NI PXI-7358

8-Axis High-Performance Stepper/Servo Motion Controller

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High-Performance Stepper/Servo Motion Controllers

NI 735x

- Up to 8 axes of motion
- Configurable stepper or servo control
- Up to 4 MHz stepper output rate
- 62 µs PID loop update rate for up to 2 axes
- 3D linear and circular interpolation
- 3D contouring
- Sinusoidal commutation for brushless motors
- Buffered breakpoints for high-speed integration
- Patented step generation technology for smooth stepper motion

Operating Systems

- Windows Vista/XP/2000
- LabVIEW Real-Time

Recommended NI Software

- LabVIEW
- NI Motion Assistant
- LabWindows™/CVI
- Measurement Studio

Other Compatible Software

- Visual Basic
- C/C++

Driver Software (included)

- NI-Motion

Overview and Applications

NI 735x PCI and PXI stepper and servo motion controllers are for machine builders and users who need the highest performance and a high-axis count in a small space. The NI PXI-7358 is the first 8-axis stepper or servo motion controller packaged as a 1-slot 3U PXI module. It offers many advanced features, including sinusoidal commutation for brushless motors. NI 735x motion controllers are available in 2-, 4-, 6-, and 8-axis versions for PXI and PCI.

Motion Control and LabVIEW Real-Time

Many motion applications require very high reliability and integration with other types of I/O. NI PXI motion controllers are compatible with the NI LabVIEW Real-Time Module, with which you can create an integrated motion and I/O system that runs embedded in a real-time OS. A PXI motion controller with a PXI RT Series controller can run LabVIEW Real-Time and function as a stand-alone Ethernet-based motion controller. With this technology, you can create distributed motion control systems that integrate tightly with data acquisition or vision.

I/O Capabilities

NI 735x motion controllers have diverse I/O that is useful in many motion applications. You can use the 64 bits of digital I/O for a wide variety of applications such as opening or closing valves or turning on and off solid-state relays using the SSR adapter. These motion controllers also have eight channels of 16-bit analog I/O useful for reading potentiometers or other analog measurements.

Synchronizing Multiple Axes for Parallel Mechanism Applications

Because NI 735x controllers can control up to eight axes, they are ideal for high-axis parallel mechanisms where all axes need to be tightly synchronized. Using the NI-Motion driver software, you can start all axes at once and have each axis follow the acceleration and velocity profiles you have defined. This is useful when working with parallel mechanisms such as hexapods when the axes must move simultaneously.

Static-Friction Compensation

The frictional force present before an object starts moving is called static friction. Static friction is often higher than dynamic friction (frictional force present during motion) and if the difference between the two is large enough, it can make the system difficult to tune. The static-friction compensation feature of the NI 735x motion controllers compensates for this difference in friction for easier tuning and precise control. Piezoelectric systems exhibit high static friction and can benefit from the static friction compensation feature of the NI 7350 series motion controllers. In addition, to help you tune your system, NI offers the free Piezo Tuning Wizard. After tuning your system using the Piezo Tuning Wizard, you can easily program the system using LabVIEW software and NI Motion Assistant just as you would program any other system.

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Sinusoidal Commutation

Brushless servo motors require sinusoidal commutation. Although many advanced motor drives have built-in commutation capability, many lower-cost drives require the motion controller to provide commutation. With sinusoidal commutation, offered by the NI 7350, you can obtain the smoothest possible motion with a brushless servo motor and a lower cost drive.

Note that when using the sinusoidal commutation feature, use two axis resources for each drive you connect to. This is because two analog outputs are needed to provide the commutation.

Increasing Integration Speed with New Breakpoint and High-Speed Capture Enhancements

NI 7350 series motion controllers offer buffered breakpoints for precise timing between motion and measurements or vision. Using this feature, you can send a buffer of position breakpoints to the controller that trigger a digital signal upon reaching the positions in the buffer. Buffered breakpoints can trigger at rates as high as 2 kHz. For equally spaced positions, you can use periodic breakpoints to achieve even higher speeds of up to 4 MHz. With periodic breakpoints, you supply a position modulus. Each time the position reaches that modulus position, the breakpoint triggers. Another new feature that enhances integration speed is the new buffered high-speed position capture for NI 735x controllers. This feature captures positions based on a trigger from an external source or from a data acquisition or machine vision device. The high-speed capture can capture positions at rates of up to 2 kHz per axis.

Additional Features

For the NI 735x controllers, your PID update rate can be 62.5 µs for up to two axes. This means that for multiaxis applications, the PID rates can be twice as fast as those for previous boards. An NI 735x also has increased resolution for analog-to-digital conversion, giving you high resolution for analog position feedback.

