HIOKI

IMPULSE WINDING TESTER ST4030A

NEW

200 MHz speed	High-speed sampling
12-bit resolution	High-precision waveform detection



Transforming Motor Winding Testing

(optional upgrade for the ST4030A)

NEW Quantification of response waveforms

- Test rotor assembly status
- Detect single-turn faults
  *Depends on measurement conditions
- Improve quality by capturing accumulated turn fault data as feedback for upstream processes

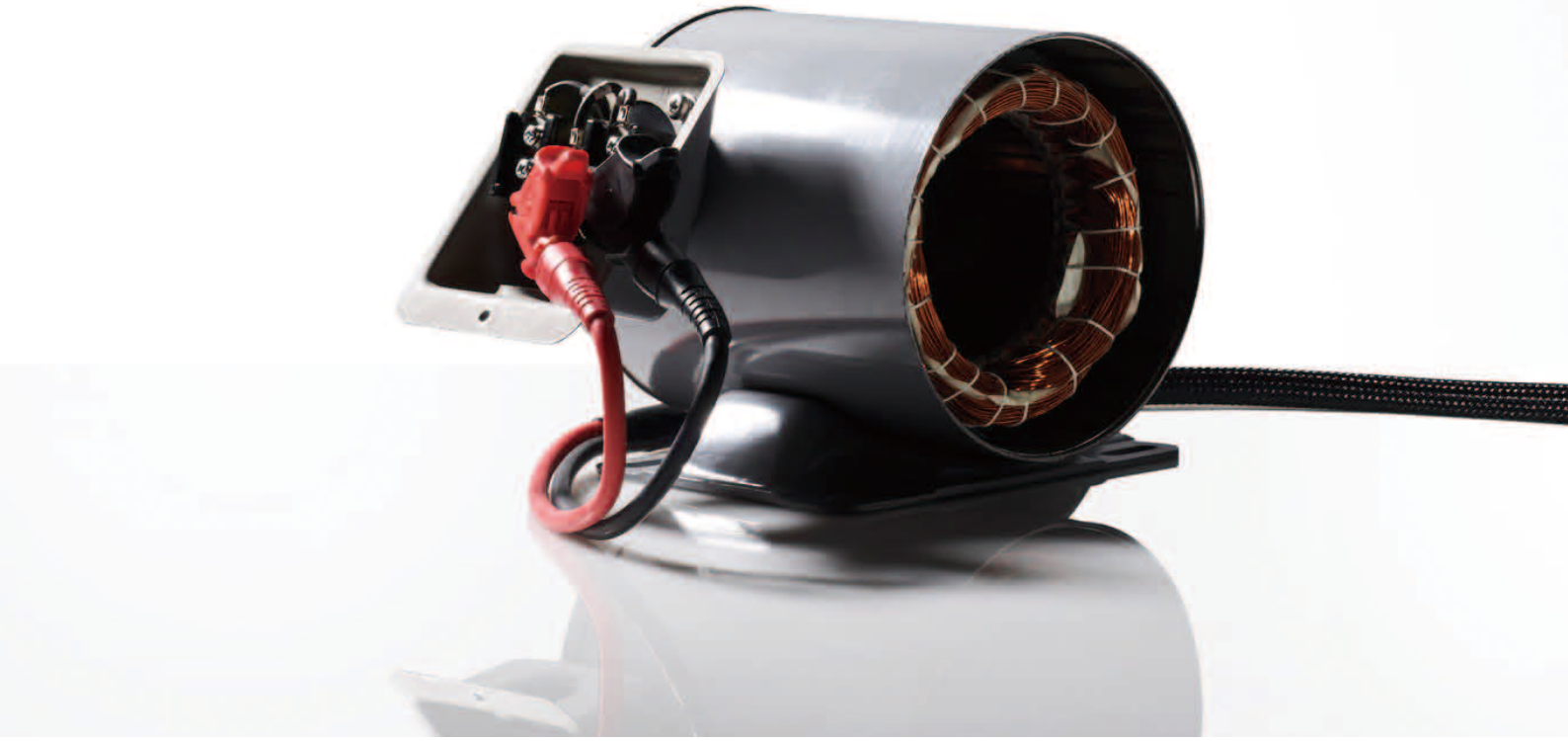
NEW DISCHARGE DETECTION UPGRADE

- Detect partial discharges at high precision
- Identify insulation defects (pseudo-shorts) between motor windings
- Easily detect discharges
  No need for peripheral equipment
  (discharge detection antenna, etc)

CE

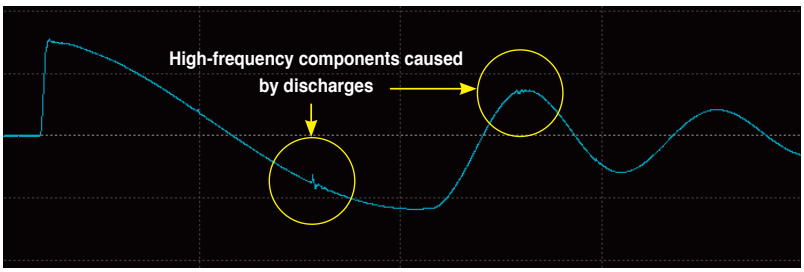
The new standard in winding testing

Detect defects that were impossible to detect in the past



Detect minuscule changes in response waveforms

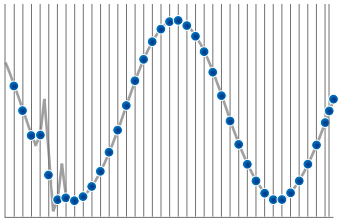
High-speed sampling × high resolution



100 MHz

Past issue

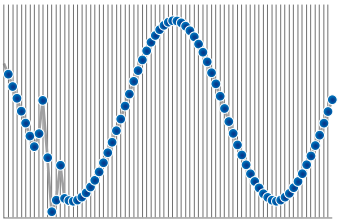
Difficult to detect instantaneous variations



