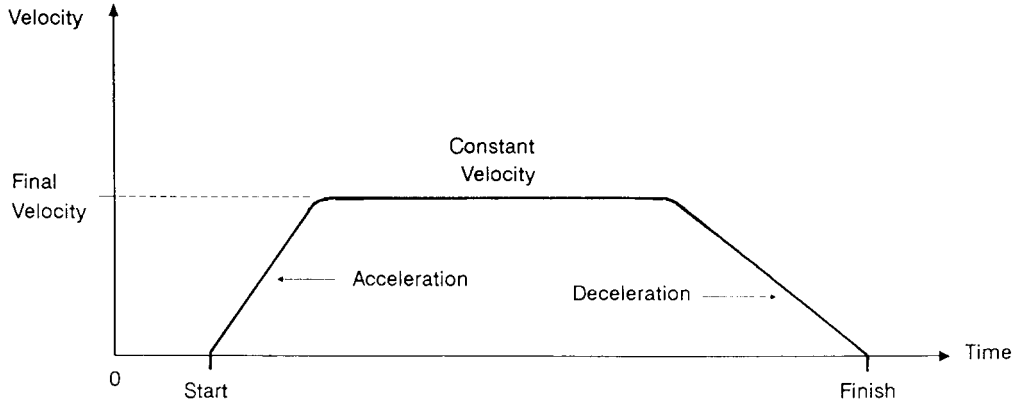
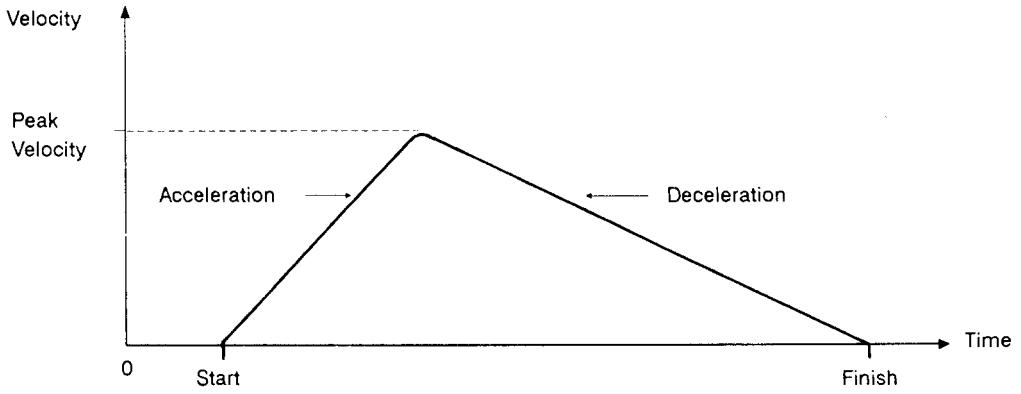


Figure 3
Ramp Profile



Velocity Smoothing

The 1771-QB lets you select a “jerk” constant (the time rate of change of acceleration and deceleration) which permits higher acceleration and deceleration value with less tendency to overshoot the intended end position. We refer to “jerk” constant as velocity smoothing because the four corners of the velocity profile become rounded. You can adjust the amount of velocity smoothing to suit your application and significantly reduce equipment wear.