Feature	NI 735x
Number of Axes	2, 4, 6, 8
PAC Platforms	PCI, CompactPCI/PXI
Linear, Circular, Spherical, and Helical Interpolation; Blending	✓
Trapezoidal, S-Curve Profiles	✓
Closed-Loop Stepper Control	✓
Contouring, Electronic Gearing, Onboard Programming	✓
Sinusoidal Commutation for Brushless Servo Motors	✓
Buffered Breakpoints, Buffered High-Speed Capture, 4 MHz Periodic Breakpoints	✓
Number of Axes per 62.5 µs PID Rate	2
PWM Lines/DIO Lines/Analog Input Resolution	2/64/16-bit
Maximum Step Output Rate/Encoder Input Rate	8 MHz/20 MHz
Programming API	NI-Motion Driver
Software	NI Motion Assistant, NI LabVIEW, C, Visual Basic

NI 7350 Motion I/O Connector Pinouts

(two 68-pin VHDCI connectors)

Axis 1 Dir (CCW)	1	35	Axis 1 Step (CW)
Digital Ground	2	36	Axis 1 Encoder Phase A
Digital Ground	3	37	Axis 1 Encoder Phase B
Axis 1 Home Switch	4	38	Axis 1 Encoder Index
Trigger 1	5	39	Axis 1 Forward Limit Switch
Axis 1 Inhibit	6	40	Axis 1 Reverse Limit Switch
Axis 2 Dir (CCW)	7	41	Axis 2 Step (CW)
Digital Ground	8	42	Axis 2 Encoder Phase A
Digital Ground	9	43	Axis 2 Encoder Phase B
Axis 2 Home Switch	10	44	Axis 2 Encoder Index
Trigger 2	11	45	Axis 2 Forward Limit Switch
Axis 2 Inhibit	12	46	Axis 2 Reverse Limit Switch
Axis 3 Dir (CCW)	13	47	Axis 3 Step (CW)
Digital Ground	14	48	Axis 3 Encoder Phase A
Digital Ground	15	49	Axis 3 Encoder Phase B
Axis 3 Home Switch	16	50	Axis 3 Encoder Index
Trigger 3	17	51	Axis 3 Forward Limit Switch
Axis 3 Inhibit	18	52	Axis 3 Reverse Limit Switch
Axis 4 Dir (CCW)	19	53	Axis 4 Step (CW)
Digital Ground	20	54	Axis 4 Encoder Phase A
Digital Ground	21	55	Axis 4 Encoder Phase B
Axis 4 Home Switch	22	56	Axis 4 Encoder Index
Trigger 4	23	57	Axis 4 Forward Limit Switch
Axis 4 Inhibit	24	58	Axis 4 Reverse Limit Switch
Digital Ground	25	59	Host +5 V
Breakpoint 1	26	60	Breakpoint 2
Breakpoint 3	27	61	Breakpoint 4
Digital Ground	28	62	Shutdown
Analog Output 1	29	63	Analog Output 2
Analog Output 3	30	64	Analog Output 4
Analog Output Ground	31	65	Reserved
Analog Input 1	32	66	Analog Input 2
Analog Input 3	33	67	Analog Input 4
Analog Reference (Output)	34	68	Analog Input Ground

Motion I/O Connector for Axes 1-4

Axis 5 Dir (CCW)	1	35	Axis 5 Step (CW)
Digital Ground	2	36	Axis 5 Encoder Phase A
Digital Ground	3	37	Axis 5 Encoder Phase B
Axis 5 Home Switch	4	38	Axis 5 Encoder Index
Trigger 5	5	39	Axis 5 Forward Limit Switch
Axis 5 Inhibit	6	40	Axis 5 Reverse Limit Switch
Axis 6 Dir (CCW)	7	41	Axis 6 Step (CW)
Digital Ground	8	42	Axis 6 Encoder Phase A
Digital Ground	9	43	Axis 6 Encoder Phase B
Axis 6 Home Switch	10	44	Axis 6 Encoder Index
Trigger 6	11	45	Axis 6 Forward Limit Switch
Axis 6 Inhibit	12	46	Axis 6 Reverse Limit Switch
Axis 7 Dir (CCW)	13	47	Axis 7 Step (CW)
Digital Ground	14	48	Axis 7 Encoder Phase A
Digital Ground	15	49	Axis 7 Encoder Phase B
Axis 7 Home Switch	16	50	Axis 7 Encoder Index
Trigger 7	17	51	Axis 7 Forward Limit Switch
Axis 7 Inhibit	18	52	Axis 7 Reverse Limit Switch
Axis 8 Dir (CCW)	19	53	Axis 8 Step (CW)
Digital Ground	20	54	Axis 8 Encoder Phase A
Digital Ground	21	55	Axis 8 Encoder Phase B
Axis 8 Home Switch	22	56	Axis 8 Encoder Index
Trigger 8	23	57	Axis 8 Forward Limit Switch
Axis 8 Inhibit	24	58	Axis 8 Reverse Limit Switch
Digital Ground	25	59	Host +5 V
Breakpoint 5	26	60	Breakpoint 6
Breakpoint 7	27	61	Breakpoint 8
Digital Ground	28	62	Shutdown
Analog Output 5	29	63	Analog Output 6
Analog Output 7	30	64	Analog Output 8
Analog Output Ground	31	65	Reserved
Analog Input 5	32	66	Analog Input 6
Analog Input 7	33	67	Analog Input 8
Analog Reference (Output)	34	68	Analog Input Ground

