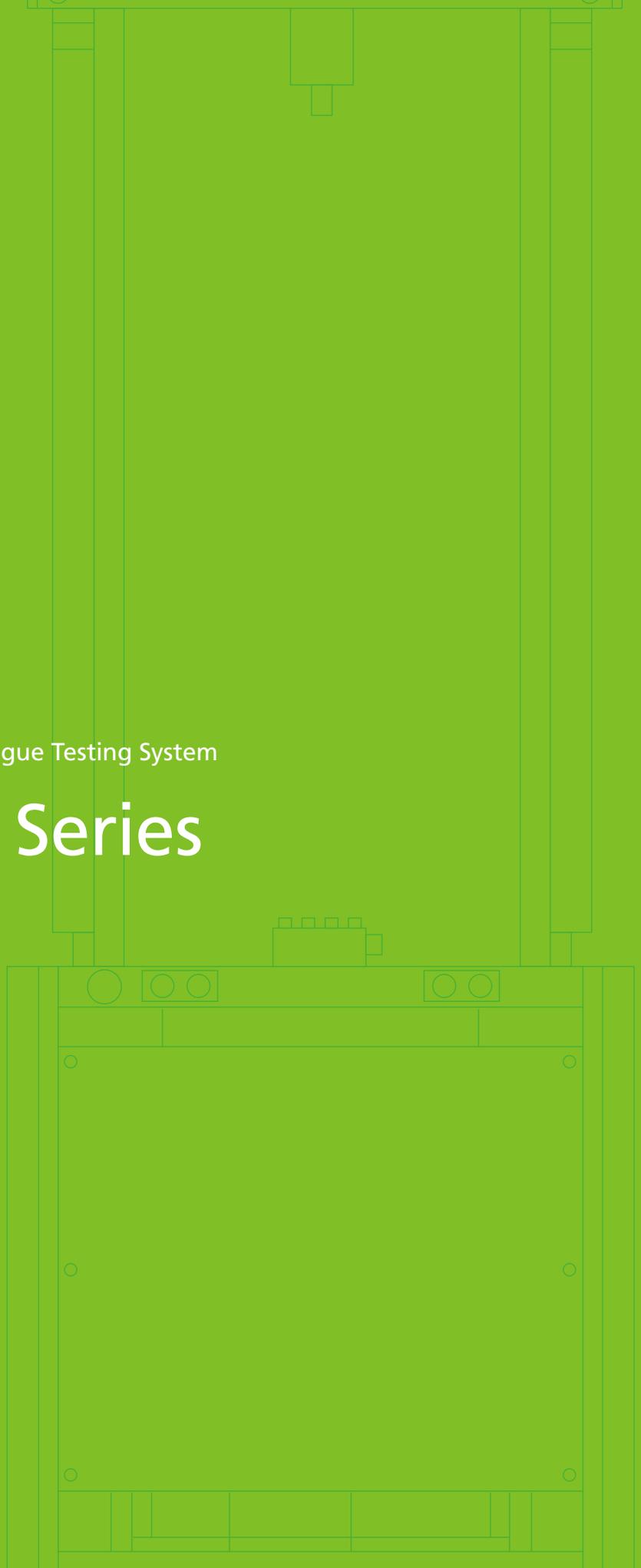


Electromagnetic Force Dynamic and Fatigue Testing System

EMT/MMT Series



Electromagnetic Force Dynamic and Fatigue Testing System

Shimadzu Servopulser series electromagnetic force dynamic and fatigue testing systems feature electromagnetic actuators with extremely high frequency response. In combination with a closed-loop control system, they allow testing in a clean environment at high speeds or with stroke lengths ranging from micro to long.



With No Hydraulic Oil Required, Maintenance Is Easy

Generates no environmentally unfriendly waste oil.
Requires no hydraulic oil, filters, or other consumables.



Eco-Friendly Energy Efficiency

The eco-friendly operation uses electricity efficiently based on the test force.
Power consumption is minimized to only what is required.
Since the system is clean, it will not contaminate the installation site.



High-Speed High-Accuracy Testing

Performs tests with strokes ranging from micro to long at high speeds and high frequencies. This allows dynamic testing with high accuracy.



Low Noise



Space Saving

Electromagnetic actuators are quieter than hydraulic actuators, which require a hydraulic power supply unit. The low noise provides more freedom in selecting an installation site.

The only things required are the main testing machine unit and controller.
Requires less space than electric-hydraulic dynamic testing machines.