Figure 4
Motion without velocity smoothing

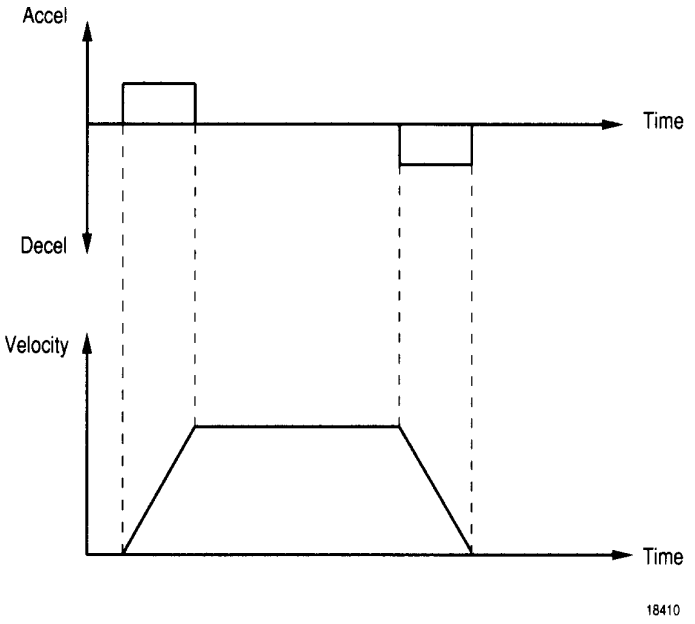
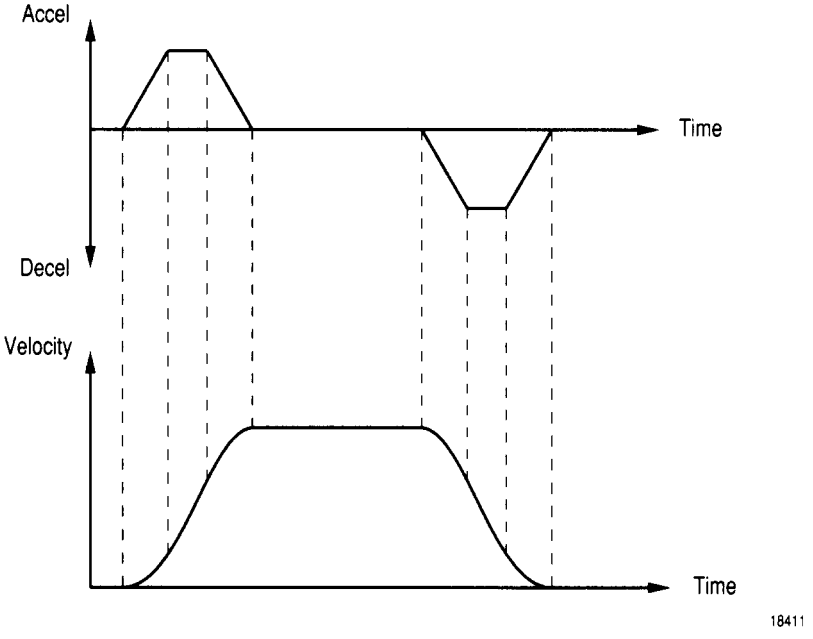


Figure 5
Motion with velocity smoothing



Compatibility

Transducers

The 1771-QB module is specifically designed to work with the Temposonics Linear Positioning Displacement Transducer with a Digital Recirculation (interface) box, and the Temposonics II which is also available with built-in digital recirculation. This unit is manufactured by:

MTS Systems Corp.
Sensors Division
Box 13218
Research Triangle Park
North Carolina 27709
(919) 677-0100

The alternate linear displacement transducers are:

Balluff
P.O. Box 937
8125 Holton Drive
Florence, KY 41042
(606) 727-2200
Model BTL

Norstat Inc.
150 River Road
Montville, NJ 07045
(201) 263-4900
Model GYRG

Servo Valves

The analog outputs from the Linear Positioning module can directly control these servo valves:

Manufacturer	Series
Moog	62
Pegasus	M
Pegasus	MP
Vickers	SM4
Atchley	231

Processors

The module is compatible with Allen-Bradley 1771 Universal I/O chassis and with all Allen-Bradley programmable controllers capable of performing block transfers. You need sufficient memory to store your program and the parameters for the 1771-QB.

Specifying Loop Parameters

You specify loop parameters using the programmable controller for each controlled hydraulic axis. The module setup is accomplished using the parameter block words. Axis 1 is defined by word 2 to 30 and axis 2 by 31 to 59 as shown in table A.

