V-141 Compact High-Precision Direct Drive Linear Stage

Ideal for Scanning, Measuring, Imaging, Alignment

- Very compact footprint
- Direct drive motor for efficient, dynamic performance
- Crossed-roller bearings for true straightness and flatness
- Direct-measuring incremental encoder for the best accuracy and repeatability

Product overview

V-141 direct-drive linear stages are designed for accuracy, precision, long life, ease of use, and can be mounted in any orientation. A version with integrated counterbalance and brake is available for vertical operation.
Even though compact, V-141 linear stages offer superior travel accuracy, flatness, and performance compared to bigger stages. With a powerful, non-cogging, direct drive motor, the V-141 linear stage family performs well in production environments. The ultra-precision cross roller bearings are intended to be low maintenance for the life of the stage.

The V-141 is designed for XY and XYZ mounting. The Z version comes with a magnetic counterbalance.

Three phase motors for higher dynamics and friction-free, maintenance-free operation

The three-phase linear motors driving the V-141 stage family transfer their force directly and friction-free to the motion platform. This eliminates backlash and play that can result from mechanical components like gears and screws in the drivetrain. Ideal for high-velocity, high-acceleration applications, these motors feature a maintenance-free, frictionless design, ensuring longevity in demanding 24/7 operations. The controller's current limit settings allow easy motor disablement, preventing damage to the stage or the application.

Crossed roller bearings improve load capacity, accuracy and lifetime

Crossed roller bearings offer a superior level of smoothness, straightness, and flatness, close to air bearing performance. By replacing the point contact of ball bearings with a line contact, rollers become considerably stiffer, requiring less preload. This reduction in friction enables smoother running and higher accuracy. Crossed roller bearings can also support more direct loads and moment loads. The anti-creep mechanism prevents roller drift, enhancing reliability. Cleanroom grease is applied for low-maintenance operation.

Incremental encoder

V-141 stages are equipped with incremental sin/cos linear encoders that measure position with utmost accuracy directly at the motion platform, enhancing linearity and ensuring immunity to mechanical play and elastic deformation of indirect measuring methods. A home signal is built in to initiate the stage.

Choosing the right precision linear stage and motion controller

Selecting the right linear stage is pivotal for optimal performance in high-precision motion applications, such as semiconductor inspection and photonics alignment. Factors such as resolution, guiding accuracy, and repeatability must be carefully considered. These linear stages offer excellent geometric accuracy (flatness, straightness, pitch, and yaw) along with 60 nanometers bi-directional repeatability in a very compact package. With high dynamic properties, including up to 2g acceleration and 1.1m/sec velocity, these compact motorized stages are ideal for 24/7 automation of highly accurate positioning tasks required for micro-assembly, alignment, or mass production of precision devices.

Partnered with PI's A-8xx series motion controllers, these stages achieve unparalleled motion performance. PI's EtherCAT®-based controllers offer remarkable flexibility, facilitating the seamless integration of third-party equipment compatible with EtherCAT®. Advanced algorithms in the A-8xx series motion controllers, such as PILOT allow for higher dynamics with reduced motor currents, virtually increasing the motor's force constant. Choose the compact V-141 for precision, reliability, and efficiency in your motion applications.

Accessories and options

- Magnetic counterbalance for vertical use.
- Single or multi-axis, ACS motion controllers and servo drives, integrated or distributed.
- Cables compatible with the A-8xx series, ACS-powered controllers.
- Multi-axis assemblies.

Application fields

Precision micro-assembly. Research. Biotechnology. General Automation. Device assembly. Laser Micro-processing. Pick and place. Photonics Alignment and Assembly.

Ordering Information

V-141.040A1
PI linear stage, 40mm travel, cross roller bearing, 80mm wide motion platform, incremental sin/cos 1Vpp encoder, brushless 3-phase direct-drive motor.

V-141.060A1
PI linear stage, 60mm travel, cross roller bearing, 80mm wide motion platform, incremental sin/cos 1Vpp encoder, brushless 3-phase direct-drive motor.

V-141.100A1
PI linear stage, 100mm travel, cross roller bearing, 80mm wide motion platform, incremental sin/cos 1Vpp encoder, brushless 3-phase direct-drive motor.

V-141.040A1Z
PI linear stage, 40mm travel, cross roller bearing, 80mm wide motion platform, incremental sin/cos 1Vpp encoder, brushless 3-phase direct-drive motor, magnetic counterbalance.

Controllers and Cables

Part Number	Description
A-81x Series	ACS based controllers (2, 4 axis versions, various configurations) with medium power
A-82x Series	ACS based controllers (4, 6, 8 axis versions, various configurations) with high power
A-851.VA03	Cable Set, V-xxx to A-8xx Controller, Sine Encoder, 3m length

Specifications

Motion	V-141.040x1	V-141.060x1	V-141.100x1	Unit	Tolerance
Active axes	X - axis				
Travel range	40	60	100	mm	max
Pitch [1]	170	175	175	µrad	max.
Yaw [1]	300	175	200	µrad	max.
Straightness [1]	2.5	1.5	2.0	µm	max.
Flatness [1]	1.5	2.0	2.0	µm	max.
Bidirectional repeatability	± 0.06	± 0.06	± 0.06	µm	max.
Positioning accuracy, calibrated [2]	± 2	± 2.5	± 3	µm	max.