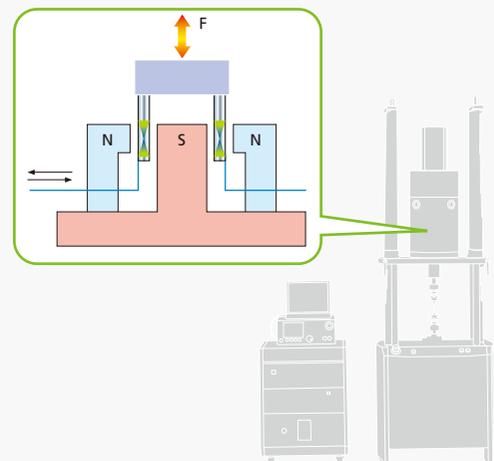
Electromagnetic Actuators

The section that generates test forces consists of a permanent magnet and a force coil, where the magnet is fixed and the coil moves up and down. Applying an electrical current to the coil generates an electromagnetic force F that is proportional to the coil current. This relationship is expressed by the following formula.

$$F=2\pi nBI$$

r : Coil radius
 n : Number of coil turns
 B : Magnetic flux density of magnet
 I : Coil current

The micro test load is controlled with high accuracy by generating the electromagnetic force through the control of coil current I using the closed loop system.



Electromagnetic Force Dynamic and Fatigue Testing System

EMT Series

Allows Long Stroke Lengths and Fast and Highly Accurate Testing in a Clean Environment



High-Rigidity Frame

A very rigid loading frame is used that resistant to resonance is used.

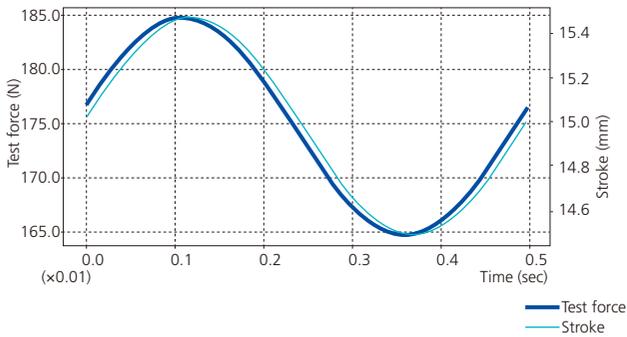
Large Testing Table

A larger testing table allows testing of even large samples.

Lifting/lowering the crosshead can provide a testing space large enough to install a thermostatic chamber.

Capable of $\pm 20 \mu\text{m}$ Displacement Cycles at a 200 Hz Frequency

Fatigue tests can be done at high frequency, which can significantly reduce the overall testing time.



EMT-1kN



EMT-5kN

Achieves Stroke Lengths from 0 to 100 mm (± 50 mm)

The system can be used for large-displacement and high-speed fatigue testing of rubbers. It also supports tensile and compression testing.



A dual-stage drive mechanism enhances safety.



An optional safety cover is also available to help ensure operator safety.



Due to the large testing space, tests can be performed inside a thermostatic chamber.

Actuator

The electromagnetic actuator is coupled with low-friction bearings to achieve high waveform reproducibility.

Electric Crosshead Drive and Manual Clamp Levers

The crosshead can be raised or lowered using an electric switch. The crosshead can be immobilized easily using manual clamp levers.

Servo Controller 4830 and Control/Data Analysis Software

The controller allows high-performance and high-functionality dynamic and fatigue testing.

Power Amplifier Unit

Internal electronic power circuits are used to drive the electromagnetic actuator. The top surface can be used as a table for the controller.

Dual-Stage Crosshead Drive Mechanism

Using two buttons to operate the crosshead and clamps helps prevent operating errors and accidents.



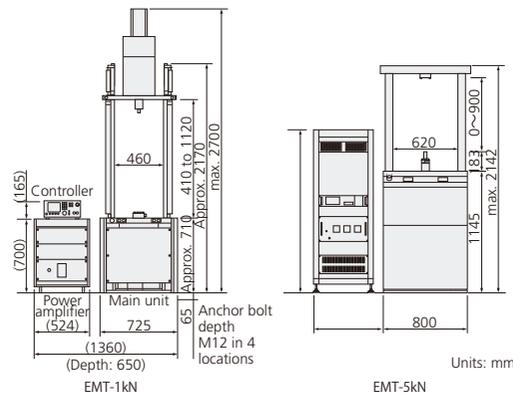
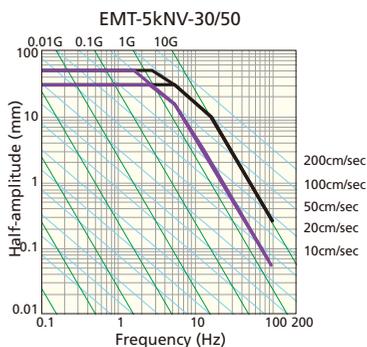
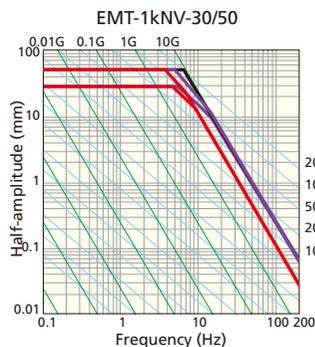
Specifications