200 MHz

ST4030A

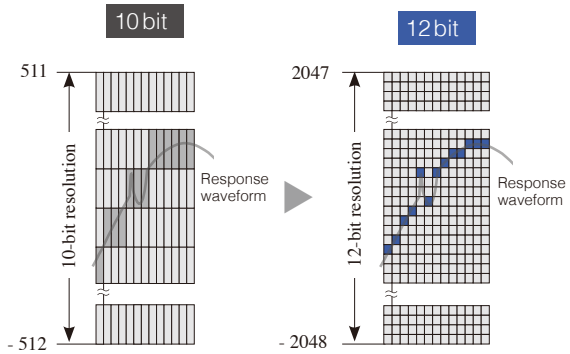
Instantaneous variations can be captured at a higher level of detail



High resolution

It's difficult to detect the difference between defective and non-defective parts.

Differences between waveforms can be captured at a higher level of detail.



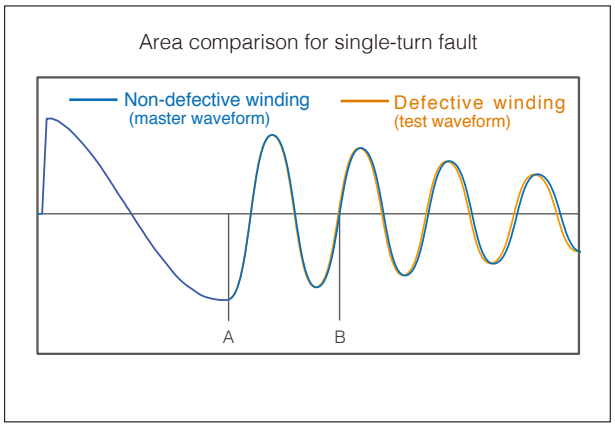


Detect single-turn faults

NEW Quantification of response waveforms

Conventional approach

Area comparison based on waveforms

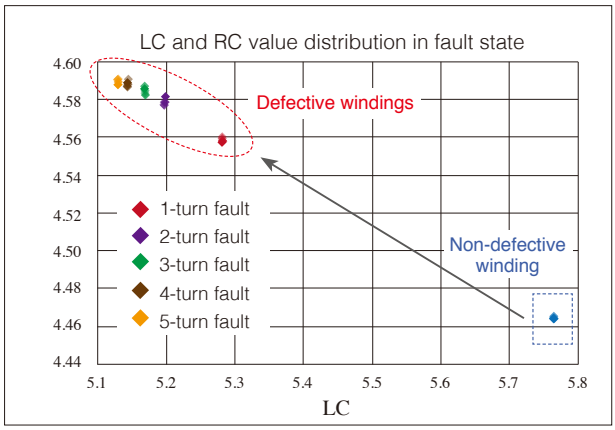


Pass/fail judgments are difficult when area differences do not exceed several percentage points.

Pass/fail judgments are made by calculating the difference in area between the master waveform and the test waveform for the interval specified by the A and B cursors.

New approach

Quantification of response waveforms



The distributions of values differ for defective and non-defective windings.

The new approach of using LC and RC values makes it possible to detect discrepancies between defective and non-defective windings, including when the differences between waveforms are too minuscule to detect using conventional means*. Since detection thresholds can be clearly defined, the instrument can give provide a clear pass/fail decision.

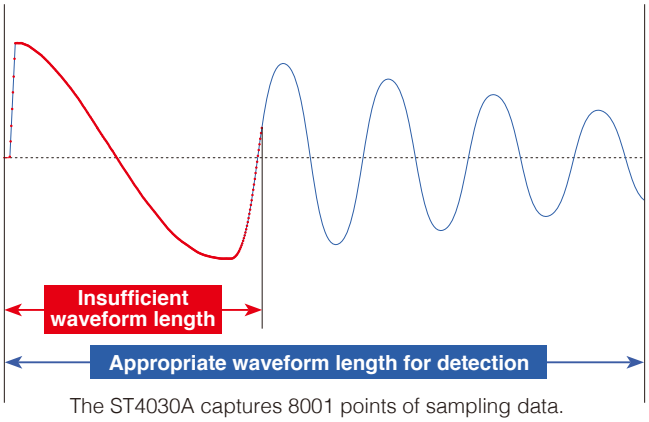
*See “Testable inductance range” in the specifications on the last page for more information about motors for which detection is possible. Performance may depend on conditions. Please consult with your local Hioki distributor for a test demonstration prior to purchase.

Ample sampling data for proper detection

Capture minuscule variations in response waveforms

However, since the ST4030A supports a large number of sampling points, the instrument can capture waveforms of sufficient length to support detection, even when sampling at 200 MHz.





The ST4030A captures 8001 points of sampling data.

Improved applied voltage reproducibility

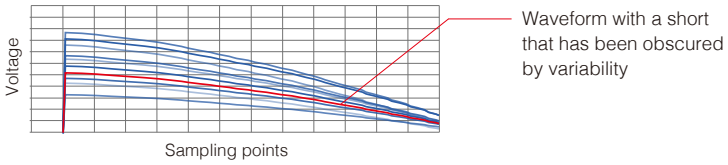
Detect defective parts with a high degree of repeatability

The ST4030A can detect defective parts with a high degree of precision thanks to low variability in the applied voltage it generates. In addition, differences between instruments when testing the same workpiece are slight, so you can continue to use master workpiece data even after one instrument is swapped out for another.