Table A
User Defined Parameters

Word	Description
1	Parameter Control Word
2 (31)	Analog Range
3 (32)	+ Analog Calibration Constant
4 (33)	– Analog Calibration Constant
5 (34)	(MS) Transducer Calibration Constant
6 (35)	(LS) Transducer Calibration Constant
7 (36)	(MS) Zero-Position Offset
8 (37)	(LS) Zero-Position Offset
9 (38)	+ Software Travel Limit
10 (39)	– Software Travel Limit
11 (40)	In-position Band
12 (41)	PID Band
13 (42)	Dead Band
14 (43)	Excess Following Error
15 (44)	Maximum PID Error
16 (45)	Integral Term Limit
17 (46)	Proportional Gain
18 (47)	Gain Break Speed
19 (48)	Gain Reduction Factor
20 (49)	Integral Gain
21 (50)	Derivative Gain
22 (51)	Feed-forward Gain
23 (52)	Global Velocity
24 (53)	Global Acceleration
25 (54)	Global Deceleration
26 (55)	Velocity Smoothing Jerk Constant
27 (56)	Low Jog Rate
28 (57)	High Jog Rate
29 (58)	(Reserved)
30 (59)	(Reserved)

Status Information

The 1771-QB returns a rich set of diagnostic and positioning information to the PLC processor through the status block words. The word definitions are presented in Table B.