Mechanical	V-141.040x1	V-141.060x1	V-141.100x1	Unit	Tolerance
Bearing	Ultra-precision, cross-roller bearing				
Motion platform	80 x 80	110 x 80	160 x 80	mm	
Stage Height		25		mm	
Load capacity, [3]		40		N	max.
Moving mass, unloaded	0.24	0.33	0.5	kg	typ.
Overall mass	0.75	1.0	1.1	kg	typ.
Materials	Aluminum				

Drive properties	V-141.040x1	V-141.060x1	V-141.100x1	Unit	Tolerance
Drive type					
Intermediate circuit voltage	48	48	48	V DC	max.
Peak force	17	17	17	N	max.
Nominal force	6	6	6	N	max.
Force constant, RMS	11.7	11.7	11.7	N/Arms	typ.
Peak Current	1.5	1.5	1.5	A	max.
Nominal Current, RMS	0.5	0.5	0.5	A	max.
Resistance, phase-phase	25	25	25	Ω	±10%
Inductance, phase-phase	8.8	8.8	8.8	mH	±10%
Back EMF, phase-phase	12	12	12	V/m/s	±10%
# of Pole Pairs					
Magnet Pitch NN	NA	NA	NA	mm	typ.
Linear Velocity [3]	1.1	1.1	1.1	m/s	max.
Acceleration[3]	20	20	20	m/s^2	max.

NOTES

[1] Dependent on the quality of the mounting surface, the payload, orientation, and external forces that act on the stage. Please contact PI for application-specific parameters. The specified values are static (no rotary motion during measuring) and without load.

[2] The specified values are without error compensation. The positioner must be ordered with a controller from PI to reach better accuracy values, usually 2-3 times the repeatability values. Accuracy values assume short-term duration and do not consider the long-term effects of thermal drift on the stage.

[3] Can be limited by imbalance of the payload or the controller and the drive. Horizontal orientation.

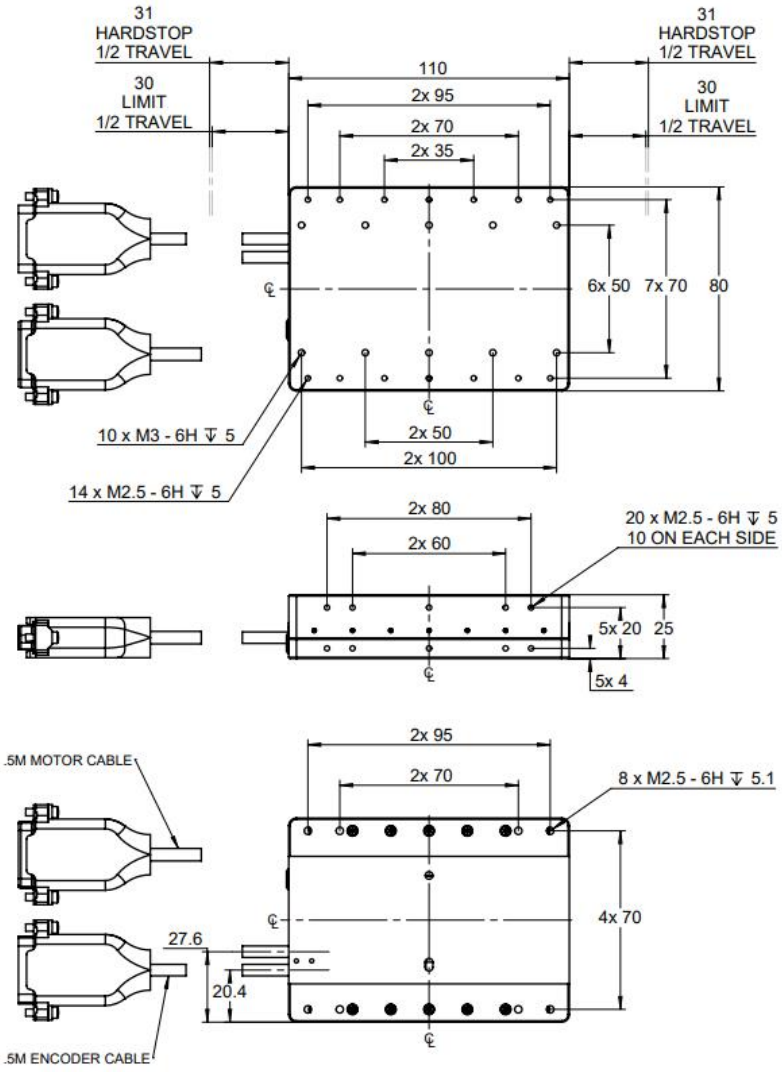
Measurement Sensor	V-141.xxxA1
Integrated sensor	Incremental encoder
Sensor signal type	Sin/cos, 1 V peak-peak
Sensor resolution	100nm
Reference point switch	1 at middle of travel, 1 V peak-peak