Applied voltage variability

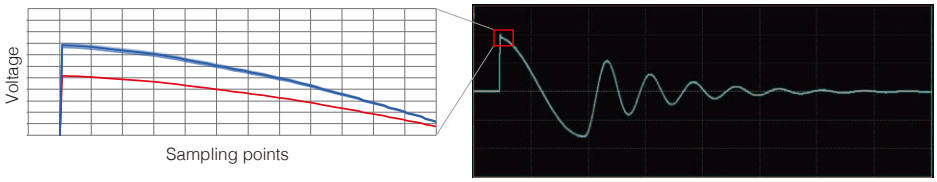
Conventional instruments

Variability in waveforms makes it difficult to detect shorts.



ST4030A

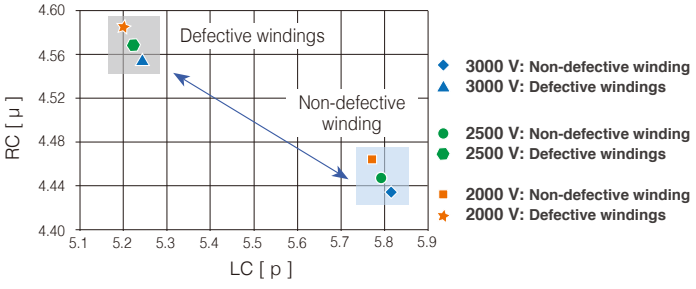
Low waveform variability allows defective windings to be detected with a high degree of precision.



Reduced damage thanks to lower applied voltages

LC and RC values can be used to distinguish between defective and non-defective parts, without regard to the magnitude of the applied voltage. As a result, the applied voltage can be lowered, reducing damage to workpieces.

The distributions of values differ even when the applied voltage is reduced, allowing the instrument to distinguish between defective and non-defective windings.



Optional upgrade for the ST4030A

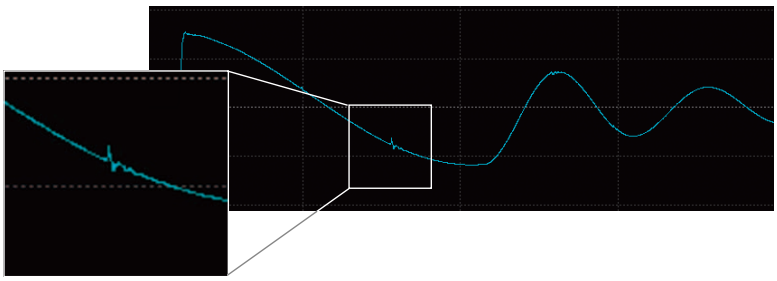
NEW DISCHARGE DETECTION UPGRADE ST9000

Detect pseudo-shorts with a high degree of precision

By detecting minuscule partial discharges that are obscured by noise, the ST9000 makes it possible to detect insulation defects (pseudo-shorts) between motor windings.

Proprietary Hioki filtering process

Of the high-frequency components that appear in response waveforms, noise components that appear throughout the waveform are rejected so that the instrument can extract and make judgments based solely on partial discharge components.



High-precision waveform detection

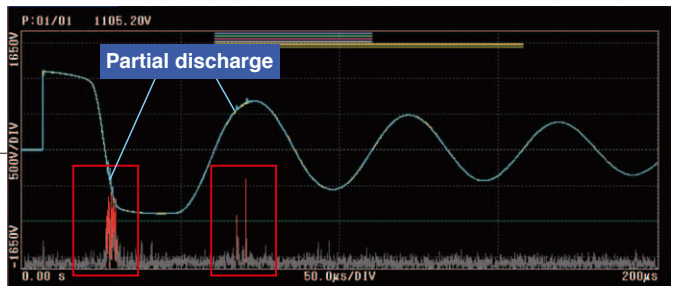
200 MHz, 12-bit sampling

Isolation of noise components

Proprietary HIOKI filter

Easy discharge detection

No need for peripheral equipment (discharge detection antenna, etc.)



High-frequency discharge components are isolated by a proprietary Hioki filtering process.

Insulation breakdown voltage testing (**B**reak **D**own **V**oltage)

The ST4030A also provides functionality for performing insulation breakdown voltage testing, which is required by various standards. An impulse test is performed while the voltage applied to the workpiece is gradually increased, and the insulation breakdown voltage is evaluated based on factors such as the response waveform's LC and RC values, the amount of discharge, and the waveform area.

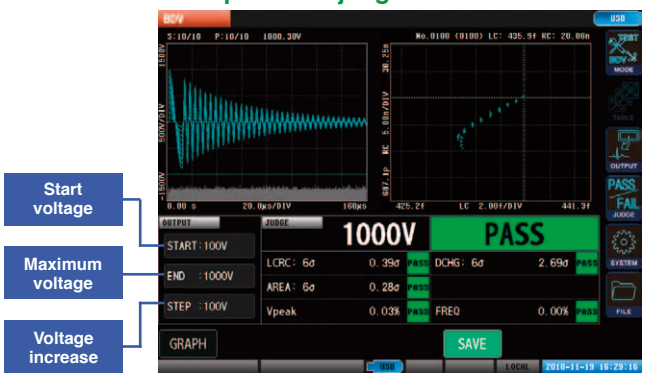
Stable detection with an extensive range of judgment parameters

- LC and RC values
- Discharge magnitude
- Waveform area comparison
- Peak voltage value
- Oscillation frequency

BDV setting range

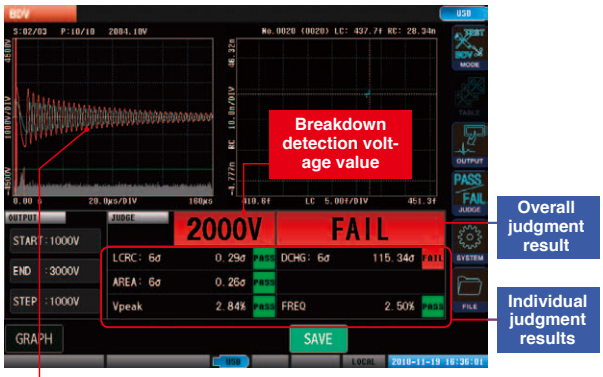
Setting range: 100 V to 4200 V
Setting resolution: 10 V
Number of steps: Up to 32

Example PASS judgment



If all judgments yielded a PASS result, testing continues to the maximum voltage.