Model	EMT-1kNV-30	EMT-1kNV-50	EMT-5kNV-30	EMT-5kNV-50
Maximum test force	±1 kN (static and dynamic tests)		動的±5kN、静的±3.5kN	
Stroke	±30mm	±50mm	±30mm	±50mm
Cycle speed and amplitude	See amplitude characteristics charts.		See amplitude characteristics charts.	
Max. speed	1m/s	2m/s	1m/s	
Max. frequency	200Hz		200Hz	100Hz
Controller	Servo Controller 4830		Servo Controller 4830	
Controlled items	Test force and stroke (two can be added as option)		Test force and stroke (two can be added as option)	
Test force range and indication accuracy	Rangeless Within ±0.5 % of indicated value or ±0.02 % of maximum test force		Rangeless Within ±0.5 % of indicated value or ±0.02 % of maximum test force	
Stroke range and indication accuracy	Rangeless Within ±1 % of indicated value or ±0.1 % of rated value		Rangeless Within ±1 % of indicated value or ±0.1 % of rated value	
Frame drive mechanism	Electric		Electric	
Test space	Distance between columns: 460 mm Jig mounting spacing: 0 to 700 mm		Distance between columns: 460 mm Jig mounting spacing: 0 to 700 mm	
Weight	Main unit: 510 kg Power amplifier: 60 kg Controller: 8 kg		Main unit: 1100 kg Power amplifier: 300 kg Controller: 8 kg	
Operating noise	62 dB (reference value measured 1 m from front of main unit and floor)		62 dB (reference value measured 1 m from front of main unit and floor)	
Power requirements	50/60 Hz, 3-phase, 200 V, 4 kVA	50/60 Hz, 3-phase, 200 V, 5 kVA	50/60Hz 3相200V 9kVA、単相100V 300VA	
Power consumption at max load	4kW	5kW	5kW	6kW

Site requirements : No special foundation work is required, but the system should be installed on a sufficiently strong ground floor, with no basement. Machines must be installed with anchor bolts to prevent tipping.

Amplitude Characteristics

— No load — 500 N load — 1000 N load



- The above characteristic curves indicate the relation between half-amplitude and cycle speed during sine wave motion.
- The above characteristics do not include the frame, load cell, or sample characteristics. Compensate for the influence of these factors to determine actual amplitude characteristics.

Optional Accessories

An extensive selection of optional testing equipment, such as various testing jigs, detectors, and atmospheric control testing units, is available. For more details, refer to the separate optional accessories brochure.

EMT/ADT Series Accessories



● Pin-Type Grip for Flat Samples

These grips are designed for half-amplitude tensile fatigue testing.

Max. dynamic test force	+10kN
Operating temperature range	-20 to +300 °C
Applicable sample	Flat plate (max. 30 mm wide and 5 mm thick)

Plastics Composite materials Rubber

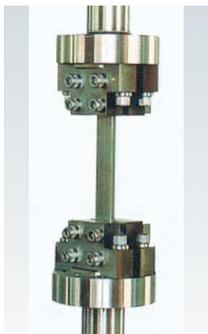


● Split Flange Rod Grip

These grips allow samples to be secured easily and firmly. They are ideal for full-amplitude tensile and compression fatigue testing of round rod samples.

Max. dynamic test force	+10kN
Operating temperature range	-RT to +100 °C -20 to 300 °C
Applicable sample	Rod

Composite materials



● Manual Non-Shift Plate Grip

These grips are designed for full-amplitude tensile and compression fatigue testing of flat plate materials and feature a simple and efficient construction.

Max. dynamic test force	±5/10kN
Operating temperature range	RT to +50 °C -196 to +300 °C
Applicable sample	Flat plate

Plastics Composite materials



● Screw Flange Rod Grip

These grips are useful for samples with a small diameter.

Max. dynamic test force	±10kN
Operating temperature range	-RT to +100 °C -20 to 300 °C
Applicable sample	Rod

Metals Plastics Composite materials



● Compression Plate

Compression plates are available with both top and bottom fixed or with the top compression plate mounted on a spherical seat.