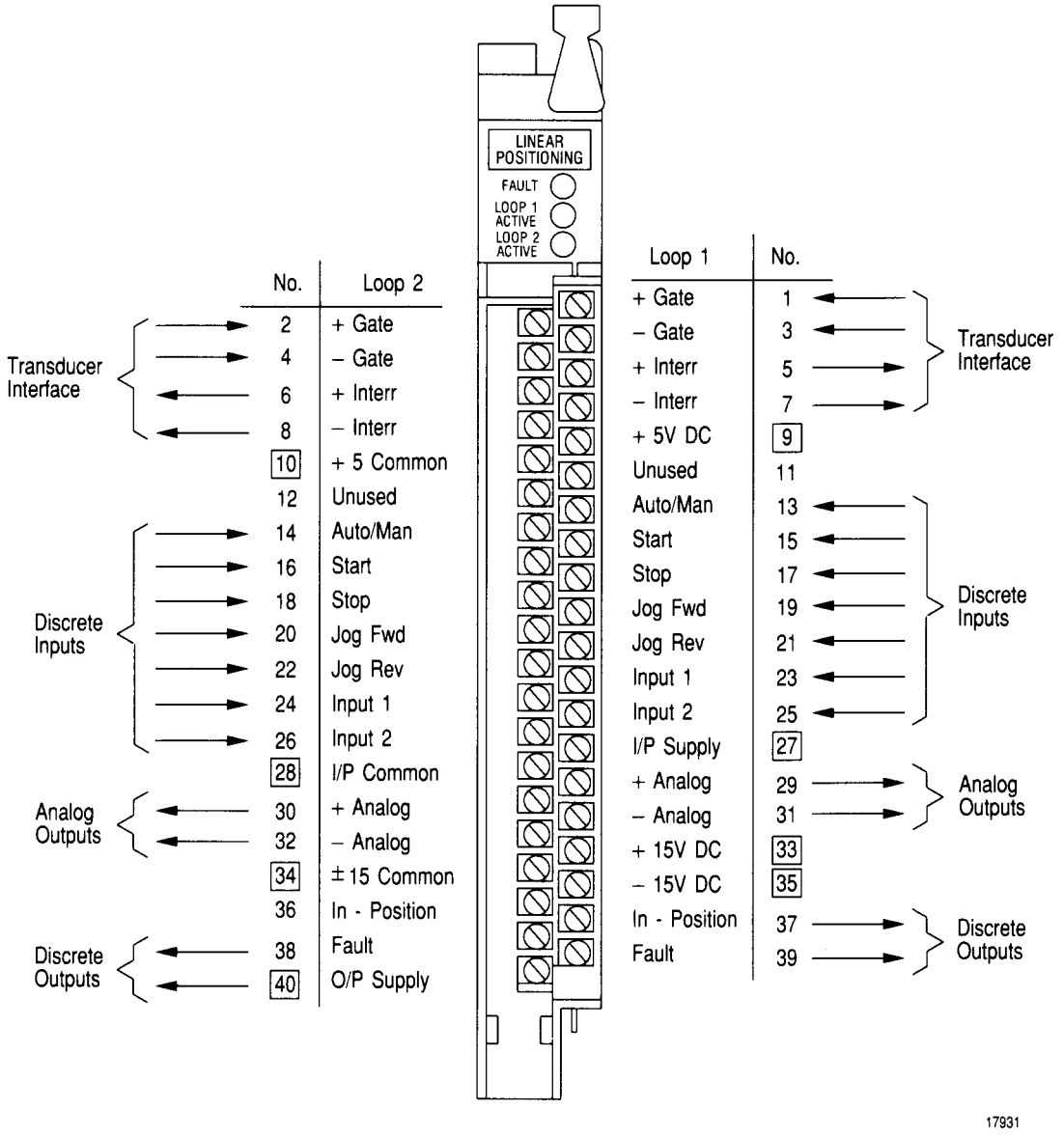
Table B

Word	Description
1	reserved
2 (6)	status word 1
3 (7)	status word 2
4 (8)	(MS) diagnostic word
5 (9)	(LS) diagnostic word
10 (11)	reserved
12 (14)	(MS) position
13 (15)	(LS) position
15 (18)	(MS) positioning error
17 (19)	(LS) positioning error
20 (21)	measured velocity
22 (23)	desired velocity
24 (25)	desired acceleration
26 (27)	desired acceleration
28 (29)	% analog output
30 (31)	maximum positive velocity
32 (33)	maximum negative velocity

Swing Arm Connections

Figure 6 shows the module and swing arm connections.

Figure 6
Swing Arm Connections



Grounding

The 1771-QB provides a separate common for the transducer, analog and discrete input interfaces. These power supply commons are electrically isolated except when one supply is used and the grounds are tied together.

Indicators

Three indicators on the front of the module aid in troubleshooting. Refer to the following table for their meaning.

Indicator	In This State	Means
FAULT	off on	normal operation fault in one or both loops
LOOP1 ACTIVE	on blink off	loop is active loop fault (analog outputs enabled) loop is inactive (analog outputs disabled)
LOOP 2 ACTIVE	on blink off	loop is active loop fault (analog outputs enabled) loop is inactive (analog outputs disabled)

Extensive troubleshooting information is also provided to the PLC in a status block.

Module Power Requirements

The 1771-QB receives its internal power from the I/O chassis. Interface to transducer, servo valves and discrete I/O requires one or more individual, external power supplies. These supplies may be totally independent (for high noise immunity) or may be one unit.

You only need to power the portion of the module you wish to use. For example, in an application where only the transducer interface is used, you do not need to power the servo valve and discrete I/O sections.

Feature Summary

General Features

- Two independent axes
- 2 millisecond update rate
- Proportional, integral, derivative, and feed-forward control
- Position, velocity, and acceleration can be changed on the fly
- Velocity smoothing reduces equipment wear
- Supports velocities up to 327.67 inches/second (3.2767 meters/ second)
- Inch or metric units
- Built-in diagnostics reduce down-time
- Simulation modes permit off-site testing
- All external connections are electrically isolated

Transducer Interface

- Direct connection to Temposonics II, or Balluff Linear Displacement Transducers or Norstat transducers
- Maximum length: 180 inches (4.572 meters)
- Resolution exceeds ± 0.002 inches over 180 inches (higher resolution can be achieved using recirculations)

Drive Outputs

- Direct connection to servo-valves or servo motor controllers
- 12-bit resolution
- Range: ± 1.0 to ± 100mA
  ± 0.1 to ± 10 Volts
- Simple adjustments for directional differences in system performance.
- Built-in diagnostics suggest optimal drive parameters

Discrete I/O

- 7 digital inputs per axis
  - Hardware Start
  - Jog Forward
  - Jog Reverse
  - Hardware Stop
  - Auto/Manual Selector
  - General Purpose Inputs (2, user-defined)
- 2 digital outputs per axis
  - In-position
  - Loop Fault