Example FAIL judgment (discharge FAIL at 2000 V)



If any of the judgments yields a FAIL result, the insulation is considered to have started to break down, and testing is halted at that point. The breakdown voltage waveform is shown in red.

Testing after rotor assembly

Once the rotor has been attached to the motor's stator, the stray capacitance between the rotor and stator will vary depending on the position at which the rotor was attached. This variation in stray capacitance means that the response waveform obtained during impulse testing varies, preventing use of the conventional waveform comparison method.
Although the LC and RC values used to quantify response waveforms also vary due to variations in those waveforms, the distributions of those values vary for defective and non-defective parts. Consequently, impulse testing can be performed after the rotor has been installed as long as defective and non-defective part judgment areas have been created.

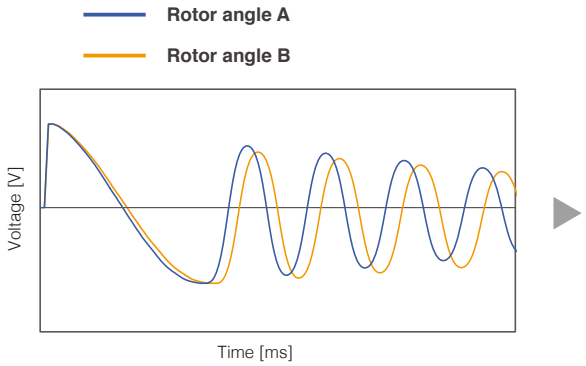


Conventional waveform detection

Clear judgment standards cannot be defined due to differences in the response waveforms depending on the position and angle at which the rotor has been attached.

Variations in the voltage waveform when the rotor is rotated (simplified illustration)

Since the waveform varies depending on the locations at which rotor angles A and B occur, it is difficult to determine a standard to use to compare the waveforms.

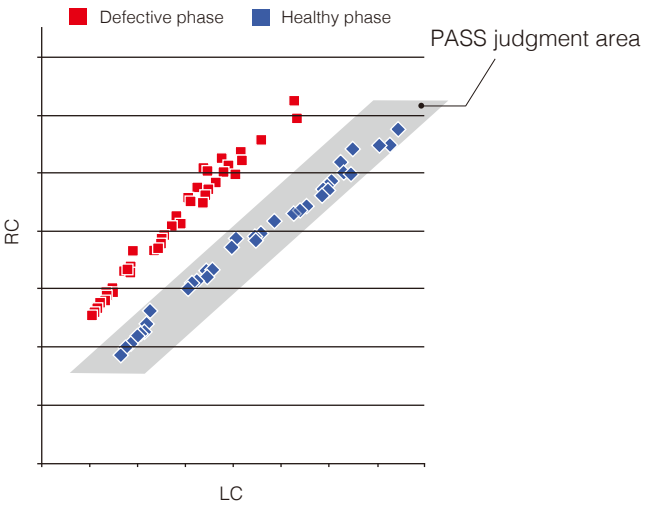


Numerical judgment using LC and RC values

If the non-defective part area is set using healthy phases, impulse testing can be performed following rotor assembly.

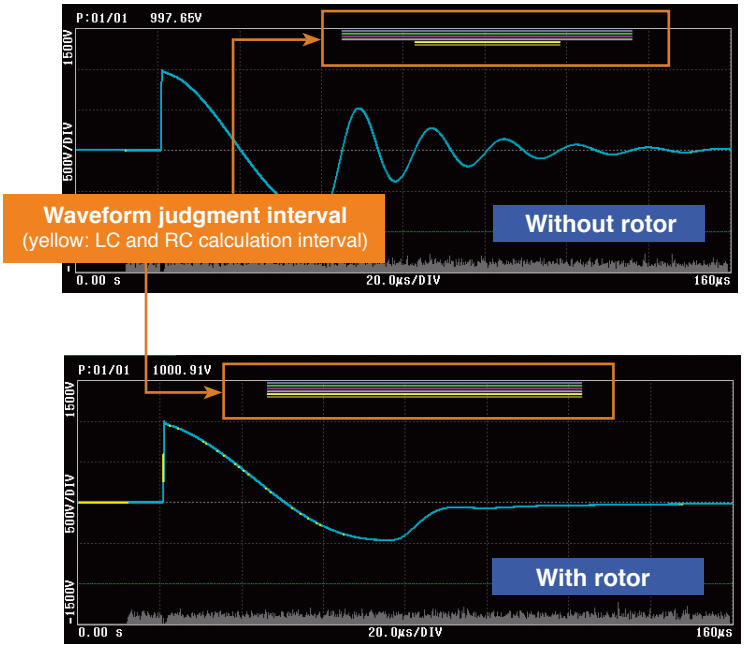
Distribution of LC and RC values when the rotor is rotated (at 50 points)

When LC and RC values are sampled while rotating the rotor, the distribution for defective phases differs from the distribution for healthy phases.



Accommodating differences in response waveform caused by motor characteristics

When testing a motor whose response waveform exhibits reduced resonance due to rotor core loss, the ST4030A automatically adjusts the judgment interval so that evaluations can be made over an interval with high voltage amplitude.



When a rotor is present, the ST4030A reduces the amount of electrical energy supplied to the motor, causing attenuation of the response waveform.