Max. dynamic test force	20 kN (multiple capacities available)
Operating temperature range	RT to +250 °C
Applicable sample	Ø60mm

Metals Plastics Composite materials
Rubber Components



● 3-Point/4-Point Bending Test Jig (for partial half-amplitude fatigue testing)

Maximum test force	2kN
Max. dynamic bending moment	50 N/m
Operating temperature range	196 to +300 °C
Jig dimensions	Lower span: 30 to 100 mm Upper span: 15 to 50 mm

Metals Plastics Composite materials



● Uniform Bending Test Jig (for full-amplitude fatigue testing)

This jig uses ball bearings at each support point to all apply uniform bending loads.

Max. dynamic test force	+2kN
Max. dynamic bending moment	+20N/m
Applicable sample	RT to +50 °C -196 to +200 °C

Metals Plastics Composite materials



● Dynamic Strain Gauge

This strain gauge offers excellent performance as a displacement gauge for high-cycle fatigue testing.

Measurement range	±0.5mm/±1.0mm
Measurement accuracy	Within ±10 % of indicated value or within ±0.5 % of rating, whichever is greater
Operating temperature range	RT to +50 °C

Metals Plastics Composite materials

MMT/EMT/ADT Series Accessories



● Tensile Jig

Max. dynamic test force	250N
Sample shape	Round rod (4 mm dia.) or flat plate (max. 5 mm wide × 1 mm thick)
Operating temperature range	RT to 50 °C (250 N model) -65 to 300 °C (100 N model)

Metals Plastics Rubber, Film
Small parts



● Hand-Tightened Tensile Test Jig

Max. dynamic test force	150N
Sample shape	Flat plate (max. 20 mm wide × 2 mm)
Operating temperature range	-65 to 300 °C (100 N model)

Paper Cloth Metals
Plastics Film Fibers



● Compression Test Jig

Max. dynamic test force	250N
Compression plate	Ø110mm
Upper compression plate	Ø30mm
Operating temperature range	RT to 50 °C

Note: Various kinds of compression test jigs are available, such as key press, toothed, and spherical types.

Metals Plastics Composite materials
Printed circuit boards Surface mounted devices



● Drill Chuck Type Grip

Max. dynamic test force	250N
Sample shape	Round rod (0.5 to 3 mm dia.) or flat plate (max. 4 mm wide × 1 mm)
Operating temperature range	RT to 50 °C

Metals Plastics Small parts



● Compression Test Jig

Max. dynamic test force	250N
Punch tip diameter × width	R2×60mm
Punch span	20×60mm
Support roller diameter × width	R2×60mm
Distance between supports	20 to 100 mm
Operating temperature range	-65 to 300 °C

Metals Plastics Composite materials
Printed circuit boards Surface mounted devices



● 3-Point Bending Test Jig

Max. dynamic test force	250N
Punch tip diameter × width	R2×60mm
Support roller diameter × width	R2×60mm
Distance between supports	20 to 100 mm
Operating temperature range	-65 to 300 °C

Metals Plastics Composite materials
Printed circuit boards Surface mounted devices



● Card Insertion Test Jig

Max. dynamic test force	250N
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● Key Press Test Jig

Max. dynamic test force	250N
Punch tip diameter	Ø3mm
Punch material	Rubber
Sample	Mobile phones, keyboards
Operating temperature range	RT to 50 °C



● Thermostatic Water Immersion Test Unit

Temperature range	R.T. +10 °C to +60 °C
Test jigs	30 mm dia. compression plate



● X-Y Stage

Movement range	±12.5mm
Test force	Max. 100 N compression

Controller for Dynamic and Fatigue Testing Systems

Servo Controller 4830

Controller for Dynamic and Fatigue Testing Systems Servo Controller 4830

Dramatically Improves Accuracy in Evaluating Endurance and Dynamic Strength of Samples Ranging From Materials to Actual Samples

This controller is designed specifically for dynamic testing machines based on Shimadzu's long history of supplying dynamic and fatigue testing systems and based on feedback from many of our customers. It boasts high performance and exceptionally user-friendly operability. Equipped with a 24-bit high-resolution analog-digital converter, and featuring excellent reproducibility of load waveforms due to fully digital control, it can accommodate a wide variety of dynamic testing requirements.