Monitoring

- Position
- Velocity
- Servo valve output
- Positioning error
- Hydraulic system performance

Specifications

Module	
Module Location	▪ 1771 Universal I/O chassis ▪ One slot
Thermal Dissipation	▪ 12.0 watts typical (179 BTU/hr) ▪ 18.0 watts max (278 BTU/hr)
Electrical Isolation	▪ 1500V RMS (transient) isolation is achieved by optoelectronic coupling between I/O circuits and control logic
Environmental Conditions	▪ Operating Temperature: 32 to 140° (0 to 60°C) ▪ Storage Temperature: –40 to +185°F (–40 to +85°C) ▪ Relative Humidity: 5 to 95% (non-condensing)
Keying	▪ Between 16 and 18, between 30 and 32
Sampling Period	▪ 2 ms each loop
Wiring Arm[1]	
Type	▪ 40-terminal 1771-WN
Conductors	▪ Wire Size: 14 gage stranded, (max) ▪ 3/64ths inch insulation (max) ▪ Category 2
Power Requirements	
Backplane Current	▪ 1.6A (max), 1.1A (typical) @ +5Vdc

Transducer Interface External Power Requirements	▪ +5Vdc ±5% @ 300 mA (max)
Analog Interface External Power Requirements	▪ +15Vdc ±5% @ 540 mA (max) ▪ -15Vdc ±5% @ 360 mA (max)
Discrete Input External Power Requirements	▪ +15Vdc (min) ▪ +24Vdc (max) @ 50 mA (max)
Discrete Output External Power Requirements	▪ +30Vdc @ 400 mA (max) ▪ Maximum voltage drop from supply to output = 1.6 Vdc @ 100 mA (requires +11.6 Vdc (min) for compatibility with discrete inputs)
Inputs and Outputs	▪
Discrete Inputs	▪ Current: 8mA/input @ 12Vdc; 16mA/input @ 24Vdc ▪ Logic 0:0 to 4Vdc ▪ Logic 1: 10to30Vdc
Discrete Outputs	▪ Single-ended, source ▪ 100 mA, maximum source drive (ON state) ▪ 1.0 mA, maximum source leakage (OFF state) ▪ Logic 0: No voltage applied to output (low) ▪ Logic 1: User-supplied voltage applied to output (high)
Analog Outputs (Switcselectable)	▪ ± 10V dc up to 10 mA ▪ ± 20 mA up to 600ohms ▪ ± ×50 mA up to 240 ohms ▪ ± 100 mA up to 120 ohms ▪ 12-bit resolution

Positioning Transducer	▪ MTS Temposonics Linear Displacement Transducer – Stroke (max): 180 inches/4.572 meters – Interface required: digital interface box configured for external interrogation; box not required for Temposonics II – Interface box to QB module (max): 200 feet (Belden 8227 or equivalent) – Positioning resolution: 0.002 incor better – Interface external power requirements: ±15Vdc +5Vdc ±5% @ 0.3A max. ▪ Balluff BTL Linear Displacement Transducer – Stroke (max): 180 inches/4.572mm – Interface required: built-in – Transducer to QB module distance: limited by load resistance – Positioning resolution: 0.002 incor better – Interface external power requirements: 24Vdc ±10% @ 150mA ▪ Norstat GYRG Linear Displacement Transducer – Stroke (max) 180 inches – Interface required built-in – Position resolution: 0.002 or better – Interface external power requirements: ±15Vdc ±10% @ 48mA

[1]Refer to publication 1770-4.1, "Programmable Controller Wiring and Grounding Guidelines"

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As a subsidiary of Rockwell International, one of the world's largest technology companies — Allen-Bradley meets today's challenges of industrial automation with over 85 years of practical plant-floor experience. More than 11,000 employees throughout the world design, manufacture and apply a wide range of control and automation products and supporting services to help our customers continuously improve quality, productivity and time to market. These products andservices not only control individual machines but integrate the manufacturing process, while providing access to vital plant floor data that can be used to support decision-making throughout the enterprise.

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