Attenuation of response waveforms

Reductions in electrical energy are primarily the result of the following types of loss:

Core loss

(1) Hysteresis loss
Loss caused by changes in the orientation of the magnetic molecules in the iron core

(2) Eddy current loss
Loss caused when an eddy current occurs in the iron core

Output

Conversion of electrical energy into mechanical energy that tries to rotate the rotor

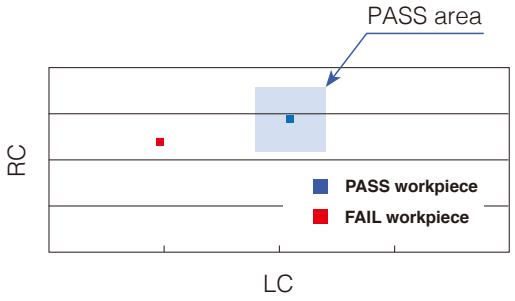
As long as the response waveforms for defective and non-defective motors differ, even if they are attenuated, the motors can be tested.

Improve parts quality by using quantified test results as feedback for upstream processes

Quantitatively manage testing by quantifying response waveforms

Clarify judgment standard values

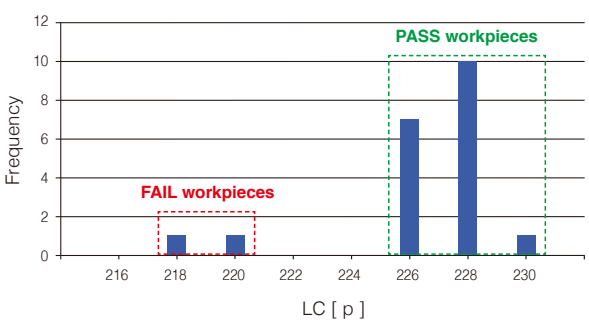
Clearly determine judgment standards based on numerical data for defective and non-defective workpieces. This information provides a basis for understanding how much the two can differ.



Use test results to manage manufacturing quality

Utilize statistical quality control techniques and accumulate statistical data to estimate when winding defects will occur so as to properly take steps to prevent such issues.

Workpiece	LC [p]	RC [μ]
1	228	4.21
2	227	4.22
3	226	4.22
4	228	4.23
5	227	4.22
6	226	4.21
7	227	4.23
8	225	4.22
9	219	6.51
17	227	4.22
18	228	4.21
19	218	6.52
20	229	4.23



Create a PASS judgment area from the distribution of LC and RC values

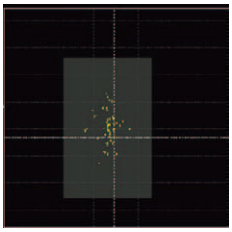
Full support to assist in setting testing conditions

Automatic configuration of the PASS judgment area

To make PASS and FAIL judgments, capture master LC and RC values from a known-good master workpiece.
The ST4030A will automatically create a PASS judgment area based on those values.

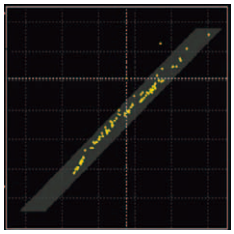
Choose the shape of the PASS judgment area.

HI-LO Rectangular PASS judgment area



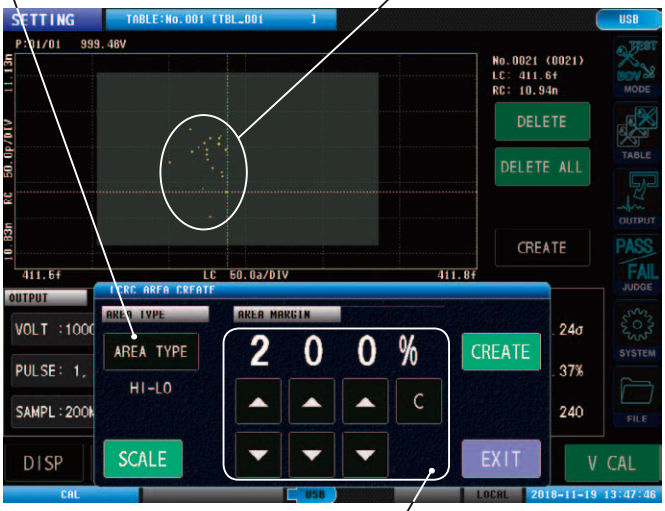
Select when the master workpiece's LC and RC values are distributed in close proximity

FIT Trapezoidal PASS judgment area



Select when the motor's rotor has been attached and the distribution of the LC and RC values assumes a belt shape according to the rotor position or angle

Captured LC and RC master values



Set the margin

Set the margin to use when the PASS judgment area is automatically created.

CREATE

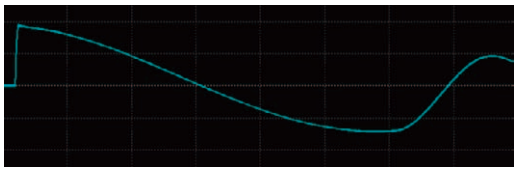
Automatically create the area by touching this button.

The created PASS judgment area will be shown as a quadrilateral on the LC/RC graph.

Automatic configuration of the waveform capture range

The oscillation frequency of response waveforms varies with the type of workpiece. To allow a sufficient amount of waveform data to be used in LC/RC value calculation and waveform judgment, the sampling frequency and sampling data count are automatically adjusted so as to optimize the waveform capture range.

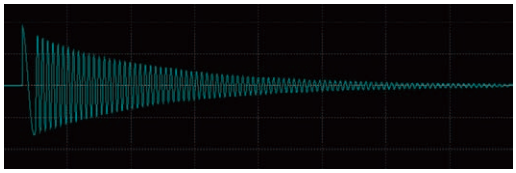
Workpiece A (low oscillation frequency)



The captured waveform length is inadequate due to the response waveform's low oscillation frequency.
The sampling frequency needs to be decreased.