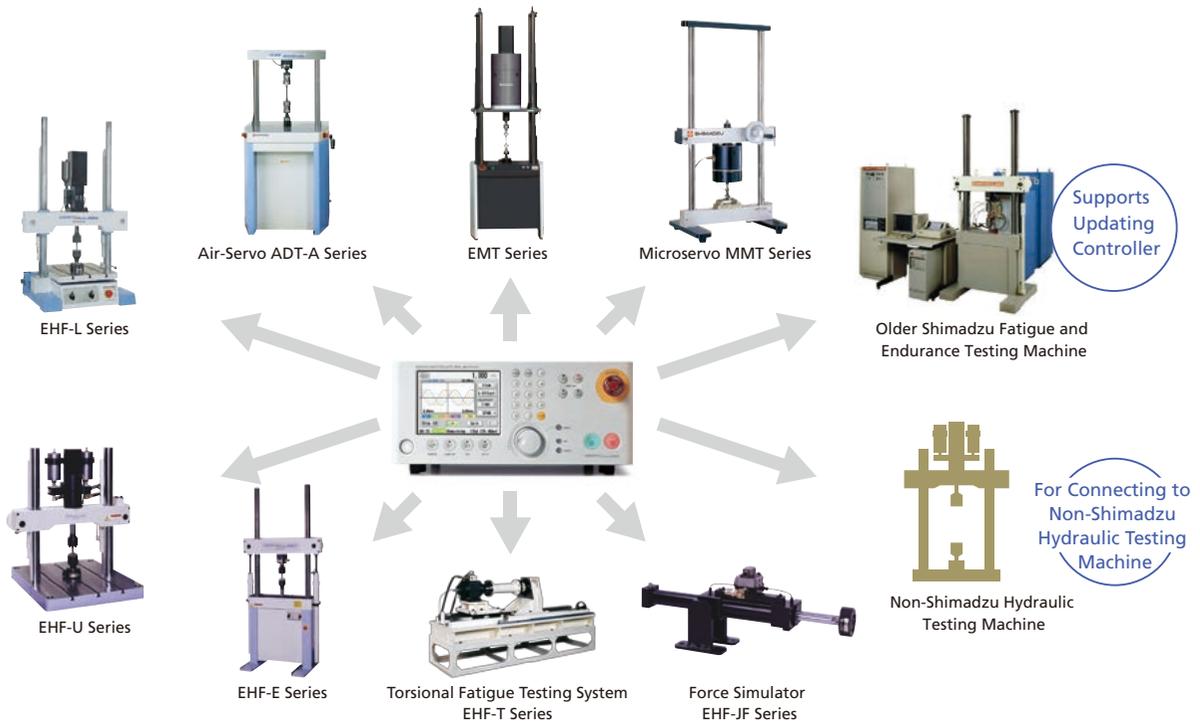


Connectivity to the Entire Family of Shimadzu Dynamic and Fatigue Testing Machines and Non-Shimadzu Hydraulic Testing Machines

Note: Excludes HITS series and USF-2000 models.

The controller can be connected to Servopulser series electric-hydraulic, electromagnetic force, and pneumatic testing systems, jack systems (actuators), and various other testing machines.

It also can be used to update older Shimadzu systems, or controllers for non-Shimadzu hydraulic testing machines.





Very Easy to Operate

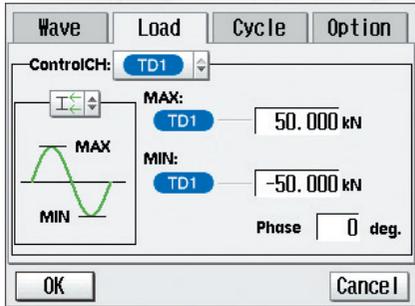
Testing parameters can be specified using the touch panel or jog dial. Test parameter settings, such as test force and displacement, can be changed at any time during tests.

Color Touch Panel

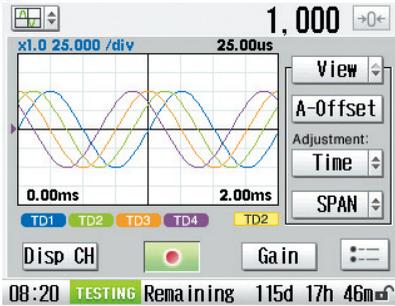
Enables all parameters to be specified and the test status to be monitored.

Jog Dial

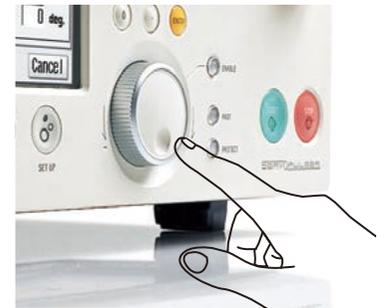
Allows use of an analog type interface to make subtle operating adjustments.