Motion I/O Connector for Axes 5-8

NI 7350 Digital I/O Connector Pinouts

(two 68-pin VHDCI connectors)

+5 V	1	35	Digital Ground
PCLK	2	36	Digital Ground
Reserved	3	37	Digital Ground
Reserved	4	38	DPull (P1:P4)
PWM1	5	39	Digital Ground
Reserved	6	40	Reserved
Reserved	7	41	Digital Ground
Reserved	8	42	Digital Ground
PWM2	9	43	Digital Ground
Port 1:bit 0	10	44	Port 1:bit 1
Digital Ground	11	45	Port 1:bit 2
Port 1:bit 3	12	46	Digital Ground
Port 1:bit 4	13	47	Port 1:bit 5
Digital Ground	14	48	Port 1:bit 6
Port 1:bit 7	15	49	Digital Ground
Port 2:bit 0	16	50	Digital Ground
Port 2:bit 1	17	51	Port 2:bit 2
Digital Ground	18	52	Port 2:bit 3
Digital Ground	19	53	Port 2:bit 4
Digital Ground	20	54	Port 2:bit 5
Port 2:bit 6	21	55	Digital Ground
Port 2:bit 7	22	56	Digital Ground
Port 3:bit 0	23	57	Port 3:bit 1
Digital Ground	24	58	Port 3:bit 2
Port 3:bit 3	25	59	Digital Ground
Port 3:bit 4	26	60	Port 3:bit 5
Digital Ground	27	61	Port 3:bit 6
Port 3:bit 7	28	62	Digital Ground
Port 4:bit 0	29	63	Port 4:bit 1
Digital Ground	30	64	Port 4:bit 2/Axis 1, Hall 1
Axis 1, Hall 2/Port 4:bit 3	31	65	Digital Ground
Axis 1, Hall 3/Port 4:bit 4	32	66	Port 4:bit 5/Axis 2, Hall 1
Digital Ground	33	67	Port 4:bit 6/Axis 2, Hall 2
Axis 2, Hall 3/Port 4:bit 7	34	68	Digital Ground

Digital I/O Connector for Axes 1-4

+5 V	1	35	Digital Ground
Reserved	2	36	Digital Ground
Reserved	3	37	Digital Ground
Reserved	4	38	DPull (P5:P8)
Reserved	5	39	Digital Ground
Reserved	6	40	Reserved
Reserved	7	41	Digital Ground
Reserved	8	42	Digital Ground
Reserved	9	43	Digital Ground
Port 5:bit 0	10	44	Port 5:bit 1
Digital Ground	11	45	Port 5:bit 2
Port 5:bit 3	12	46	Digital Ground
Port 5:bit 4	13	47	Port 5:bit 5
Digital Ground	14	48	Port 5:bit 6
Port 5:bit 7	15	49	Digital Ground
Port 6:bit 0	16	50	Digital Ground
Port 6:bit 1	17	51	Port 6:bit 2
Digital Ground	18	52	Port 6:bit 3
Digital Ground	19	53	Port 6:bit 4
Digital Ground	20	54	Port 6:bit 5
Port 6:bit 6	21	55	Digital Ground
Port 6:bit 7	22	56	Digital Ground
Port 7:bit 0	23	57	Port 7:bit 1
Digital Ground	24	58	Port 7:bit 2
Port 7:bit 3	25	59	Digital Ground
Port 7:bit 4	26	60	Port 7:bit 5
Digital Ground	27	61	Port 7:bit 6
Port 7:bit 7	28	62	Digital Ground
Port 8:bit 0	29	63	Port 8:bit 1
Digital Ground	30	64	Port 8:bit 2/Axis 3, Hall 1
Axis 3, Hall 2/Port 8:bit 3	31	65	Digital Ground
Axis 3, Hall 3/Port 8:bit 4	32	66	Port 8:bit 5/Axis 4, Hall 1
Digital Ground	33	67	Port 8:bit 6/Axis 4, Hall 2
Axis 4, Hall 3/Port 8:bit 7	34	68	Digital Ground