Miscellaneous	V-141.xxxx1
Motor/Encoder Connector	DB15 (male)
Operating Temp Range	5 to 50 °C
Recommended Controller	A-81x Series A-82x Series
Recommended Cables	A-851.Vxx Series

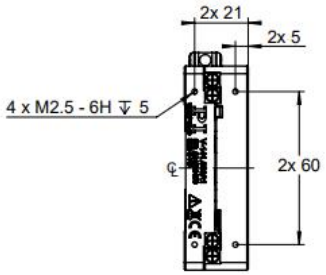
2024-09-06

Drawings / Images

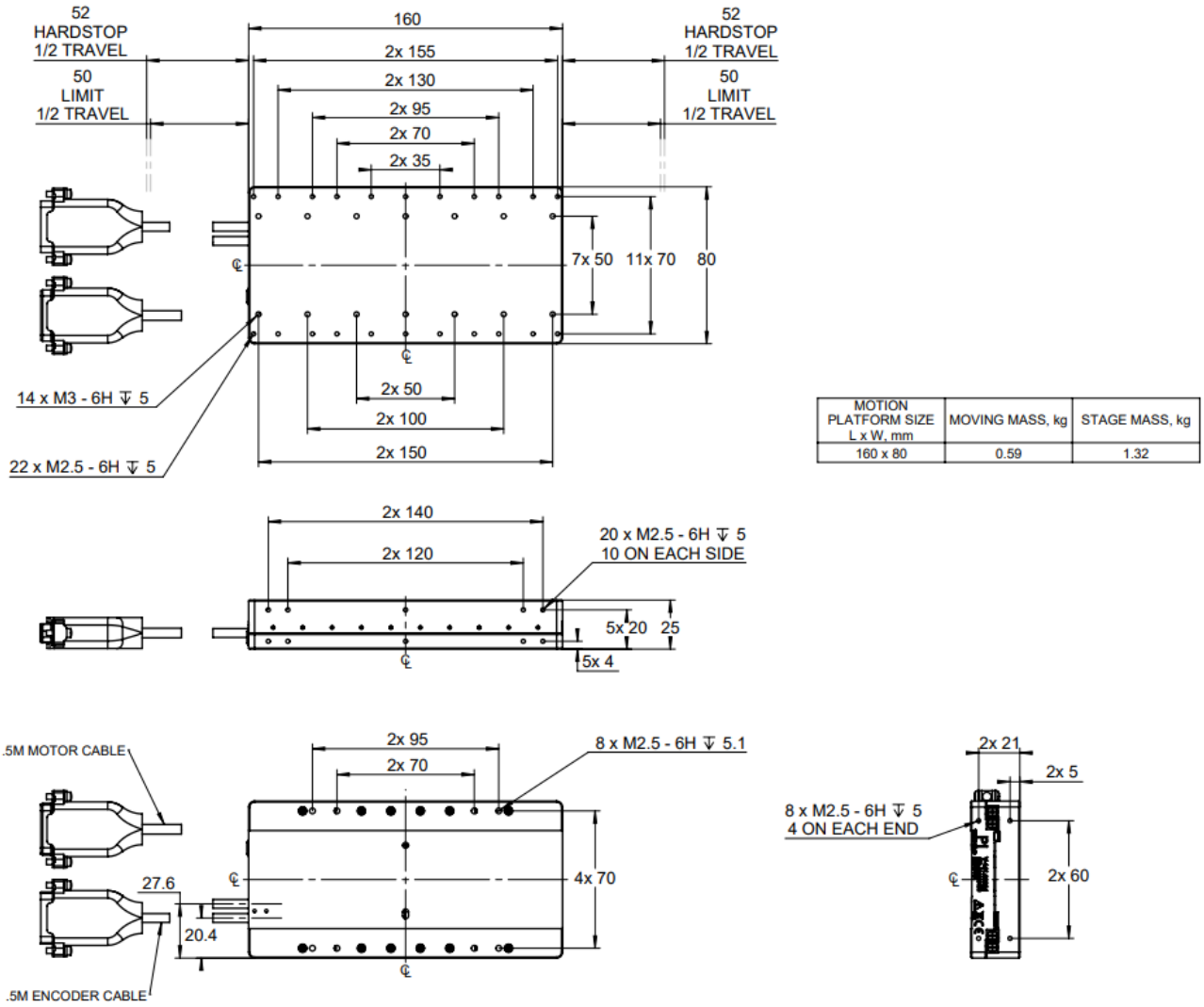
V-141.040A1, dimensions in mm



MOTION PLATFORM SIZE L x W, mm	MOVING MASS, kg	STAGE MASS, kg
110 x 80	0.41	0.99



V-141.060A1, dimensions in mm



MOTION PLATFORM SIZE L x W, mm	MOVING MASS, kg	STAGE MASS, kg
160 x 80	0.59	1.32

V-141.100A1, dimensions in mm