Loading Parameter Settings



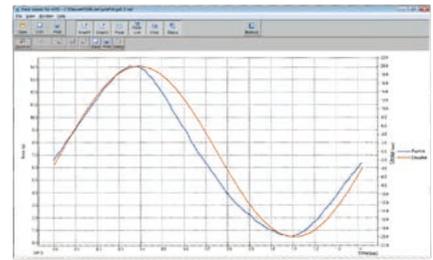
Waveform Display Functions



Jog Dial

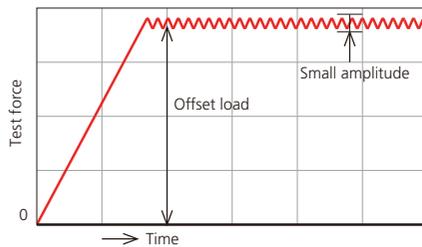
Autotuning and Automatic Gain Control Functions Ensure Loading Waveforms are Input Precisely

The autotuning function automatically determines the optimal parameters for controlling tests based on the actual test status and sample material. The automatic gain control function makes corrections so that peak values in loading cycles are consistent with parameter settings. Together, these functions help ensure precise loading waveforms. Consequently, even operators performing tests for the first time can automatically achieve highly accurate testing by simply setting parameters and starting testing.



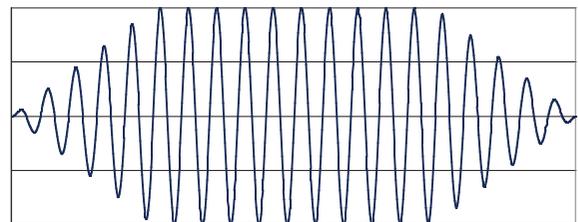
Offset Load Tests

Offset load testing makes it possible to accurately apply offset micro loads while applying large test force loads.



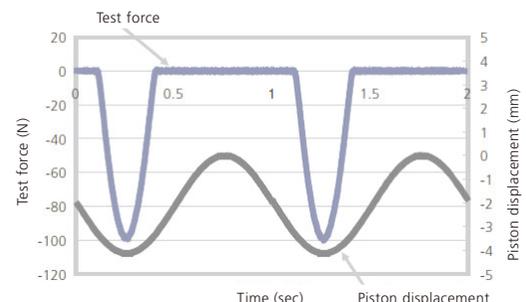
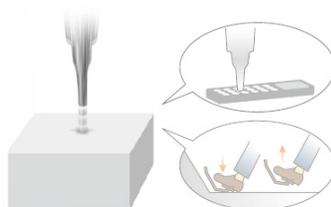
Slow Start/Stop

A slow start/stop time setting can be specified for tests. This eliminates operating differences between operators and helps ensure highly reproducible tests.



Push Test Function

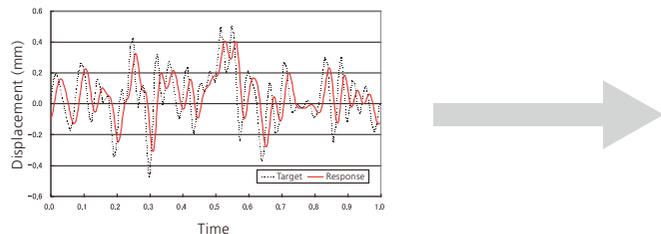
This allows controlling peak test force values in a stable manner, even for samples with "play" (where no test force is applied).



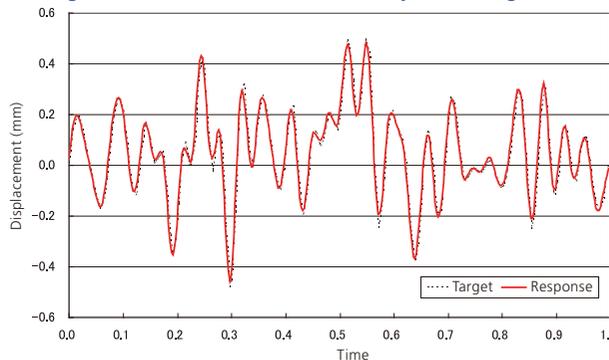
1 Hz Displacement Control with Target Test Force of -100 N

Waveform Distortion Correction Function

Because it can correct for loading mechanism-specific periodic strain, it can cancel out unwanted strain components and accurately control loads according to the target waveform.



The loading waveform is tracked to ensure consistency with the target waveform.