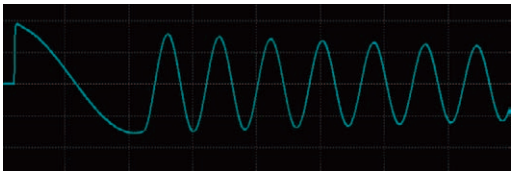
Optimizing the waveform capture range

Workpiece B (high oscillation frequency)



An unnecessary amount of waveforms is being captured due to the response waveform's high oscillation frequency.
Either the sampling frequency needs to be increased, or the sampling data count needs to be decreased.

Waveform length after optimization using automatic adjustment



Functionality for recording and utilizing quantified test results

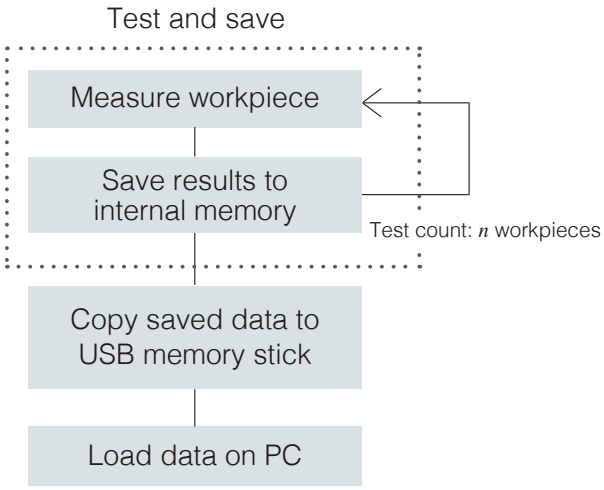
Easily analyze test results on a computer

Memory function and USB memory stick



The ST4030A can save the results of up to 1000 tests in its internal memory. You can then copy that data to a USB memory stick, open the measurement data using a spreadsheet application, and use it to analyze variability and manage testing data.





Data stored in internal memory

Test results: CSV file format

Data that can be saved to a USB memory stick

Test results: CSV file format
Measurement screens: BMP file
Instrument settings: User-defined table settings and all other settings

Analyze data using a spreadsheet application

Support for PLC and computer programming

Build testing lines quickly

EXT. I/O test

Verify whether signals output from the external control terminal (EXT. I/O) are being properly output and whether input signals are being properly read.

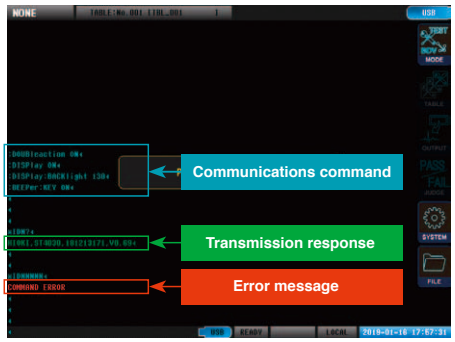


I/O OUT: The signal is output (turned on) from the I/O output pin with the name of the selected button.

I/O IN: The names of signals being input (turned on) are shown in green. Signals for which no input is being received are grayed out.

Communications monitor

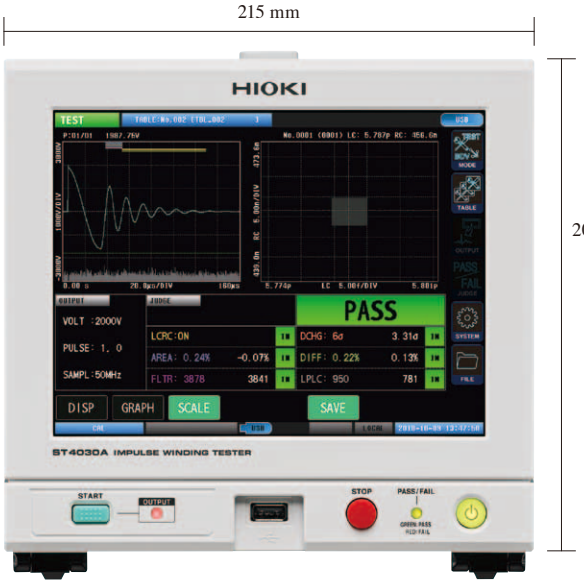
Since you can display communications and query responses on the screen, you can build a testing line while checking the status of instrument operation in real time.



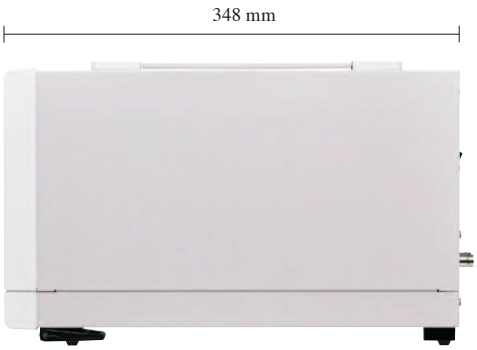
Commands are shown on the communications monitor in different colors to simplify the process of verifying proper operation.