Digital I/O Connector for Axes 5-8

Ordering Information

NI PXI-7358 (8-axis) 778540-08
NI PXI-7356 (6-axis) 778540-06
NI PXI-7354 (4-axis) 778540-04
NI PXI-7352 (2-axis) 778540-02
NI PCI-7358 (8-axis) 778440-08
NI PCI-7356 (6-axis) 778440-06
NI PCI-7354 (4-axis) 778440-04
NI PCI-7352 (2-axis) 778440-02

Includes NI-Motion software libraries and examples.

Accessories

NI Motion Assistant 778553-01

Wiring Interfaces

- NI UMI-7764.....777978-02
- NI UMI-7772.....778556-01
- NI UMI-7774.....778558-01

Power Drives

- NI MID-7604.....777936-01
- NI MID-7602.....778003-01
- NI MID-7654.....778005-01
- NI MID-7652.....778004-01
- P70530 780097-01
- P70360 780098-01

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For complete product specifications, pricing, and accessory information, call 800 813 3693 (U.S.) or go to **ni.com/info** and enter **ni7350**.

Specifications

Performance

PID update rate range	62.5 to 500 µs/sample
Maximum PID update rate	62.5 µs/axis
8-axis PID update rate	250 µs total
Multiaxis synchronization	<1 update sample
Trajectory parameters	
Absolute position range	$\pm 2^{31}$ counts
Maximum relative move size	$\pm 2^{31}$ counts
S-curve time range	1 to 32,767 samples
Following error range	±32,767 counts
Velocity range	Servo: 1 to ±20,000,000 counts/s
Velocity range	Stepper: 1 to 8,000,000 steps/s
Acceleration/deceleration	244 to 512,000,000 counts/s^2 at a PID rate of 250 µs
Gear ratio	±32,767:1 to ±1:32,767
Servo control loop modes	PID, PIVff, S-curve, dual loop
PID (Kp, Ki, and Kd) gains	0 to 32,767
Stepper outputs	
Maximum pulse rate	8 MHz (full, half, and microstep)
Minimum pulse width	50 ns at >4 MHz
Step output mode	Step and direction or CW/CCW
Voltage range	0 to 5 V

System Safety

Watchdog timer function	Resets board to startup state
Shutdown input	Disable all axes and command outputs

Motion I/O

Servo command analog outputs	
Voltage range	±10 V, 16 bits (0.000305 V/ LSB)
Programmable torque (velocity) limits and programmable offset	±10 V (-32,768 to +32,767)
Encoder inputs	Quadrature, incremental, single-ended
Maximum count rate	20 MHz
Forward, reverse, and home inputs	
Number of inputs	24 (3 per axis)
Control	Individual enable/disable, stop on input, prevent motion, find reference
Trigger (position capture) inputs	8 (one per axis)
Maximum buffered capture rate[1]	2 kHz per axis
Breakpoint (position compare) outputs	8 (one per axis), programmable polarity
Maximum periodic rate	4 MHz
Maximum buffered trigger rate[1]	2 kHz per axis
Inhibit/enable output	8 (one per axis), programmable polarity
Analog inputs	up to 8, 16-bit resolution, ±10 V range, 25 µs scan rate
Analog outputs	8, 16-bit resolution, ±10 V range

[1]Assumes a PID update rate of 250 µs. 2 kHz per axis for PID rates between 62.5 and 250 µs, and 1 kHz per axis for PID rates greater than 250 µs. This value must not exceed 8 kHz total for all ongoing buffered breakpoint (position compare) and trigger (position capture) operations.

Digital I/O

Ports	8, 8-bit TTL ports, bit configurable, sink or source 24 mA outputs
Open-loop PWM outputs	
Number of PWM outputs	2, 50 kHz
Clock sources	Internal or external

Power Requirements

+3.3 V (±10%)	2 A
+5 V (±5%)	2 A
+12 V (±5%)	30 mA
-12 V (±10%)	0 mA
Power consumption	18 W, maximum

Physical

Dimensions (not including connectors)	
PXI	16 by 10 cm (6.3 by 3.9 in.)
PCI	17.5 by 9.9 cm (6.9 by 3.9 in.)
Connectors	
Motion I/O connector	68-pin female high-density VHDCI type
Digital I/O connector	68-pin female high-density VHDCI type

Environment

Operating temperature	0 to 55 °C
Storage temperature	-20 to 70 °C
Relative humidity range	10 to 90% (noncondensing)

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