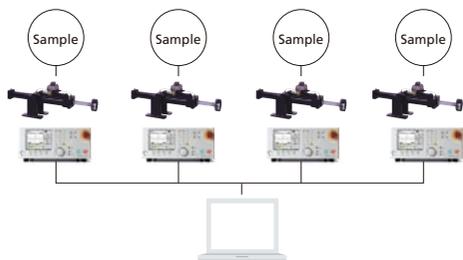


Broad Applicability

Up to four testing machines can be operated for synchronous testing. X-T, X-Y, peak graphs, and a variety of other waveforms can be displayed. By connecting to a computer via a USB cable, a wide variety of test settings and sophisticated data acquisition settings can be specified.

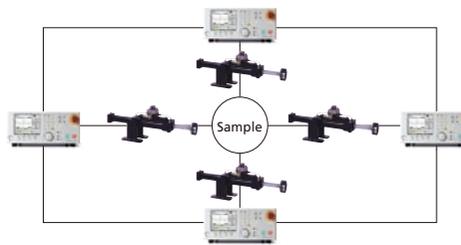
Multiple Tests

A single computer can be used to simultaneously perform up to four different tests using different test parameters. For example, four endurance tests can be performed in parallel to acquire peak values and cycle data.



Synchronized Testing

Control and measurements of up to four testing machines can be synchronized by synchronizing the controller connection. The phase can also be freely set for each actuator.



Specifications

Model	Servo Controller 4830
Display unit	5.7-inch color LCD
Control panel	Touch panel, function keys, jog dial, numeric keypad, test operation keys, power unit operation keys
Test waveforms	Sine, triangular, rectangular, haversine, haver-triangular, trapezoidal, ramp, 1/2 haversine, step, sweep, and random waves, external input, programmed waves (optional*), file waves (optional*)
Test frequency	0.00001 to 1000 Hz
Slow settings	Slow start/stop
Test parameter registration	Max. 9 parameters
Waveform display functions	Time, X-Y, and peak waveforms
Measurement functions	1 range (rangeless) 24-bit Max. 40 kHz sampling with 4 acquisition channels Linear correction (linearization) function
Size	W350 x D420 x H148 mm
Control method	Full digital two-degree-of-freedom PID
Control functions	Amplitude, average gain correction (AGC), PID autotuning, sample anti-overloading function (contact load), user-specified phase differential control by synchronized operation, waveform distortion correction*1(transfer function correction)
Limit functions	Measurement value 4-point limiter, cycle counter, external input
Communications functions	USB interface
Other functions	Calculation function (such as adding, subtracting, averaging, and stress/strain), push testing function, consumable consumption time management function
External input/output	Analog Output: 4 channels (± 10 V), Input: 1 channel (± 10 V) For monitoring or waveform input Digital Output: 8 channels Input: 8 channels
Control signal input	Test force (TD1), stroke (TD2), and external input (AUX) Note: Up to two amplifiers can be added as an option.
Power requirements	Single-phase AC 100 to 230 V*2 50/60 Hz 300 VA

*1 Only during software use

*2 The standard power cord included with the system is only for AC 100 V.

Also Supports Updating Controller

Updating older controllers to the latest model improves control performance and enables using the most up-to-date software.



Software for 4830

Easier, More Convenient, and More Sophisticated

Using systems in combination with dedicated software opens up a new world of testing. The dedicated software for the Servo Controller 4830 consists of basic software, add-on testing software, and GLUON 4830 fracture toughness testing software, which collectively support a variety of control and data analysis applications, such as basic fatigue testing, loading tests with simulated actual loads, and physical properties testing compliant with the latest standards.

Software	Single test	Multiple tests (simultaneous testing with 2 to 4 actuators)	Synchronized tests (measurement tests with synchronized control of up to 4 actuators)		
			2	3	4
Basic Software	Fatigue and Endurance Testing	⊙	⊙	○	○
	Program Function Testing	⊙	⊙	○	○
	Static Characteristics Testing	⊙	⊙	—	—
	Combination Testing	⊙	⊙	—	—
Add-On Software Note: Requires basic software	Static Testing	⊙	—	—	—
	Frequency-Sweep Testing	⊙	—	○	—
	Resonance Frequency Tracking Testing	⊙	—	○	—
	Multi-Axis Combination Sine Wave Testing (without waveform distortion correction)	⊙	—	○	○
	Multi-Axis Combination Sine Wave Testing (with waveform distortion correction)	⊙	—	☆	☆
Multi-Axis Working Waveform Simulation Testing	⊙	—	☆	☆	○
GLUON 4830	Crack Propagation Testing Software	⊙	—	—	—
	KIC/COD Testing Software	⊙	—	—	—
	JIC Testing Software	⊙	—	—	—

⊙ : Compatible ○ : Does not consider response results from other controllers (cannot be used if mutual interference is strong)
 ☆ : Considers response results from other controllers (mutual interference correction)
 — : Not compatible

Menu bar allows test operations such as starting and stopping, changing controls or resetting limits, etc.