Ideal for embedding in winding inspection systems

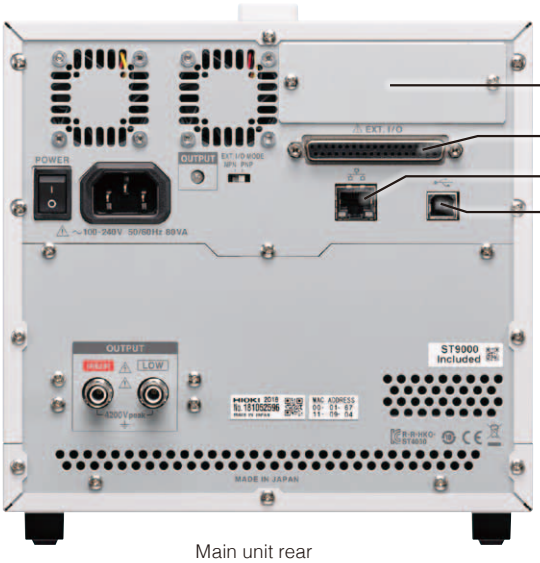
Space-saving Half-rack Size



Main unit front



Main unit side



Main unit rear

1. GP-IB
2. RS-232C

*The GP-IB and RS-232C interfaces are optional

3. EXT I/O (Handler interface)
4. LAN
5. USB (for PC connectivity)



GP-IB INTERFACE Z3000



RS-232C INTERFACE Z3001

Extensive range of interfaces

Interfaces

The ST4030A can be controlled from a computer using communications commands sent via its USB, LAN, GP-IB, or RS-232C interface.

LAN

Connector	RJ-45 connector
Electrical specifications	IEEE802.3 compliant
Transmission method	10BASE-T/ 100BASE-TX/ 1000BASE-T Auto detected
Protocol	TCP/IP

GP-IB (optional)

Reference standard	IEEE-488.2
Functional specifications	SH1, AH1, T6, L4, SR1, RL1, PP0, DC1, DT1, C0
Device address	0 to 30

USB (for PC connectivity)

Connector	USB Type B receptacle
Electrical specifications	USB2.0 (Full Speed/High Speed)

RS-232C (optional)

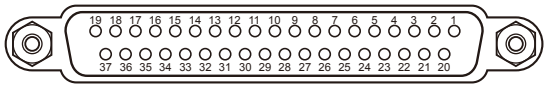
Connector	D-sub 9-pin male connector
Communication method	Full duplex
Synchronization method	Start stop synchronization
Flow control	Software (XON/XOFF control)
Transmission speed	9600, 19200, 38400, 57600 bps

EXT. I/O

The EXT. I/O interface allows you to output signals such as the measurement complete signal (EOM) and the judgment results signal (PASS/FAIL) to an external device and to control the instrument based on input such as a START signal from an external device.

Connectors

Connectors to use (unit side)	D- sub 37-pin
	Female connector with #4-40 inch screws
Compliant connectors	DC-37P-ULR (solder type)
	DCSP-JB37PR (pressure weld type)
	Japan Aviation Electronics Industry, Ltd.



Input signals

Pin	Pin name	Description
1	START	The instrument starts testing at the START signal's ON edge.
20	STOP	The instrument stops testing when it detects the ON edge of the STOP signal during testing.
3	$\overline{\text{INTERLOCK}}$	If the instrument's interlock setting is enabled, the interlock state is canceled while the $\overline{\text{INTERLOCK}}$ signal is ON.
4 to 7, 22 to 25	TBL0 to 7	Selects the table number in which switchable test conditions have been saved.

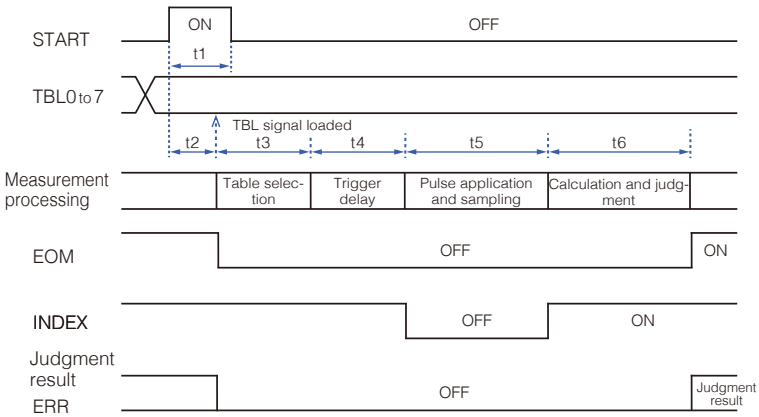
Output signals

Pin	Pin name	Description
29	INDEX	Indicates that analog measurement (pulse application and sampling) has ended. When this signal changes from OFF to ON, the probes can be placed in the open state.
28	EOM	This signal is output when testing is complete. The judgment results and ERR signals are refreshed once the EOM signal is output.
10	ERR	This signal is output when a measurement error such as an open error or hardware error occurs.
18	PASS	This signal is output when the overall judgment result is PASS.
37	FAIL	This signal is output when the overall judgment result is FAIL.
11 to 13 30 to 32	OUT_XXX	These signals are output when a judgment function generates an OUT judgment.
16, 17,35	OUT0 to 2	These signals can be used as general-purpose output. The output signal can be controlled using the :IO:OUTPut command.

Insulated power source output

Pin	Pin name	NPN/PNP switch settings	
		NPN	PNP
8	ISO_5V	Insulated power source +5 V	Insulated power source -5 V
9, 27	ISO_COM	Insulated power source common	Insulated power source common

Example of measurement timing



Item	Description	time
t1	START signal ON time	1 ms or greater
t2	Trigger detection time	1 ms (typical value)
t3	Table selection time	10 ms (typical value) *Add the internal discharge time if the test voltage for the table after switching is less than the test voltage before switching.
t4	Trigger delay time	0.000 s to 9.999 s
t5	Analog measurement time	50 ms (typical value for a set voltage of 3000 V, sampling frequency of 200 MHz, and 1 pulse application)
t6	Calculation and judgment time	15 ms (typical value when the AREA, DIFF, FLUTTER, or LAPLACIAN judgment function is enabled) *When applying multiple pulses, indicates the judgment and calculation times for the final pulse.

Test times (reference values)

Measurement times (EOM)	EOM = (INDEX + software processing time + judgment times × number of pulses applied *Degaussing pulses do not entail software processing time or judgment time. *When applying multiple pulses, the testing process is controlled so that each pulse application interval is not less than the minimum pulse application interval set time.
Analog measurement times (INDEX)	Time through charging, application, and sampling end (typical value)

Set voltage	100 V	1000 V	2000 V	3000 V
INDEX time	30 ms	30 ms	40 ms	50 ms

Software processing time	Software processing time covering data transfers, etc.(typical value), Processing time: 10 ms *S/s: 200 MHz, DISP: THIN
Judgment time	Processing time when each judgment function is enabled (typical value)

Judgment	Processing time
AREA*1	1 ms
DIFF*1	1 ms
FLTR*1	1 ms
LAPC*1	1 ms
LC·RC*2	100 ms
DISCHARGE*3	75 ms

*1 Judgment area: 1500 pt
*2 Calculation interval: 1500 pt
*3 Judgment interval with sampling speed of 200 MHz: 8001 pt

Electrical specifications

Input signals	Input type	Photocoupler-isolated non-voltage contact input (with current sink/source output support)
	Input ON	Residual voltage of 1 V or less; input ON current of 4 mA (reference values)
	Input OFF	OPEN (breaking current of 100 µA or less)
Output signals	Output type	Photocoupler-isolated open-drain output (non-polar)
	Maximum load voltage	DC 30 V
	Maximum load current	50 mA/ch
	Residual voltage	1 V or less (load current of 50 mA) / 0.5 V or less (load current of 10 mA)
Internally isolated power supply	Output voltage	Sink output support: +5.0 V ±0.8V; source output support: -5.0 V ±0.8 V
	Maximum output current	100 mA
	Insulation	Floating from protective ground potential and measurement circuit
	Insulation rating	Terminal-to-ground voltage of 50 V DC, 30 V AC rms, 42.4 V AC peak or less

Specifications (Accuracy guaranteed for 1 year, Post-adjustment accuracy guaranteed for 1 year)

Applied voltage	100 V to 4200 V (resolution set in 10 V steps)	
Testable inductance range	10 μH to 100 mH	
Sampling speed	200 MHz / 100 MHz / 50 MHz / 20 MHz /10 MHz	
Sampling resolution	12 bit	
Voltage detection accuracy	DC accuracy: ±5% of setting, AC band: 100 kHz, ±1 dB Accuracy guarantee conditions: 23°C ±5°C, 80% RH or less	
Number of samples	1001 to 8001 points (set in 1000 point steps)	
Judgment method	The same impulse voltage is applied to a master workpiece and the workpiece under test, and a PASS/FAIL judgment is made by comparing the shapes, LC and RC values, and discharge component magnitudes of the respective response waveforms.	
	LC/RC value judgment	LC/RC value judgment (LCRC AREA)
	Waveform judgment	Waveform area comparison judgment (AREA) Waveform differential area comparison judgment (DIFF-AREA) Waveform flutter detection judgment (FLUTTER) Waveform second derivative detection judgment (LAPLACIAN)
	Discharge detection (With ST9000)	Discharge detection (DISCHARGE)
Insulation breakdown voltage testing mode	The workpiece is subjected to impulse testing while gradually raising the applied voltage to determine the voltage at which the insulation breaks down. Waveform area judgment, discharge judgment, and LC/RC value judgment are used to judge insulation breakdown.	
Number of test condition tables	255 (test condition settings, detection condition settings, master waveforms)	
Test duration	Approx. 60 ms (reference value when tester is configured for 3000 V, 1 pulse, detection off)	
Display	Touch screen display: 8.4-inch SVGA color TFT LCD (800 × 600 dots)	
Safety functionality	Key lock, interlock, double-action design (to prevent erroneous operation when starting testing)	

*Maximum applied energy: Approx. 88 mJ

General specifications

Operating environment	Use indoors at an elevation of 2,000 m or less in an environment with a maximum pollution level of 2
Operating temperature and humidity range	0°C to 40°C (32°F to 104°F), 80% RH or less (no condensation)
Storage temperature and humidity	-10°C to 50°C (14°F to 122°F), 80% RH or less (no condensation)
Standards compliance	Safety: EN 61010, EMC: EN 61326 Class A
Power supply	AC100 V to 240V, 50 Hz/60 Hz
External interface	Standard equipment: EXT. I/O, USB host (memory stick), USB device (for communications), LAN Options: RS-232C (Z3001), GP-IB (Z3000)
Dimensions	Approx. 215 mm (8.46 in) W × 200 mm (7.87 in) H × 348 mm (13.7 in) D (excluding protrusions)
Mass	Approx. 6.7 kg (236.3 oz)
Accessories	Power cord, instruction manual, application disc, operating precautions

Model: IMPULSE WINDING TESTER ST4030A

Model No. (Order Code)

ST4030A

Additional function options

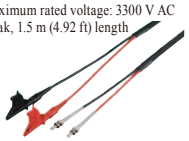
DISCHARGE DETECTION UPGRADE ST9000

The Discharge Detection Upgrade ST9000 is a factory option for the Impulse Winding Tester ST4030A. Please specify at the time of order.

Options

CLIP TYPE LEAD L2250

Maximum rated voltage: 3300 V AC peak, 1.5 m (4.92 ft) length



UNPROCESSED LEAD CABLE L2252

Maximum rated voltage: 4200 V AC peak, 2 m (6.56 ft) length



Caution: Effect of cable parasitic components

The oscillation waveform varies with the length of the cable. Please contact your Hioki distributor concerning availability of special-order cables whose capacitance values fall within the acceptable range.



GP-IB INTERFACE Z3000



GP-IB CONNECTOR CABLE 9151-02
2 m (6.56 ft) length



RS-232C INTERFACE Z3001



RS-232C CABLE 9637
9 pin - 9 pin, cross, 1.8 m (5.91 ft) length

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