Pause test Immediate waveform data acquisition button Dynamic characteristic values can be calculated for each cycle

Testing machine status display
Test in progress / stopped

Real-time measurement value display
Color-coded control parameters

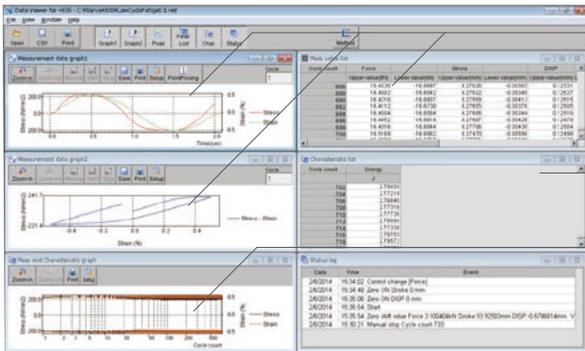
Cycle count vs. control parameter graph makes it possible to check reproducibility of test peaks

Plots S-S curves

Allows checking of waveforms in real time
Allows loading of waveform data from 1000 cycles

Test parameter confirmation window

Fatigue and Endurance Testing Window in Basic Software

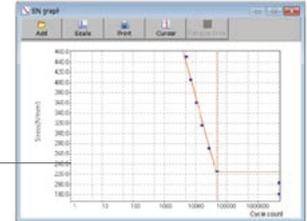


It is possible to confirm the input waveform, stress-strain curve, and various parameters for each acquisition cycle. Data for any specific point can also be extracted from any cycle waveform using the point picking function.

Dynamic characteristic values can be confirmed from each data acquisition cycle.

Peak value graph

S-N curves can be plotted automatically from test results.



● Basic Software



Fatigue and Endurance Testing

During fatigue/endurance tests, dynamic characteristics can be calculated, which allows S-N curves plotting. Data can be acquired for up to 10,000 cycles (during interval acquisition).



Combination Testing

Combining fatigue/endurance and static characteristics tests makes it possible to measure the changes in static spring constants.



Static Characteristics Testing

This allows users to apply static loads, such as tension or compression, to samples and measuring the static characteristic values (such as the static spring constant).



Program Function Testing

This allows users to combine the loading waveforms available in the controller, such as ramp and sine waves.

● Static Software



Static Testing

Available static tests include tensile, compression, 3-point bending, and 4-point bending. Various characteristic values can be calculated automatically. These include elasticity, upper yield point, lower yield point, yield strength, intermediate test force, intermediate displacement, maximum test force, break point, or energy.

● Frequency-Sweep and Resonance Frequency Tracking Test Software



Frequency-Sweep Testing

Makes it possible to sweep across to test dynamic characteristics over a range of frequencies, and allows endurance testing that repeats sweep cycles. Dynamic characteristic values can also be calculated for each frequency.



Resonance Frequency Tracking Testing

This makes it possible to automatically detect the resonance frequency of test samples before applying loads. The frequency can be automatically tracked if it is changed due to sample fatigue. Acceleration and strain values can be set directly and automatically readjusted even during testing.

● Multi-Axis Combination Sine Wave Testing Software



Multi-Axis Combination Sine Wave Testing

This allows use of multiple axes to perform tests with a combination of sine waves with different amplitudes.

● Multi-Axis Actual Waveform Testing Software



Multi-Axis Working Waveform Simulation Testing

This allows users to load actual working waveform data in CSV format, and to perform sophisticated simulation tests of actual loads by simply starting the test. A strain correction function helps ensure even the waveform details are reproduced precisely and accurately.

● Fracture Toughness Testing Software



Fracture Toughness Testing

Allows data analysis in compliance with the most up-to-date fracture toughness test standards. It supports crack propagation testing, KIC/CTOD testing, and JIC testing.

ASTM E647-13, ISO 12108:2012

Crack Propagation Testing

This is for evaluating the crack propagation behavior of notched samples. It is also ideal for introducing preliminary cracks for KIC and JIC testing.

ASTM E399-12, ISO 12737-96
BS 7448-1:1991, ASTM E1820-11

KIC/CTOD Testing

This is for evaluating fracture toughness values. It calculates CTOD values corresponding to the fracture mode and determines the validity of KIC values.

ASTM E1820-11, ASTM E813-89
JIS Z 2284-98

JIC Testing

This is for evaluating elastic fracture toughness values (JIC). It makes it easy to perform JIC tests, which involve complicated procedures.